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Companion

to Corporate Finance

by Ivo Welch

Basic Content: Individual Appendices; then Ch21=Firm Scale, Ch22=Capital Structure Dynamics, Ch23=Capital Structure Patterns (in the US), Ch24=Investment Banking and M&A, Ch25=Corporate Governance, Ch26=International Finance, and Ch27=Options and Derivatives.

Warning

Although the content in this material is (mostly) correct (although most of the tables in Chapter 24 [investment banking] are now outdated), the formatting is completely broken. It is readable, but not pretty.

This is not a book to read through. Instead, use the table of contents to go where you want to go.

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Part I

Individual Appendices to Chapters in the Main Book

Susan Huot: Inconsistent Capitalization

parttext

Chapter 3

Stock and Bond Valuation: Annuities and Perpe

A.3.A Different Lives and Rental Equivalents

You have already briefly met the concept of an equivalent annual cost (eac) in Question **??** on Page **??**. It is the constant rent payment at which you would be indifferent between renting and owning. This concept becomes more useful if you know how to work with annuities.

Comparing Annual Payments to Multiyear Contracts

Let's work out a first example. Assume that the prevailing interest rate is 10% per annum. Would you rather sign a lease contract that obliges you to pay \$1,000, \$650, and \$650 in consecutive years, or would you rather pay rent of \$780 every year? x

The present value of the lease payments is

$$\$1{,}000 + \frac{\$650}{1.1} + \frac{\$650}{1.1^2} \approx \$2{,}128.10$$

The proposed alternative rent would be

$$\$780 + \frac{\$780}{1.1} + \frac{\$780}{1.1^2} \approx \$2{,}133.72$$

The 3-year lease is cheaper for you—of course, assuming that you really want to use the building for 3 years. If you really needed the building for only 1 year, then a 1-year rental contract could be much better. x

Can you work out at what annual rent you would be indifferent between leasing and renting? (This is the equivalent annual cost, eac.) Easy:

$$eac + \frac{eac}{1.1} + \frac{eac}{1.1^2} = \$2{,}128.10 \quad \Rightarrow eac \approx \$777.95$$

This tells you that you are indifferent between the ($1,000, $650, $650) 3-year lease and an annual payment of $777.95, first payment due immediately. Another version of this calculation has you pay the rent at the end of the year. In this case,

$$\frac{eac}{1.1} + \frac{eac}{1.1^2} + \frac{eac}{1.1^3} = \$2{,}128.10 \quad \Rightarrow eac \approx \$855.74 \tag{3.1}$$

You would therefore also be indifferent between the 3-year lease, and paying $855.74 for 3 years with rent payments occurring at year-end, not at year-start. Of course, you could have simply multiplied $777.95 by 1.1 to arrive at $855.74.

important

To work out the equivalent annual cost of a contract, use a two-step procedure:

1. Determine the present value of the cost of the contract.
2. Use an annuity calculation to translate this cost into regular and equal flows.

x

Now stare at Formula 3.1. The left-hand side is an annuity with an unknown payment per year, the "eac," an interest rate of 10%, and a duration of three years:

$$\frac{eac}{10\%} \cdot \left[1 - \left(\frac{1}{1.1}\right)^3\right] = \$2{,}128.10 \quad \Rightarrow eac \approx \frac{\$2{,}128.10}{2.48685} \approx \$855.74$$

x

If you prefer the version where the first payment occurs immediately, simply discount this by 10%:

$$\frac{\$855.74}{1.10} \approx \$777.95$$

$$\frac{eac_{\text{beginning payments immediately}}}{1+r} = eac_{\substack{\text{discount the beginning} \\ \text{payments next year}}}$$

Don't get too worked up over this specific example. For three years, you don't need to use the annuity formula if you prefer working with the long Formula 3.1 instead. However, if you have many payments, the annuity formula quickly becomes more convenient.

x

For practice, let us work another lease example. A 5-year lease requires a one-time upfront payment of $1,600, followed by four payments of $500. The prevailing interest rate is 10%. What is the equivalent annual cost of this lease? First, work out the present value of the lease payments. This is

$$\text{PV} = \$1{,}600 + \$500/1.1 + \$500/1.1^2 + \$500/1.1^3 + \$500/1.1^4 \approx \$3{,}184.93$$

Now you must solve

$$eac + \frac{eac}{1.1} + \frac{eac}{1.1^2} + \frac{eac}{1.1^3} + \frac{eac}{1.1^4} = \$3{,}184.93$$

which is

$$eac \cdot (1 + 0.9091 + 0.8264 + 0.7513 + 0.6830) \approx \$3{,}184.93$$

$$\Rightarrow eac \approx \$3{,}184.93/4.1699 \approx \$763.80$$

Put differently, you would be indifferent between this 5-year lease and payment of $763.80 per month, first payment immediately. Using the annuity formula with five years duration and an interest rate of 10%, you get

$$\frac{eac}{10\%} \cdot \left[1 - \left(\frac{1}{1.1}\right)^5\right] = \$3{,}184.93 \quad \Rightarrow eac \approx \frac{\$3{,}184.93}{3.7908} \approx \$840.17$$

with the first payment at the end of the year.

x

Ready to move on to a real-world example? My car lease quoted $1,500 due at signing, followed by $500 per month for 35 months. What would be the EAC for this contract, assuming the prevailing interest rate was 0.5% per month? The present value cost of this contract was

$$\$1{,}500 + \frac{\$500}{0.005} \cdot \left[1 - \left(\frac{1}{1.005}\right)^{35}\right] \approx \$1{,}500 + \$16{,}018 = \$17{,}518$$

The equivalent annual cost—i.e., what a rental without an upfront payment would have been—is therefore

$$\frac{eac}{0.005} \cdot \left[1 - \left(\frac{1}{1.005}\right)^{36}\right] \approx \$17{,}518 \Rightarrow eac = \frac{\$17{,}518}{32.8710} \approx \$532.93(3.2)$$

payable only at the end of each month.

Comparing Different Multiyear Contracts

x

Let's now compare two multiyear leases, instead of a multiyear lease versus an annual rent. For example, compare the 3-year lease from the previous section to the 5-year lease. First, note that before you even ask this question, you should consider your use of the building. If you need it for only 3 years, you should obviously choose the 3-year lease. If you need it for exactly 5 years, you would have to figure out how much it would cost you to obtain leases for 2 more years

if you went with the 3-year lease. However, we shall make our lives simple. The particular question that we are interested in assumes that you do not care about whether you sign a 3-year or a 5-year lease. You only care about lowest cost. x

On to the substance. The 3-year lease costs \$2,128.10. The 5-year lease costs \$3,184.93. Obviously, the 3-year lease is cheaper. Does this mean that the 3-year lease is better? Obviously not—the 5-year lease gives you 5 years of access, not just 3 years. This is why a 5-year lease is more expensive. So, how can you compare these two leases?

You have two methods, which always come to the same answer:

1. **Repeated lease:** You can repeat both leases until they end up with the same number of years. For example, to compare a 3-year lease with a 5-year lease, you would work out what 15 years worth of leases would cost. That is, you would compare the cost of 5 consecutive 3-year leases with the cost of 3 consecutive 5-year leases.

   We already worked out that a single 3-year lease beginning now would cost \$2,128.10. Thus, the first 3-year lease would cost \$2,128.10 in year 0. You would have to repeat it in year 3, when it would cost you another \$2,128.10 then. Repeat this in year 6, in year 9, and in year 12. Your present value cost of a 15-year lease is therefore

   $$\$2{,}128.10 + \frac{\$2{,}128.10}{1.1^3} + \frac{\$2{,}128.10}{1.1^6} + \frac{\$2{,}128.10}{1.1^9} + \frac{\$2{,}128.10}{1.1^{12}} \approx \$6{,}509$$

   Your alternative 5-year lease would cost \$3,184.93 in year 0, \$3,184.93 in year 5, and \$3,184.93 in year 10. Therefore, your cost would be

   $$\$3{,}184.93 + \frac{\$3{,}184.93}{1.1^5} + \frac{\$3{,}184.93}{1.1^{10}} \approx \$6{,}390$$

   Consequently, the 5-year lease is cheaper.

   This method works, but it is quite tedious. If you had to compare four different leases, say, a 3-year, 5-year, 7-year, and 11-year lease, you would have to work out what these leases cost over a 1,155-year period.

2. **Work out the equivalent annual costs:** Instead of comparing leases to one another, work out what their equivalent annual rents would be, and compare these. Well, you have already worked this out for these two leases. The 3-year lease has an EAC of \$777.95; the 5-year lease has an EAC of \$763.80. Therefore, the 5-year contract is cheaper on a per-annum basis. (If you used the year-end payment EAC, the cost of both would be 10% higher, so the 5-year lease would still be cheaper.)

Moreover, you can use this to compare any number of contracts easily. There is no more need to work out the total cost for thousands of years!

Similar rental equivalent value problems also often arise when you compare different technologies—for example, you can purchase a machine that is likely to last for 18 years, and you must compare it against another machine that is likely to last for 22 years. The method for solving these problems is exactly the same, so try it in the next question.

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question

Go back to the car lease example on Page 7. The same car dealer also quoted me a 48-month lease in which the first installment was \$2,000 and the other 47 monthly payments were only \$450. The prevailing interest rate is 0.5%/month. What does the privilege of switching to a new car after 36 months cost me per month? (Recall from Formula 3.2 the EAC for the 36-month lease was \$532.93.)

answer

This contract costs \$2,000 plus $\$450/0.005 \cdot (1 - 1/1.005^{47}) \approx \$18{,}807$ for a total of \$20,807. The eac is therefore \$488.65, payable at the end of every month. The difference is $\$532.93 - \$488.65 - \$44.28$ per month.

question

Machine A costs \$10,000 up front, and lasts for 18 years. It has annual maintenance costs of \$1,000 per year. Machine B costs \$15,000 up front, lasts for 22 years, and has annual maintenance costs of \$800 per year. Both machines produce the same product. The interest rate is 12% per annum.

1. What is the PV of the cost of each machine?
2. What is the rental equivalent of each machine?
3. Which machine is the better purchase if you assume no value to flexibility and do not expect different machine costs or contracting conditions in the future?

answer

1. Machine A is

$$\begin{aligned} \mathrm{PV}\big(\text{Cost}\big) &= \$10{,}000 + \text{Annuity}(\$1{,}000, 18 \text{ years}, 12\%) \\ &= \$10{,}000 + \frac{\$1{,}000}{12\%} \cdot \left[1 - \frac{1}{1.12^{18}}\right] \\ &\approx \$17{,}249.67 \end{aligned}$$

Machine B is

$$\begin{aligned}\text{PV}\big(\text{Cost}\big) &= \$15{,}000 + \text{Annuity}(\$800, 22 \text{ years}, 12\%)\\ &= \$15{,}000 + \frac{\$800}{12\%}\cdot\left[1-\frac{1}{1.12^{22}}\right]\\ &\approx \$21{,}115.72\end{aligned}$$

2. The equivalent rental values are

$$\begin{aligned}\text{Annuity}(x, 18 \text{ years}) &\equiv \frac{x}{0.12}\cdot\left(1-\frac{1}{1.12^{18}}\right)\\ &\approx \$17{,}249.67\end{aligned}$$

$$\Leftrightarrow x \approx \frac{\$17{,}249.67}{7.24967} \approx \$2{,}379.37 \text{ for machine A}$$

$$\begin{aligned}\text{Annuity}(x, 22 \text{ years}) &\equiv \frac{x}{0.12}\cdot\left(1-\frac{1}{1.12^{22}}\right)\\ &\approx \$21{,}115.72\end{aligned}$$

$$\Leftrightarrow x \approx \frac{\$21{,}115.72}{7.6446} \approx \$2{,}762.16 \text{ for machine B}$$

3. The 18-year machine has the lower rental cost, so it is the better deal—of course, under all the appropriate assumptions such as same ongoing need.

A.3.B Derivations of Perpetuity and Annuity Formulas

A perpetuity: The formula is

$$\frac{C}{1+r}+\frac{C}{(1+r)^2}+\cdots\frac{C}{(1+r)^t}+\cdots=\frac{C}{r}$$

You want to show that this is a true statement. Divide by C,

$$\frac{1}{1+r}+\frac{1}{(1+r)^2}+\cdots+\frac{1}{(1+r)^t}+\cdots=\frac{1}{r} \tag{3.3}$$

Multiply (3.3) by $(1+r)$,

$$1+\frac{1}{(1+r)}+\cdots+\frac{1}{(1+r)^{t-1}}+\cdots=\frac{(1+r)}{r} \tag{3.4}$$

Subtract (3.3) from (3.4),

$$1 = \frac{(1+r)}{r} - \frac{1}{r}$$

The RHS simplifies into r/r, which makes this a true statement.

A growing perpetuity: You know from the simple perpetuity formula that

$$\sum_{t=1}^{\infty} \frac{C}{(1+r)^t} = \frac{C}{r} \Leftrightarrow \sum_{t=1}^{\infty} \frac{C}{f^{\,t}} = \frac{C}{f-1}$$

Return to the definition of a growing perpetuity, and pull out one $(1+g)$ factor from its cash flows,

$$\sum_{t=1}^{\infty} \frac{C \cdot (1+g)^{t-1}}{(1+r)^t} = \left(\frac{1}{1+g}\right) \cdot \sum_{t=1}^{\infty} \frac{C \cdot (1+g)^t}{(1+r)^t} = \left(\frac{1}{1+g}\right) \cdot \sum_{t=1}^{\infty} \frac{C}{\left[\frac{1+r}{1+g}\right]^t}$$

Let $\left[\frac{1+r}{1+g}\right]$ be f, and use the first formula. Then

$$\left(\frac{1}{1+g}\right) \cdot \left\{\sum_{t=1}^{\infty} \frac{C}{\left[\frac{1+r}{1+g}\right]^t}\right\} = \left(\frac{1}{1+g}\right) \cdot \left\{\frac{C}{\left[\frac{1+r}{1+g}\right] - 1}\right\}$$

and simplify this,

$$= \left(\frac{1}{1+g}\right) \cdot \left\{\frac{C}{\left[\frac{(1+r)-(1+g)}{1+g}\right]}\right\} = \left(\frac{1}{1+g}\right) \cdot \left\{\frac{C \cdot (1+g)}{[r-g]}\right\} = \frac{C}{r-g}$$

An annuity: Consider one perpetuity that pays \$10 forever, beginning in year 1. Consider another perpetuity that begins in 5 years and also pays \$10, beginning in year 6, forever. If you purchase the first annuity and sell the second annuity, you will receive \$10 each year for 5 years, and \$0 in every year thereafter.

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	Y0	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	⋯
Perpetuity 1		+\$10	+\$10	+\$10	+\$10	+\$10	+\$10	+\$10	+\$10	…
equivalent to	+\$10/r									
Perpetuity 2							–\$10	–\$10	–\$10	…
equivalent to						−\$10/r				
Net Pattern		+\$10	+\$10	+\$10	+\$10	+\$10				
equivalent to	+\$10/r					−\$10/r				
Discount Factor		$\frac{1}{(1+r)^1}$	$\frac{1}{(1+r)^2}$	$\frac{1}{(1+r)^3}$	$\frac{1}{(1+r)^4}$	$\frac{1}{(1+r)^5}$				

This shows that \$10, beginning next year and ending in year 5, should be worth

$$\begin{aligned} \text{PV} &= \frac{\$10}{r} - \frac{1}{(1+r)^5} \cdot \frac{\$10}{r} \\ &= \frac{C}{r} - \frac{1}{(1+r)^5} \cdot \frac{C}{r} \end{aligned}$$

which is just the annuity formula, $(C/r) \cdot \left[1 - 1/(1+r)^T\right]$.

EOC MATTER

eocproblems

question
You can sell your building for \$200,000. Alternatively, you can lease out your building. The lessee will pay you \$2,000 per month. You will have to budget \$700 per month for upkeep, attention, and so on. At the end of the 20-year lease, you expect the building to be worthless, but the land to have a residual value of \$150,000. Your cost of capital is 0.5% per month. Should you sell or lease your building?

answer
Ownership: The present value of the land is $\$150{,}000/1.005^{240} = \$45{,}314.42$. The net lease inflows are $\$1{,}300 \cdot [1 - 1/1.005^{240}] \approx \$181{,}455.00$. The sum total value of ownership is thus \$226,769.42. This is more than the \$200,000 that you would receive if you sold the building.

question
The discount rate is 12.68% per annum. Your competitor offers a 5-year airplane lease for an upfront cost of \$30,000. The lessee will have to pay \$3,000 per year in insurance (each year in advance) and service costs, and \$3,000 per month lease fees.

1. What is the customer's equivalent monthly cost of leasing an airplane?
2. Your boss believes that customers would prefer a 4-year lease to a 5-year lease if it saves on lease payments. Assume insurance (of \$3,000 per year) and upfront lease payment (of \$30,000) stay the same. What would be the monthly lease payment to remain even?

(Assume that your customers can compute net present values and that airplanes do not age.)

answer
The interest rate is 1% per month.

1. The rental equivalent for the upfront payment solves $\$30{,}000 = RE/r \cdot (1 - 1/1.01^{60})$, which is

$$RE = \frac{1\% \cdot \$30{,}000}{1-\left(\frac{1}{1.01}\right)^{60}} \approx \$667.33$$
$$RE = \frac{r \cdot P}{1-\left(\frac{1}{1+r}\right)^{T}}$$

In addition, the lessee needs to pay $3,000 for insurance at the beginning of each year. Spread over the year, the monthly cost of insurance is

$$RE = \frac{1\% \cdot \$3{,}000}{1-\left(\frac{1}{1.01}\right)^{12}} \approx \$266.55$$
$$RE = \frac{r \cdot P}{1-\left(\frac{1}{1+r}\right)^{T}}$$

Finally, there is the $3,000 lease fee itself. An airplane thus costs $3,934 per month.

2.
$$RE = \frac{1\% \cdot \$30{,}000}{1-\left(\frac{1}{1.01}\right)^{120}} \approx \$790.01$$
$$RE = \frac{r \cdot P}{1-\left(\frac{1}{1+r}\right)^{T}}$$

Thus, you could lower the monthly lease payment by $122.68, i.e., from $3,000 to $2,877.32. The reason is that you would receive your valuable airplane (with an opportunity to get another $30,000 upfront fee) a year earlier.

Chapter 5

Time-Varying Rates of Return and the Yield Cur

There are many more fine details to bonds, including to Treasury bonds. Although these details are not necessary to follow the material in the remainder of this book, they are important for CFOs. After all, U.S. Treasuries make up the most important homogeneous financial market in the world. Corporate cash is often "parked" in U.S. Treasuries. Borrowing is also critically important in most corporate contexts, and many corporate bonds are more or less linked to the price of equivalent Treasuries. Any CFO who wants to finance projects by issuing corporate bonds will inevitably run into the issues discussed in this appendix.

A.5.A Extracting Forward Interest Rates

Let's first revisit the forward rate computation from Table **??**, but let's do it a little slower and more systematically. First, write down the generic relationships:

		Rates of Return	
Maturity	**Total Holding**	**Annualized**	**Individually Compounded**
1 Year	$(1+r_{0,1})$	$=(1+r_{\bar{1}})^1$	$=(1+r_{0,1})$
2 Years	$(1+r_{0,2})$	$=(1+r_{\bar{2}})^2$	$=(1+r_{0,1})\cdot(1+r_{1,2})$
3 Years	$(1+r_{0,3})$	$=(1+r_{\bar{3}})^3$	$=(1+r_{0,1})\cdot(1+r_{1,2})\cdot(1+r_{2,3})$

Start by entering the rates that you can read off the yield curve, the third column. In December 2004, these interest rates were as follows:

		Rates of Return	
Maturity	**Total Holding**	**Annualized**	**Individually Compounded**
1 Year	$(1+r_{0,1})$	$=(1+2.23\%)^1$	$=(1+r_{0,1})$
2 Years	$(1+r_{0,2})$	$\approx(1+2.58\%)^2$	$\approx(1+r_{0,1})\cdot(1+r_{1,2})$
3 Years	$(1+r_{0,3})$	$\approx(1+2.85\%)^3$	$\approx(1+r_{0,1})\cdot(1+r_{1,2})\cdot(1+r_{2,3})$

This is what you always start with—the yield curve. To work out the remaining interest rates requires you to systematically (1) work out all holding rates of return; and then (2) work out individually compounded rates of return, going down the table, using the holding rates of return and the individually compounded rates of return that you just computed earlier.

Step by Step Calculations

The first step is to compute the holding rates of return in the second column:

		Rates of Returns	
Maturity	Total Holding	Annualized	Individually Compounded
1 Year	$(1+2.23\%)$	$=(1+2.23\%)^1$	$=(1+r_{0,1})$
2 Year	$(1+5.23\%)$	$\approx(1+2.58\%)^2$	$=(1+r_{0,1})\cdot(1+r_{1,2})$
3 Year	$(1+8.80\%)$	$\approx(1+2.85\%)^3$	$=(1+r_{0,1})\cdot(1+r_{1,2})\cdot(1+r_{2,3})$

Ultimately, you want to know what the implied future interest rates are. Work your way down. The first row is easy: You know that $r_{0,1}$ is 2.23%. You can also substitute this return into the other rows:

		Rates of Returns	
Maturity	Total Holding	Annualized	Individually Compounded
1 Year	$(1+2.23\%)$	$=(1+2.23\%)^1$	$=$ $(1+2.23\%)$
2 Year	$(1+5.23\%)$	$\approx(1+2.58\%)^2$	$\approx$ $(1+2.23\%)$ $\cdot(1+r_{1,2})$
3 Year	$(1+8.80\%)$	$\approx(1+2.85\%)^3$	$\approx$ $(1+2.23\%)$ $\cdot(1+r_{1,2})\cdot(1+r_{2,3})$

Now you have to work on the 2-year row to determine $r_{1,2}$: You have one equation and one unknown in the 2-year row, so you can determine the interest to be

$$(1+5.23\%) = (1+2.23\%)\cdot(1+r_{1,2}) \iff (1+r_{1,2}) = \left(\frac{1+5.23\%}{1+2.23\%}\right) \approx 1+2.93\%$$

Substitute this solution back into the table:

		Rates of Returns	
Maturity	Total Holding	Annualized	Individually Compounded
1 Year	$(1+2.23\%)$	$=(1+2.23\%)^1$	$=(1+2.23\%)$
2 Year	$(1+5.23\%)$	$\approx(1+2.58\%)^2$	$\approx(1+2.23\%)\cdot$ (1+2.93%)
3 Year	$(1+8.80\%)$	$\approx(1+2.85\%)^3$	$\approx(1+2.23\%)\cdot$ (1+2.93%) $\cdot(1+r_{2,3})$

Now work on row 3. Again, you have one equation and one unknown in the 3-year row, so you can determine the interest to be

$$(1+8.80\%) = (1+2.23\%)\cdot(1+2.93\%)\cdot(1+r_{2,3})$$
$$\implies (1+r_{2,3}) = \frac{1+8.80\%}{(1+2.23\%)\cdot(1+2.93\%)} \approx 1+3.39\%$$

		Rates of Returns	
Maturity	Total Holding	Annualized	Individually Compounded
1 Year	$(1+2.23\%)$	$=(1+2.23\%)^1$	$=(1+2.23\%)$
2 Year	$(1+5.23\%)$	$\approx(1+2.58\%)^2$	$\approx(1+2.23\%)\cdot(1+2.93\%)$
3 Year	$(1+8.80\%)$	$\approx(1+2.85\%)^3$	$\approx(1+2.23\%)\cdot(1+2.93\%)\cdot$ (1+3.39%)

Given the annualized rates of return in the yield curve, you can determine the whole set of implied forward interest rates. For example, the implied interest rate from year 2 to year 3 is 3.39%. x

Behind this arithmetic lies a pretty simple intuition: An annualized 2-year interest rate is "really sort of" an "average" interest rate over the interest rates from the first year and the second year. (In fact, the annualized rate is called the **geometric average**.) If you know that the average interest rate is 2.58%, and you know that the first half of this average is 2.23%, it must be that the second half of the average must be a number around 2.9% in order to average out to 2.58%. And, indeed, you worked out that the forward 1-year interest rate was 2.93%. It is not exact—due to compounding and cross-product terms—but it is fairly close.

question
Continuing the yield curve example in the text, compute the 1-year forward interest rate $r_{3,4}$ from year 3 to year 4 if the 4-year annualized interest rate was 3.10%.

answer
$r_{0,3}$ was computed in the text as 8.80%. The 4-year holding rate of return is $r_{0,4} \approx 1.031^4 - 1 \approx 12.99\%$. Therefore, the 1-year forward rate from year 3 to year 4 is $r_{3,4} = (1 + r_{0,4})/(1 + r_{0,3}) - 1 \approx (1 + 12.99\%)/(1 + 8.80\%) - 1 \approx 3.85\%$.

A.5.B Shorting and Locking in Forward Interest Rates

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One important reason for dwelling on forward rates is that you can lock them in! That is, you can contract today for a 1-year interest rate for a loan that will begin in, say, 2 years. When would you want to do this? Computing and locking rates are rarely important to ordinary small retail investors, but it can be very important for CFOs and paramount for bond traders. For example, as CFO, you may have a corporate project that will require a cash outlay in two years and then will pay off cash the year after. You may want to lock in financing today, but have actual money coming in only when you need it, and money going out when you have it. Thus, you may want to lock in the forward rate that is determined by the yield curve today. This particular transaction is called a **forward transaction**. Incidentally, this particular type of forward transaction is so popular that an entire financial market on [pl]interest forward has developed that allows speculators to

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do it all in one transaction. How these contracts are priced is now explained.

The interest rate that you can lock in is the forward rate. For the example, we called it $r_{2,3}$, the 1-year interest rate beginning in 2 years. Still, to be clear, I now want to rename this rate $f_{2,3}$, both for better memorization and for the real world, where you sometimes need to distinguish this forward interest rate (that you know today) from the 1-year interest rate that will actually come about in 2 years. (In the real world, this is an interest rate that you cannot know today. It is only in our artificial world of perfect certainty that the forward interest rate and

x

the future actual interest rate must be identical.)

How can you buy and sell (short) Treasury bonds cleverly, so that you can lock in the future interest rates embedded in the yield curve? Working with (and speculating) on forward rates is the "bread-and-butter" not only for bond traders but also for many corporate treasurers. To learn the mechanism, assume that you can buy and sell Treasury bonds, even if you do not own them. In effect,

Figure 5.1: The Mechanics of an Apple Short Sale

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There are three involved parties: You (the party going short), an Apple lender (who has Apples), and an Apple market in which everyone can buy or sell apples at a fair price.

Today:

1. You borrow 1 apple from the lender in exchange for your safe promise to the lender to return this 1 apple next year. (You also pay the lender an extra 1 cent lending fee.)

2. You sell 1 apple into the apple market at the currently prevailing apple price. Say 1 apple costs $5 today. You now have $5 cash, which you can invest. Say you buy bonds that earn you a 1% interest rate.

Next Year:

1. You owe the lender 1 apple. Therefore, you must purchase 1 apple from the apple market.

    - If apples now cost $6, you must purchase 1 apple from the market at $6. You return the apple to the lender. Your net return on the apple is thus −$1, plus the $0.05 interest on $5, minus the 1 cent fee to the lender. You therefore lost 96 cents.
    - If apples now cost $4, you must purchase 1 apple from the market at $4. You return the apple to the lender. Your net return on the apple is thus +$1, plus the $0.05 interest on $5, minus the 1 cent fee to the lender. You therefore gained $1.04.

Net Effects:

- The apple lender has really continued to own the apple throughout and can sell the apple in year 1. There is no advantage for the lender to keep the apple in his own apple cellar rather than to lend it to you. In addition, the lender earns 1 cent by lending.

- The apple market buyer purchased an apple from you today and will never know where it came from (i.e., from a short sale).

- The apple market seller next year will never know what you do with the apple (i.e., that you will use it to make good on your previous year's apple loan).

- You speculated that the price of an apple would decline.

- Note that you did earn the interest rate along the way. Except for the fee you paid to the lender, you could sell the apple in the apple market today and use the proceeds to earn interest, just as an apple grower could have.

we assume that you can borrow Treasury securities, sell them to third parties, receive the cash, buy back the bonds later in the market, and return them to the lender of the Treasury securities. This is called a **short sale** (the opposite—buying securities—is said to be a long position). Figure 5.1 explains the basic idea behind shorting. In effect, for Treasury bonds, short-selling enables you to do what the government does—"issue" a security, take in money, and return it to the lender with interest at a later date.

For example, you may sell short \$91,915.15 of a 3-year, zero-coupon Treasury note today with a 2.85% rate of interest. This will give you \$91,915.15 cash today but require you to come up with \$100,000 for repayment in 3 years. In effect, selling a Treasury short is a way of borrowing money. Physically, short transactions in the real world are often arranged by a broker, who finds someone who owns the 3-year Treasury note and who is willing to lend it to you (for a small fee). You will have to return this Treasury note to this lender the instant before the Treasury pays off the \$100,000. In the real world, for professional bond traders who can prove that they have enough funds to make good on any possible losses, this is easily possible and can be executed with extremely small transaction costs, perhaps 1-2 basis points. Thus, assuming no transaction costs is a reasonable assumption.

Holding a security (i.e., being long) speculates that the value will go up, so selling a financial instrument (i.e., being short) speculates that the value will go down. If the price of the note tomorrow were to go down to \$50,000 (an annualized interest rate of $(\$100{,}000/\$50{,}000)^{1/3} - 1 \approx 26\%$), you could then purchase the Treasury note for \$50,000 to cover the \$100,000 commitment you have made for \$91,915.15, a profit of \$41,915.15. In fact, you could just return the Treasury to your lender right away. But if the price of the note tomorrow were to go to \$99,000 (an annualized interest rate of 0.33%), you would lose \$7,084.85.

Now assume that you are able to buy a 2-year, zero-coupon Treasury note at an annualized interest rate of 2.58%, and able to sell (short) a 3-year note at an annualized interest rate of 2.85%, and do so without transaction costs. For the 3-year note, you would have to promise to pay back $\$100 \cdot 1.0880 \approx \$108.80$ in 3 years (cash outflow to you) for each \$100 you are borrowing today (cash inflow to you). For the 2-year note, you would invest these \$100 (cash outflow to you) and receive $\$100 \cdot 1.0523 \approx \$105.23$ in 2 years (cash inflow to you).

Looking at Table 5.1, from your perspective, the simultaneous transaction in the two bonds results in an inflow of \$105.23 in year 2 followed by a cash outflow of \$108.80 in year 3. Effectively, you have committed to borrowing \$105.23 in year 2 and paying back \$108.80 in year 3. The interest rate for this loan is

Table 5.1: Locking in a Future Interest Rate via the Long-Short Forward Interest Rate Spread

—This shows the net flows at different points in time.

Time	Purchased 2-Year Note Cash Flows		Shorted 3-Year Note Cash Flows		Net Cash Flow	
Today (Y0)	–$100.00	(outflow)	+$100.00	(inflow)	$0.00	
Year (Y1)	$0.00		$0.00		$0.00	
Year (Y2)	+$105.23	(inflow)	$0.00		+$105.23	(inflow)
Year (Y3)	$0.00		–$108.80	(outflow)	–$108.80	(outflow)

Figure lock with width 1*fullwidth

$$f_{2,3} \approx \frac{\$108.80 - \$105.23}{\$105.23} \approx 3.39\%$$

$$f_{2,3} = \frac{C_0 \cdot (1 + r_{0,3}) - C_0 \cdot (1 + r_{0,2})}{C_0 \cdot (1 + r_{0,2})}$$

which is exactly the forward interest rate in Table **??**. X

There are many ways to skin a cat.PS: Why do English speakers want to skin cats?? Here is an alternative way to work this problem, which you may or may not find easier. Start with the amount that you want to borrow/lend in a future period. For example, say you want to lend $500 in year 2 and repay however much you need to in year 3. Lending $500 in year 2 requires an outflow, which you can only accomplish with an inflow today. (Therefore, the first "leg" of your transaction is that you borrow, i.e., short the 2-year note.) Specifically, your inflow today is $\$500/1.0258^2 \approx \$475.17$. Now, invest the entire $475.17 into the 3-year note, so that you have zero net cash flow today. (This second "leg" of your transaction is that you lend, i.e., purchase the 3-year note.) Done. What do these two transactions do? You will earn an inflow of $\$475.17 \cdot 1.0285^3 \approx \$516.97$ in 3 years. In total, your financial transactions have committed you to an outflow of $500 in year 2 in exchange for an inflow of $516.97 in year 3—otherwise known as 1-year lending in year 2 at a precommitted interest rate of 3.39%. x x

Should you engage in this transaction? If the 1-year interest rate in 2 years will be higher than 3.39% using the forward lock-in strategy, you will have borrowed at a lower interest rate than what will be possible then. Of course, if the interest rate will be lower than 3.39%, you will have committed to borrow at an interest rate that is above what you could have gotten then. In real life, the 1-year Treasury

rate in December 2006 was 4.94%. Thus, the forward-lock transaction would have turned out great *ex-post*.

---

question

If you want to commit to saving at an interest rate of $f_{3,4}$ in December 2004, what would you have to do? (Assume any amount of investment you wish, and work from there.)

answer

The 3-year rate is 2.85%. The 5-year rate is 3.35%. First, interpolate the 4-year interest rate: $r_{\bar{4}} = (2.85\%+3.35\%)/2 = 3.10\%$. Buy \$1,000 of the 4-year, zero note and short \$1,000 of the 3-year, zero note (2.85%/year). Today, you receive and pay \$1,000, so the transaction does not cost you anything. In 3-years, you need to pay the 3-year note—that is, you need to pay $\$1{,}000 \cdot 1.0285^3 \approx \$1{,}087.96$. In 4 years, you receive from the 4-year note $\$1{,}000 \cdot 1.031^4 \approx \$1{,}129.89$. This is the equivalent of saving at an interest rate $r_{3,4}$ of 3.85%.

question

If you want to commit to saving \$500,000 in 3 years (i.e., you will deposit \$500,000) at an interest rate of $f_{3,4} \approx 3.85\%$ (i.e., you will receive about \$519,250), given $r_{\bar{3}} = 2.85\%$ and $r_{\bar{4}} = 3.10\%$, what would you have to do?

answer

To commit to saving in year 3, you would need a cash outflow of \$500,000 in year 3. To get this, you need a cash inflow of $\$500{,}000/1.0285^3 \approx \$459{,}575.76$. Buy 4-year Treasuries for this amount today. Finance them by short-selling simultaneously 3-year Treasuries for the same amount.

A.5.C Bond Duration

x

X In Section **??**, you learned that you can summarize or characterize the multiple cash flows promised by a bond with the YTM. But how can you characterize the "term length" of a bond? The final payment, that is, the maturity, is flawed: Zero-bonds and coupon bonds may have the same maturity, but a high coupon bond could pay out a good amount of money early on. For example, a coupon bond could pay a \$99 coupon the first month and leave \$1 for one payment in 30 years. It would count as a 30-year-maturity bond—the same as a zero-bond that pays

x \$100 in 30 years.

To measure the payout pattern of a bond, investors often rely not only on maturity, but also on the **duration**, which is a measure of the effective time-length of a project. The simplest duration measure computes the time-weighted average

of bond payouts, divided by the sum of all payments. For example, a 5-year coupon bond that pays \$250 for 4 years and \$1,250 in the fifth year, has a duration of 3.89 years, because

$$\text{Plain Duration} = \frac{\$250{\cdot}1 + \$250{\cdot}2 + \$250{\cdot}3 + \$250{\cdot}4 + \$1{,}250{\cdot}5}{\$250 + \$250 + \$250 + \$250 + \$1{,}250} \approx 3.89$$

$$\frac{\text{Payment at Time 1}{\cdot}1 + \text{Payment at Time 2}{\cdot}2 + \cdots + \text{Payment at Time T}{\cdot}T}{\text{Payment at Time 1} + \text{Payment at Time 2} + \cdots + \text{Payment at Time T}}$$

(You can think of this as the "payment-weighted" payout year.) The idea is that you now consider this 5-year coupon bond to be shorter-term than a 5-year zero-bond (which has a 5-year duration)—and perhaps more similar to a 3.9-year zero-bond. x

Duration is sometimes illustrated through the physical analog in Figure 5.2: If all payments were weights hanging from a (time) line, the duration is the point where the weights balance out, so that the line tilts neither right nor left. x

Macaulay duration alters plain duration by using the present value of payouts, not just nominal payouts. Thus, unlike plain duration, which merely characterizes bond cash flows regardless of economy-wide interest rates, Macaulay duration also depends on the prevailing yield curve. If the interest rate on all horizons is 5%, the Macaulay duration for your coupon bond is

$$\text{MD} = \frac{\$250/1.05{\cdot}1 + \$250/1.05^2{\cdot}2 + \$250/1.05^3{\cdot}3 + \$250/1.05^4{\cdot}4 + \$1{,}250/1.05^5{\cdot}5}{\$250/1.05 + \$250/1.05^2 + \$250/1.05^3 + \$250/1.05^4 + \$1{,}250/1.05^5}$$

$$= \frac{\$238{\cdot}1 + \$227{\cdot}2 + \$216{\cdot}3 + \$206{\cdot}4 + \$979{\cdot}5}{\$238 + \$227 + \$216 + \$206 + \$979} \approx 3.78$$

$$\frac{\text{PV}\big(\text{Payment at Time 1}\big){\cdot}1 + \text{PV(Payment at Time 2)}{\cdot}2 + {\cdot}s + \text{PV(Payment at Time T)}{\cdot}T}{\text{PV(Payment at Time 1)} + \text{PV(Payment at Time 2)} + {\cdot}s + \text{PV(Payment at Time T)}}$$

Macaulay duration is the more commonly used duration measure in the real world.

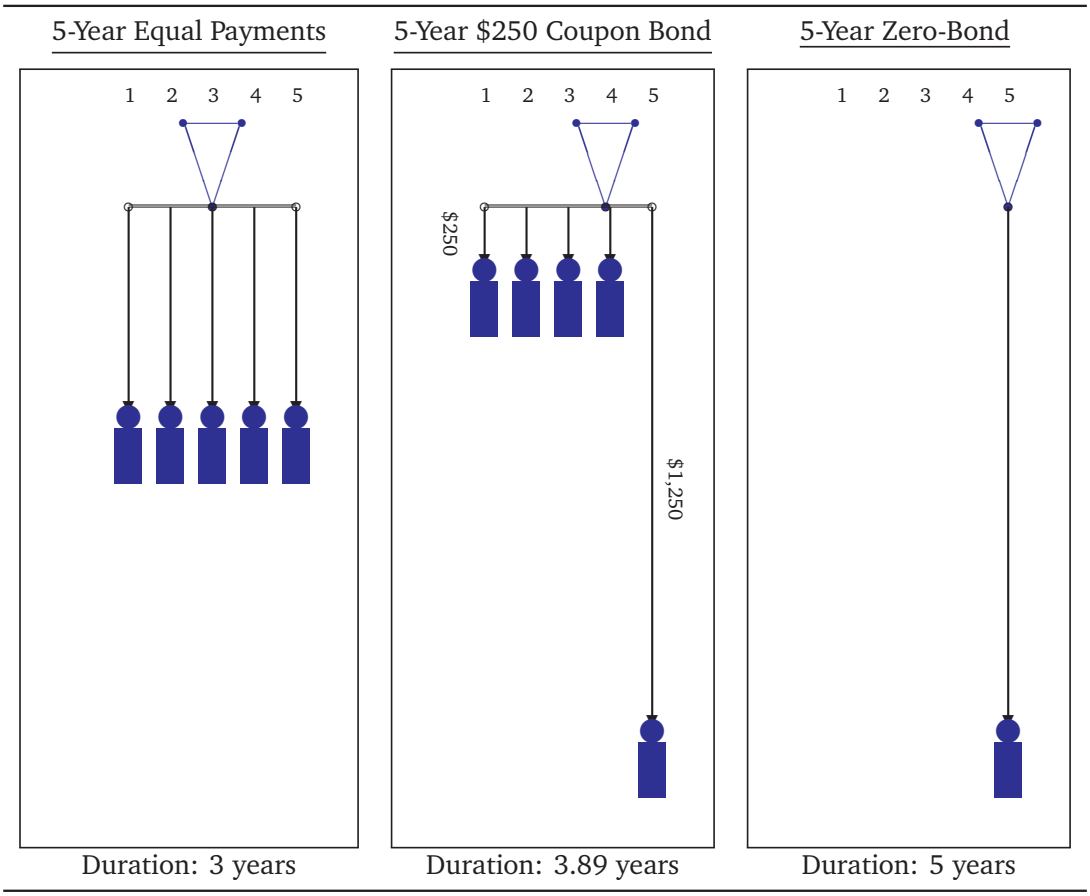
---

question

A 2-year bond costs \$25,000 today. It pays \$1,000 interest at the end of the first year and \$1,000 interest at the end of the second year. At the end of the second year, it also repays the principal of \$25,000. (Use 4 decimal places of accuracy when computing durations.)

1. What is its plain duration?
2. If the yield curve is a flat 0%, what is its Macaulay duration?
3. If the yield curve is a flat 3%, what is its Macaulay duration?
4. If the yield curve is a flat 10%, what is its Macaulay duration?

Figure 5.2: Physics Analogy Illustrating Plain Duration



answer

For the bond with cash flows of \$25,000, −\$1,000, and −\$26,000, the durations (all quoted in units of years, because we quote the multiplication factors "1" and "2" in years) are as follows:

1. The plain duration is

$$\begin{aligned}\text{Plain Duration} &= \frac{\left(\sum_{t=1}^{1} \$1{,}000{\cdot}t\right) + \$26{,}000{\cdot}2}{\left(\sum_{t=1}^{1} \$1{,}000\right) + \$26{,}000} \\ &= \frac{53{,}000}{27{,}000} \approx 1.96296\end{aligned}$$

2. If the yield curve is a flat 0%, plain and Macauley durations are the same. Thus, it is 1.96296 years.
3. This Macauley duration is

$$\begin{aligned}\text{MD at 3\%} &= \frac{\left(\sum_{t=1}^{2} \frac{\$1{,}000 \cdot t}{1.03^t}\right) + \frac{\$26{,}000 \cdot 2}{1.03^2}}{\left(\sum_{t=1}^{2} \frac{\$1{,}000}{1.03^t}\right) + \frac{\$26{,}000}{1.03^2}} \\ &= \frac{\frac{\$1{,}000 \cdot 1}{1.03^1} + \frac{\$1{,}000 \cdot 2}{1.03^2} + \frac{\$25{,}000 \cdot 2}{1.03^2}}{\frac{\$1{,}000}{1.03^1} + \frac{\$1{,}000}{1.03^2} + \frac{\$25{,}000}{1.03^2}} \\ &\approx \frac{49{,}985.86}{25{,}478.37} \approx 1.96189\end{aligned}$$

4. This Macauley duration is

$$\begin{aligned}\text{MD at 10\%} &= \frac{\left(\sum_{t=1}^{2} \frac{\$1{,}000 \cdot t}{1.10^t}\right) + \frac{\$25{,}000 \cdot 2}{1.10^2}}{\left(\sum_{t=1}^{2} \frac{\$1{,}000}{1.10^t}\right) + \frac{\$25{,}000}{1.10^2}} \\ &= \frac{\frac{\$1{,}000 \cdot 1}{1.10^1} + \frac{\$1{,}000 \cdot 2}{1.10^2} + \frac{\$25{,}000 \cdot 2}{1.10^2}}{\frac{\$1{,}000}{1.10^1} + \frac{\$1{,}000}{1.10^2} + \frac{\$25{,}000}{1.10^2}} \\ &\approx \frac{43{,}884.30}{22{,}396.69} \approx 1.95941\end{aligned}$$

A.5.D Duration Similarity

Duration can also be used as a measure for how long-term corporate projects (that are not bonds) are. (Watch out, though: duration only works if all incoming cash flows are positive—otherwise, it may produce nonsense.) Such a duration measure can be helpful, because you can use it to judge the exposure (risk) of your projects to changes in discount or interest rates. For example, if you have a safe project (or bond portfolio) that has an average duration of 6.9 years, then it is probably more similar to the 7-year, Treasury zero note than to the 5-year, or 10-year, Treasury zero notes.

Now assume that the Treasury yield curve is 5% for 1-year, zero notes; 10% for 2-year, zero notes; and 15% for 3-year, zero notes. You can purchase a project that will deliver \$1,000 in 1 year, \$1,000 in 2 years, and \$1,500 in 3 years, and costs \$2,500. This project would be a good deal, because its present value would

be $2,765.10. It has a YTM of 17.5% and a Macaulay duration of 2.01 years. (We shall only work with the Macaulay duration.) But, let's assume you are also worried about interest rate movements. For example, if interest rates were to quadruple, the project would not be a good one. How does the value of your project change as the yield curve moves around?

x

Let's work out how changes in the yield curve affect your projects and pure zero-notes, each promising $1,000 at maturity. First, your project. Assume that the entire yield curve shifts upward by 1%—the 5% zero note yield becomes a 6% yield, the 10% becomes 11%, and the 15% becomes 16%. Your project value would now be

$$\text{PV} = \frac{\$1{,}000}{1.06} + \frac{\$1{,}000}{1.11^2} + \frac{\$1{,}500}{1.16^3} \approx \$2{,}716.01$$

The 1% increase in interest rates caused an instant rate of return of your project of $(\$2{,}716.01 - \$2{,}765.10)/\$2{,}765.10 \approx -1.78\%$.

Present Value of the Project	
Base Case	$2,765.10
Entire yield curve shifts upward by 1%	$2,716.01
Rate of Return	–1.78%

Is this more similar to how the value of a 1-year zero note would change; or how the 2-year note would change; or how the 3-year note would change? Of course, zero notes are only affected by their specific interest rates, so you can work out the percent change one at a time or all simultaneously, and you would get the same answer.

	Yield	Present Value of Treasuries		
	Curve	Base Case	1% Shift Up	Rate of Return
1-Year Bond	5%→6%	$952.38	$943.40	–0.94%
2-Year Bond	10%→11%	$826.45	$811.62	–1.79%
3-Year Bond	15%→16%	$640.66	$657.52	–2.56%

The answer is that your project's value change is most similar to the 2-year, zero note value change. This is what your project's duration of 2.01 years told you—your project has a discount rate sensitivity that is similar to that of the 2-year note.

A.5.E Duration Hedging

Now you know how your project would suffer from a change in the interest rate, but what can you do about it? The idea is to **hedge** your risk: You try to own the same assets long and short—you are matching liabilities and assets—so that you are insured against adverse changes. For example, it would be a perfect hedge if you purchased the project (the long position) and also shorted $1,000 in the 1-year note, $1,000 in the 2-year note, and $1,500 in the 3-year note. You would be totally uninterested in where interest rates would be moving—your wealth would not be affected. (This is the "law of one price" in action. In fact, there is absolutely no risk of losing money.) x

In the real world, perfect hedges, whereby you can match all project cash flows perfectly, are rarely possible. First, the usual scenario is that you know only roughly what cash flows your project will return. Fortunately, it is often easier to guess your project's duration than all its individual cash flows. Second, it may also be difficult for smaller companies to short, say, 137 different Treasury zero-notes to match all project cash flows—the transaction costs would simply be too high. Third, even if will not do any active matching, you might still want to know what kind of exposure you are carrying. After all, you may not only have this project as an asset, but you may have liabilities (e.g., debt payments) that have a duration of 2.4 years—and you want to know how matched or mismatched your assets and liabilities are. Or you may use the newfound duration knowledge to choose among bank or mortgage loans with different durations, so that your assets and liabilities roughly match up in terms of their durations. x

For example, you know your project assets have a duration of 2 years—what kind of loan would you prefer? One that has a 1-year duration, a 2-year duration, or a 3-year duration? If you want to minimize your interest rate risk, you would prefer to borrow $2,716 of a 2-year note—though the bank loan, too, may not be a zero note, but just some sort of loan with a 2-year duration. Would you be comfortable that the interest rate would not affect your wealth very much if you were to short the 2-year note and long the project? Yes and no—you would be comfortable that wholesale shifts of the yield curve would not affect you. You would, however, be exposed to changes in the shape of the yield curve—if only one of the interest rates were to shift, your project would be impacted differently than your 2-year note. In this case, your project's value would move less than the value of your 2-year note. In the real world, over short horizons, duration matching often works very well. Over longer horizons, however, you will have to constantly watch and rearrange assets and liabilities to prevent the gap from enlarging too much.

A.5.F Continuous Compounding

x

A subject of some interest to Wall Street traders, that is, the people who trade bonds or options for a living, is the concept of a **continuously compounded** x interest rate. This is easiest to explain by example.

Assume that you receive $120 next year for an investment of $100 today. You already know that this represents a simple rate of return of 20%. What would the interest be if it were paid twice per year, the interest rate remained constant, and the $100 would still come out to be $120 at the end of the year? You have done this before:

$$(1 + r_{\text{semiannual}}) \cdot (1 + r_{\text{semiannual}}) = (1 + 20\%) \qquad \Longrightarrow \qquad r \approx 9.54\%$$

If you multiply this semiannual interest rate by 2, you get 19.08%. What if you received interest 12 times a year?

$$(1 + r_{\text{monthly}})^{12} = (1 + 20\%) \qquad \Longrightarrow \qquad r \approx 1.53\%$$

Multiply this monthly interest rate by 12 and you get 18.36%. What if you received interest 365 times a year?

$$(1 + r_{\text{daily}})^{365} = (1 + 20\%) \qquad \Longrightarrow \qquad r \approx 0.05\%$$

X The 20% was called an "effective annual rate" in Section **??**. Multiply this daily interest rate by 365 and you get 18.25% (the annual quote). Now, what would this number be if you were to receive interest every single moment in time—the x annual rate, compounded every instant?

The answer is, you guessed it, the continuously compounded interest rate, and it can be computed by taking the natural logarithm (abbreviated "**ln**" on your X calculator) of 1 plus the simple interest rate

$$r_{\text{continuously compounded}} = \log_N(1 + 20\%) \approx 18.23\%$$

$$r_{\text{continuously compounded}} = \log_N(1 + r_{\text{simple}})$$

Figure 5.3 illustrates how different compounding frequencies affect your final x cash flow after a year.

You must never directly apply a continuously compounded interest rate to a cash flow to compute your return. In this example, investing $100 would not leave you with $118.23 after 1 year. Indeed, if someone quoted you a continuously compounded interest rate, to determine how much money you will end up with after a year, you would first have to convert the continuously compounded return into a simple interest rate

Figure 5.3: Different Compounding Frequencies

—The annual interest rate in this example is 20%, the investment is $100. If you receive 20% at the end of the year, you end up with $120. If you receive 10% twice a year, you end up with $\$100 \cdot 1.10 \cdot 1.10$. And so on. (The formula is $FV = \$100 \cdot (1 + 20\%/i)^i$.) If i is infinite, you end up with $e^{0.2} \approx 1.221402758$ times your initial investment of $100.
Figure compound-continuous with width 1*fullwidth

$$e^{18.23\%} - 1 \approx 20\%$$

$$e^{r_{\text{cont comp}}} - 1 = r_{\text{simple}}$$

and then apply this interest rate to the cash flow. Alternatively, you can multiply the cash flow not by 1 plus the simple interest rate, but by $e^{r_{\text{continuously compounded}}}$. x

Continuously compounded rates have two nice features: First, if the continuously compounded rate in period 1 is 10% and in period 2 is 20%, then the total 2-period continuously compounded rate is 30%—yes, continuously compounded interest rates can be added, so no more multiplying one-pluses! (This additivity is not a big advantage, though.) Second, they are more "symmetric." See, an ordinary rate of return lies between –100% and $+\infty$, while the continuously compounded rate of return lies between $-\infty$ and $+\infty$. (This can be an advantage in statistical work, as can be the fact that the logarithm helps "pull in" large outliers.) However, the main need for continuously compounded interest rates arises in other formulas (such as the Black-Scholes option formula). X

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question
A bond pays $150 for every $100 invested. What is its continuously compounded interest rate?

answer
The simple interest rate is 50%. The continuously compounded interest rate is $\log_N(1 + 50\%) \approx 40.55\%$.

question
Confirm my claim that you can add continuously compounded interest rates. That is, a bond pays a continuously compounded interest rate of 10%. Upon maturity, the money can be reinvested at a continuously compounded interest rate of 20%. If you invest $100 today, how much money will you end up with? What is the simple and continuously compounded interest rate over the 2 periods?

answer
A 10% continuously compounded interest rate is a simple interest rate of

$r_{0,1} = e^{0.10} - 1 \approx 10.52\%$, so you would have \$110.52 after 1 year. A 20% cc interest rate is a simple interest rate of $f_{1,2} = e^{0.20} - 1 \approx 22.14\%$. This means that your \$110.52 investment would turn into $1.02214 \cdot \$110.52 \approx \$134.99$. This means that the simple interest rate is $r_{0,2} \approx 34.99\%$. Thus, the cc interest rate is $log_N(1 + r_{0,2}) \approx log_N(1.3499) \approx 30\%$. Of course, you could have computed this faster: $V_t = e^{0.10} \cdot e^{0.20} \cdot V_0 = e^{0.10+0.20} \cdot V_0 = e^{0.30} \cdot \$100 \approx 1.3499 \cdot \$100 \approx \$134.99$.

A.5.G Compounding, Price Quotes, and STRIPS

anecdote

The term "bond coupon" comes from an era when bond buyers took possession of a physical document that promised payment. To receive interest, the bond owner would clip a coupon off the paper (much like a supermarket coupon), mail it in, and then receive cash in return.

Beginning in the 1970s, some bond buyers (especially large investment banks) would clip at least some of the coupons from the bond and resell them separately. Someone would purchase coupon bonds, put them into separate escrow accounts, and sell them individually. This practice was called **stripping**. By the early 1980s, this practice had become more extreme—it was the original method by which zero-coupon bonds were created. That is, coupon bonds had turned into many zero-bonds, one for each coupon, plus one zero-bond for the principal. Indeed they were so common that they themselves became routinely traded.

Nowadays, Treasury bond owners no longer take physical possession of their bonds. Instead, since 1982, possession only means a record in a computer at the Treasury. Still, the names "coupon" and "stripping" have stuck. In 1985, the Treasury created its own coupon stripping program, and cleverly called it—**STRIPS**. This time, it is an acronym for Separate Trading of Registered Interest and Principal of Securities. Under the STRIPS program, the U.S. government issues with maturities of 10 years or more are eligible for transfer over Fedwire. The process involves wiring Treasury notes and bonds to the Federal Reserve Bank of New York and receiving separated computer entries representing its components in return. This has reduced the legal and insurance costs associated with the process of stripping a security prior to 1982. In May 1987, the Treasury began to allow the reconstitution of stripped securities. Nowadays, financial services companies can divide payments at will, with the Treasury acting as a reliable administrative agent.

The original advantage for zero-coupon bonds was—what else?—the tax code. The United States largely caught up with the new situation in 1982, although tax-exempt accounts still get some small advantages from them. But the main reason for U.S. bond stripping today are tax loopholes in Japan and other countries.

x

Before I can relieve you of the "Treasury bonds" subject, you should know about two more issues, which up to now I have swept under the rug.

1. **Most Treasuries are not zero-bonds:** This whole chapter was based on the fiction that the yield curve was based on the discount rate of zero-bonds. This is not really true. In the United States, most Treasuries actually pay interest twice per year. In Europe, government bonds pay interest once a year. The yield curves that are usually posted therefore quote the yields-to-maturity on coupon bonds, not the yields-to-maturity on zero-bonds. X

   This means that the duration of, say, the 5-year note may really only be 4.9 years, not 5.0 years. If the yield curve is flat, this duration discrepancy makes no difference. Even if the yield curve is steep, it may cause a discrepancy of only a couple of basis points. For example, in the yield curve in our example, the difference would be about 4 basis points for a 10-year zero bond versus a 10-year coupon bond.

   To be clear—if you are a bond trader, these are differences that are of vital importance. But if you are a corporation or individual, this is almost never an issue worth wasting a lot of thought over.

   As a bond trader, it is not too difficult to convert level-coupon bonds into zero-bonds. You can think of a semiannual 30-year, level-coupon bond as a project consisting of 59 relatively small zero notes, each maturing half a year after the other, and one big zero-bond, maturing in 30 years. If you feel like it, the next question will lead you step by step through the process of converting level-coupon bonds into zero bonds.

2. **How the real world quotes Treasuries:** There are intricate calculations required to translate quotes into yields-to-maturity. If you need them, they are explained in detail at www.newyorkfed.org/aboutthefed/fedpoint/fed28.html ("Estimating Yields on Treasury Securities"). Fortunately, nowadays, most publications already do the translation into YTM for you.

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question

(Advanced) Let me lead you along in working out how you can "STRIP" a Treasury coupon bond. Assume the 12-month Treasury note costs $10,065.22 and pays a coupon of $150 in 6 months, and interest plus coupon of $10,150 in 12 months. (Its payment patterns indicate that it was originally issued as a "3% semiannual, level-coupon note.") Now assume the 6-month Treasury bill costs $10,103.96 and has only one remaining coupon-plus-principal payment of $10,200. (It was originally issued [and perhaps many years ago] as a "4% semiannual, level-coupon bill.")

1. What is the YTM of these two Treasuries?
2. Graph a yield curve based on the maturity of these two Treasuries.

3. What would be the price of a 1-year zero note?
4. Graph a yield curve based on zero notes.
5. Do the yield differences between the 1-year zero note and the 1-year coupon note seem large to you?

answer

1. To compute the YTM for the 12-month note:

$$-\$10{,}065.22 + \frac{\$150}{(1+YTM)^{0.5}} + \frac{\$10{,}150}{(1+YTM)^{1}} = 0$$

which solves to $YTM \approx 2.35\%$. To compute the YTM of the 6-month bill:

$$-\$10{,}103.96 + \frac{\$10{,}200}{(1+YTM)^{0.5}} = 0$$

which solves to $YTM \approx 1.91\%$.

2. Do it.
3. The \$150 coupon is worth $\$150/1.0191^{0.5} \approx \$148.59$. Therefore, the 1-year, zero note with one payment of \$10,150 due in 1 year costs $\$10{,}065.22 - \$148.59 = \$9{,}916.63$. This means that the 1-year, zero note with payoff of \$10,150 has a YTM of $\$10{,}150/\$9{,}916.63 - 1 \approx 2.35\%$.
4. Do it.
5. The difference between the YTM of the coupon note (1.91%) and the zero note (235%) is only 0.44 basis points—very small, even though the yield curve here is fairly steep. The reason is that the early 6-month coupon (earning a lower interest rate) makes little difference because the coupon payment is only \$150, and most of the YTM comes from the final payment. The coupon effect can become larger on very long horizons when the yield curve is steep, but it is very rarely more than 10-20 basis points.

wideonecolumn

Summary

widetwocolumns

This appendix covered the following major points:

- The information in the set of annualized rates of return, individual holding rates of return, and total holding rates of return is identical. Therefore, you can translate them into one another. For example, you can extract all forward interest rates from the prevailing yield curve.
- It explains how shorting transactions work.
- If you can both buy and short bonds, then you can lock in forward interest rates today.
- Bond duration is a characterization of when bond payments typically come in.
- The continuously compounded interest rate is $\log_N(1+r)$, where r is the simple interest rate.

EOC MATTER

eocproblems

question
Explain the difference between shorting in the real world, and shorting in a perfect world.

answer
In the real world, you often do not get use of proceeds. This costs you the interest rate. In addition, there are some other minor rules.

question
The annualized interest rates are as follows:

Year	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Interest Rate	3%	4%	5%	6%	6%	6%
Year	**Y7**	**Y8**	**Y9**	**Y10**	**Y11**	**Y12**
Interest Rate	7%	7%	7%	6%	5%	4%

1. Compute the full set of forward rates.

2. Plot the forward rates into the yield curve graph. Is there an intuitive relation between the forward rate curve and the yield curve?
3. If you wanted to lock in an interest rate for savings of $100,000 from year 3 to year 4 (a 1-year investment), how exactly would you do it using existing bonds?

answer

1. See earlier.
2. As annualized rates increase, the forward rates are increasing, as well as the reverse. However, the forward rates increase much more up or down than the annualized rates.
3. Short 3-year Treasuries of $\$100{,}000/1.05^3 \approx \$86{,}383.76$ and invest this amount into 4-year Treasuries. At the end of 3 years, you will owe $100,000 and you will receive $\$86{,}383.76 \cdot 1.06^4 \approx \$109{,}057$ at the end of 4 years. Your rate of return is 9.06%.

question
At today's prevailing 1-year and 2-year Treasury rates,

1. What is the 1-year forward interest rate on Treasuries?
2. How would you commit today to borrowing $100,000 next year at this forward rate?

answer
This depends on the time.

question
A coupon bond costs $100, pays $10 interest each year, and in 10 years pays back $100 principal (ceasing to exist). What is the coupon bond's plain duration?

answer
7.75 years.

question
A 10-year zero-bond has a YTM of 10%. What is its plain duration? What is its Macaulay duration?

answer
The duration of a zero-bond is its maturity of 10 year.

question
A 25-year bond costs $25,000 today and will pay $1,000 at year-end for the following 25 years. In the final year ($T = 25$), it also repays $25,000 in principal. (Use 4 decimal places of accuracy when computing durations.)

1. What is its YTM?
2. What is its plain duration?
3. If the yield curve is a flat 3%, what is its Macaulay duration?
4. If the yield curve is a flat 10%, what is its Macaulay duration?

answer

For this standard annual 25-year 4% level-coupon bond with \$25,000 in principal:

1. The YTM is the solution to

$$-\$25{,}000 + \sum_{t=1}^{25} \frac{\$1{,}000}{(1+r)^t} + \frac{\$25{,}000}{(1+r)^{25}} = 0$$

   The middle piece is an annuity, so $\sum_{t=1}^{25} \$1{,}000/(1+r)^t = \$1{,}000 \cdot (1-[1/(1+r)^{25}])/r$. The correct solution is $r = 4\%$.

2. The plain duration is

$$\text{Plain Duration} = \frac{\sum_{t=1}^{25} \$1{,}000 \cdot t + \$25{,}000 \cdot 25}{\sum_{t=1}^{25} \$1{,}000 + \$25{,}000} = \frac{\$950{,}000}{\$50{,}000} \approx 19.00$$

3. The Macaulay duration at 3% is

$$\text{Macaulay Duration at 3\%} = \frac{\sum_{t=1}^{25} \frac{\$1{,}000 \cdot t}{1.03^t} + \frac{\$25{,}000 \cdot 25}{1.03^{25}}}{\sum_{t=1}^{25} \frac{\$1{,}000}{1.03^t} + \frac{\$25{,}000}{1.03^{25}}} \approx \frac{\$498{,}350.24}{\$29{,}353.29} \approx 16.98$$

4. The Macaulay duration at 10% is

$$\text{Macaulay Duration at 10\%} = \frac{\sum_{t=1}^{25} \frac{\$1{,}000 \cdot t}{1.10^t} + \frac{\$25{,}000 \cdot 25}{1.10^{25}}}{\sum_{t=1}^{25} \frac{\$1{,}000}{1.10^t} + \frac{\$25{,}000}{1.10^{25}}} \approx \frac{\$134{,}457.99}{\$11{,}384.44} \approx 11.81$$

question

If the continuously compounded interest rate is 10% per annum in the first year and 20% the following year, what is your total continuously compounded interest rate over the 2 years? How much will you earn over these 2 years for \$1 of investment?

answer

Don't be tricked into thinking that continuously compounding will make it different from the usual case. Interest rate: $(1 + 10\%) \cdot (1 + 20\%) - 1 = 32\%$ You will earn \$0.1 in the first year, and \$0.22 in the second year.

Chapter 8

Investor Choice: Risk and Reward

x

This appendix develops the trade-off between risk and return, briefly covered in Section **??**. Although this is not central to the subject of corporate finance, it is central to the subject of investment finance.

Let me recap where we are and where we want to go.

- You already know that diversification reduces risk.
- Therefore, you know that you like diversification.
- You know that assets that covary negatively with the rest of your portfolio are particularly desirable from a diversification perspective.
- The beta of an asset with respect to a portfolio is its measure of "toxicity" in the context of the portfolio.

The question that we now want to work out is

- Exactly how much of each asset should you purchase?

For example, is it better to purchase 25% in A and 75% in B, or 50% in each? How do you determine good investment weights? What is your optimal investment portfolio?

The process by which this is done is called mean-variance optimizations. There are many large firms (such as Barra, Wilshire Associates, Quantal, etc.), whose primary business it is to implement clever mean-variance optimization for financial funds. Every large pension plan, endowment, bank, insurance company, and most hedge funds pay for this.

Table 8.1: Portfolios Used to Illustrate Mean-Variance Combinations

—These are the two base assets (and their combinations) used to illustrate the mean-variance efficient frontier in Section A.8.C.

	(H,I)	In S1 ([club])	In S2 ([diamond])	In S3 ([heart])	In S4 ([spade])	Reward $\mathrm{E}(r)$	Variance[a] $\mathrm{Var}(r)$	R Sdv
Only H	(1,0)	–6.0 %	+12.0%	0.0%	+18.0%	6.00%	90.0%%	9.
Only I	(0,1)	–12.0%	+18.0%	+24.0%	+6.0%	9.00%	189.0%%	13.
"J"	(1/4, 3/4)	–10.50%	+16.50%	+18.00%	+9.00%	8.25%	128.8%%	11.
"K"	(1/3, 2/3)	–10.00%	+16.00%	+16.00%	+10.00%	8.00%	114.0%%	10.
"L"	(1/2, 1/2)	–9.00%	+15.00%	+12.00%	+12.00%	7.50%	92.2%%	9.
"M"	(2/3, 1/3)	–8.00%	+14.00%	+8.00%	+14.00%	7.00%	81.0%%	9.
"N"	(3/4, 1/4)	–7.50%	+13.50%	+6.00%	+15.00%	6.75%	79.3%%	8.

A.8.A An Investor's Specific Trade-Off Between Risk and Reward

x

To practice, let's make up two new base assets, H and I. (If you wish, you can think of these assets as themselves being portfolios containing many different stocks.)

x How do you find the best combination portfolio of H and I?

Table 8.1 shows some of the portfolios you could put together. You already know how to compute all the numbers in the table, but let's confirm them for at least one combination portfolio. Portfolio K invests $w_H = 1/3$ in H and $w_I = 2/3$ in I, which means it has the following possible outcomes:

$$\begin{aligned}
&\text{In Scenario S1} \quad [\text{club}] && r_K = 1/3 \cdot (-6\%) + 2/3 \cdot (-12\%) = -10\% \\
&\text{In Scenario S2} \quad [\text{diamond}] && r_K = 1/3 \cdot (+12\%) + 2/3 \cdot (+18\%) = +16\% \\
&\text{In Scenario S3} \quad [\text{heart}] && r_K = 1/3 \cdot (0\%) + 2/3 \cdot (+24\%) = +16\% \\
&\text{In Scenario S4} \quad [\text{spade}] && r_K = 1/3 \cdot (+18\%) + 2/3 \cdot (+6\%) = +10\% \\
& && r_K = w_H \cdot (r_H) + w_I \cdot (r_I)
\end{aligned}$$

The expected rate of return of this portfolio, given the four possible future scenarios, is then

$$\mathrm{E}(r_K) = 1/4 \cdot (-10\%) + 1/4 \cdot (+16\%) + 1/4 \cdot (+16\%) + 1/4 \cdot (+10\%) = 8\%$$

$$\mathrm{E}(r) = \text{Sum over all scenarios } S\text{: } \big(Prob(\text{Scenario } S) \cdot \text{Outcome in Scenario } S\big)$$

X To compute the variance of K, you follow the procedure laid out in Section **??**: First, take out the mean from the rates of return:

$$\begin{array}{rrcr} \text{In Scenario S1 [club]} & -10\% - 8\% & = & -18\% \\ \text{In Scenario S2 [diamond]} & +16\% - 8\% & = & +8\% \\ \text{In Scenario S3 [heart]} & +16\% - 8\% & = & +8\% \\ \text{In Scenario S4 [spade]} & +10\% - 8\% & = & +2\% \end{array}$$

$$r_K - \mathrm{E}(r_K)$$

Second, square them and compute the average:

$$\mathrm{Var}(r_K) = \frac{(-18\%)^2 + (+8\%)^2 + (+8\%)^2 + (+2\%)^2}{4} = 114\%\% \quad (8.1)$$

The risk is therefore $\mathrm{Sdv}(r_J) = \sqrt{\mathrm{Var}(r_K)} = \sqrt{114\%\%} \approx 10.68\%$. You have now confirmed the three statistics for portfolio K in Table 8.1: the 8% expected rate of return (reward), the 114%% variance, and the 10.68% standard deviation (risk).

---

question

Confirm the portfolio variance and standard deviation if you invest in portfolio M ($w_H = 2/3$) in Table 8.1.

answer

The rates of return of portfolio M in Table 8.1 are –8% ([club]), +14% ([diamond]), 8% ([heart]), and 14% ([spade]). The deviations from the mean are –15%, 7%, 1%, and 7%. When squared, they are 225%%, 49%%, 1%%, and 49%%. The sum is 324%%; the average is 81%%. Thus, the standard deviation is indeed 9%.

question

Confirm the portfolio variance and standard deviation if you invest in portfolio N ($w_H = 3/4$) in Table 8.1.

answer

The portfolio variance of portfolio N in Table 8.1 is

$$\begin{aligned} &\big[(-7.5\% - 6.75\%)^2 + (13.5\% - 6.75\%)^2 \\ &\quad + (6\% - 6.75\%)^2 + (15\% - 6.75\%)^2\big]/4 \\ &= \frac{203.0625\%\% + 45.5625\%\% + 0.5625\%\% + 68.0625\%\%}{4} \\ &\approx 79.31\%\% \end{aligned}$$

Thus, the standard deviation is $\sqrt{79.31\%\%} \approx 8.91\%$.

A.8.B A Shortcut Formula for the Risk of a Portfolio

x

There is a shortcut formula that can make portfolio variance computations faster. This shortcut allows you to compute the variance of a portfolio as a function of the weights in each constituent asset. To use it, you need to know the covariances between all assets. The formula also avoids having to first work out the rate of return of the combination portfolio in each and every scenario—not a big deal when there are four scenarios, but a very big deal if you have a thousand daily observations, each of which can count as a scenario, and you want to consider many portfolios with various weights.

x

For our two assets, you need only one extra number for the new variance shortcut formula: You have to compute the covariance between your two base portfolios, here H and I. You have already worked with the covariance in Section **??**. It is defined as the average product of the two net-of-mean returns. Subtract the mean (6% for H and 9% for I) from each scenario's realization:

X

		Portfolio H		Portfolio I	
In Scenario S1	[club]	$r_H - \mathrm{E}(r_H) = -12\%$		$r_I - \mathrm{E}(r_I) = -21\%$	
In Scenario S2	[diamond]	$r_H - \mathrm{E}(r_H) = +6\%$		$r_I - \mathrm{E}(r_I) = +9\%$	
In Scenario S3	[heart]	$r_H - \mathrm{E}(r_H) = -6\%$		$r_I - \mathrm{E}(r_I) = +15\%$	
In Scenario S4	[spade]	$r_H - \mathrm{E}(r_H) = +12\%$		$r_I - \mathrm{E}(r_I) = -3\%$	

Therefore,

$$\mathrm{Cov}(r_H, r_I) = \frac{(-12\%)\cdot(-21\%) + (+6\%)\cdot(+9\%) + (-6\%)\cdot(+15\%) + (+12\%)\cdot(-3\%)}{4} = +45\%\%$$

$$\mathrm{Cov}(r_H, r_I) = \frac{\text{Sum over all scenarios (or observations) } S\text{: } \{[r_{H,S} - \mathrm{E}(r_H)]\cdot[r_{I,S} - \mathrm{E}(r_I)]\}}{N} \tag{8.2}$$

H and I are positively correlated—these investments tend to move together. Intuitively, this means, for example, that if the rate of return on portfolio H exceeds its 6% mean, portfolio I will also tend to exceed its own 9% mean.

Without further ado, here is the shortcut formula for two assets:

important

The variance of a portfolio P that consists only of A and B, that is, with returns of $r_P = w_A \cdot r_A + w_B \cdot r_B$, where w_A is the portfolio weight in component A, and w_B is the portfolio weight in component B, is

$$\mathrm{Var}\left(r_P\right) = w_A^2 \cdot \mathrm{Var}\left(r_A\right) + w_B^2 \cdot \mathrm{Var}\left(r_B\right) + 2 \cdot w_A \cdot w_B \cdot \mathrm{Cov}\left(r_A, r_B\right) \quad (8.3)$$

Let's check that this formula is correct. Try it out on portfolio K, which invests 1/3 in H and 2/3 in I:

$$\begin{aligned}\mathrm{Var}\left(r_K\right) &= (1/3)^2 \cdot \mathrm{Var}\left(r_H\right) + (2/3)^2 \cdot \mathrm{Var}\left(r_I\right) + 2 \cdot (1/3) \cdot (2/3) \cdot \mathrm{Cov}\left(r_H, r_I\right) \\ &= (1/3)^2 \cdot 90\%\% + (2/3)^2 \cdot 189\%\% + 2 \cdot (1/3) \cdot (2/3) \cdot (+45\%\%) \\ &= 114\%\%\end{aligned}$$

This is the same result as we computed in Formula 8.1, so the shortcut indeed gives the correct answer. x

One way to remember this formula—and the more general version with more than two securities—is to create a matrix of all your assets. It's simple. Write all your assets' names on both edges, their weights next to them, and write into each cell what is on the edges as well as a covariance between what's on the edges:

		A	**B**	**C**	⋯
		w_A	w_B	w_C	
A	w_A	$w_A \cdot w_A \cdot \mathrm{Cov}\left(r_A, r_A\right)$	$w_A \cdot w_B \cdot \mathrm{Cov}\left(r_A, r_B\right)$	$w_A \cdot w_C \cdot \mathrm{Cov}\left(r_A, r_C\right)$	
B	w_B	$w_B \cdot w_A \cdot \mathrm{Cov}\left(r_B, r_A\right)$	$w_B \cdot w_B \cdot \mathrm{Cov}\left(r_B, r_B\right)$	$w_B \cdot w_C \cdot \mathrm{Cov}\left(r_B, r_C\right)$	
C	w_C	$w_C \cdot w_A \cdot \mathrm{Cov}\left(r_C, r_A\right)$	$w_C \cdot w_B \cdot \mathrm{Cov}\left(r_C, r_B\right)$	$w_C \cdot w_C \cdot \mathrm{Cov}\left(r_C, r_C\right)$	
⋮					⋱

That's it. By the way, did you notice that if you have m securities, there are only m variance terms in this matrix (on the diagonal), but $m^2 - m$ covariance terms? For 500 assets, you have 500 variance cells and 249,500 covariance cells. Adding the next security to the portfolio would add 1 variance term and 500 covariance terms. It should suggest to you that it need not be far-fetched to believe that the covariances of assets—how they fit together—can be more important than their own variances. x

Now substitute our specific investment weights for portfolio K, which are $w_H = 1/3$, $w_I = 2/3$. Let me also show you that investments that you do not own (call a sample one J) just drop out of the formula:

		H	**I**	**J**	⋯
		1/3	**2/3**	**0**	
H	1/3	$1/3 \cdot 1/3 \cdot \mathrm{Cov}\left(r_H, r_H\right)$	$1/3 \cdot 2/3 \cdot \mathrm{Cov}\left(r_H, r_I\right)$	$1/3 \cdot 0 \cdot \mathrm{Cov}\left(r_H, r_J\right)$	
I	2/3	$2/3 \cdot 1/3 \cdot \mathrm{Cov}\left(r_I, r_H\right)$	$2/3 \cdot 2/3 \cdot \mathrm{Cov}\left(r_I, r_I\right)$	$2/3 \cdot 0 \cdot \mathrm{Cov}\left(r_I, r_J\right)$	
J	0	$0 \cdot 1/3 \cdot \mathrm{Cov}\left(r_J, r_H\right)$	$0 \cdot 2/3 \cdot \mathrm{Cov}\left(r_J, r_I\right)$	$2/3 \cdot 0 \cdot \mathrm{Cov}\left(r_J, r_J\right)$	
⋮					⋱

All cells with J just multiply everything with a zero, so they can be omitted. Next, use the fact that, by definition, the covariance of something with itself is its variance. So, the matrix is

		H	**I**
		1/3	**2/3**
H	1/3	$1/3 \cdot 1/3 \cdot 90\%\%$	$1/3 \cdot 2/3 \cdot 45\%\%$
I	2/3	$2/3 \cdot 1/3 \cdot 45\%\%$	$2/3 \cdot 2/3 \cdot 189\%\%$

Add up all the cells, and you have the variance of portfolio K.

$$\begin{aligned}\mathrm{Var}\left(r_K\right) &= 1/3 \cdot 1/3 \cdot 90\%\% + 1/3 \cdot 2/3 \cdot 45\%\% \\ &\quad 2/3 \cdot 1/3 \cdot 45\%\% + 2/3 \cdot 2/3 \cdot 189\%\% = 114\%\%\end{aligned}$$

Again, this is the correct answer that you already knew.

x

For H and I, this formula is not any more convenient than computing the scenario or historical time series of portfolio returns first and then computing the variance of this one series. However, the formula is a lot more convenient if you have to compute the portfolio variance of thousands of combinations of H and I and there are hundreds of scenarios. And it is precisely this process—recomputing the overall portfolio variance many times—that is at the heart of determining the best portfolio: You want to know how different portfolio weights change your portfolio risk. Your alternative to the shortcut would be to recompute the returns for each of the hundreds of possible portfolio weight combinations—which would quickly become very painful.

---

question

Show that the shortcut Formula 8.3 works for portfolio M, in which H is 2/3. That is, does it give the same 81.0%% noted in Table 8.1 on page 38?

answer

For M, the covariance between H and I was computed as 45%% in

Formula 8.2. The variance of H is 90%% (from Table 8.1 on page 38), the variance of I is 189%% (from the same figure). Therefore, using the shortcut Formula 8.3, $\mathrm{Var}\left(r_M\right) = (2/3)^2 \cdot 90\%\% + (1/3)^2 \cdot 189\%\% + 2 \cdot (2/3) \cdot (1/3) \cdot 45\%\% = 81\%\%$.

question

Show that the shortcut Formula 8.3 works for portfolio N, in which H is 3/4. That is, does it give the same 79.3%% noted in Table 8.1?

answer

The covariance between H and I is 45%% (Formula 8.2). The variance of H is 90%%, the variance of I is 189%% (Table 8.1). Therefore, the shortcut Formula 8.3 gives

$$\begin{aligned}\mathrm{Var}\left(r_M\right) = \quad & (3/4)^2 \cdot 90\%\% + (1/4)^2 \cdot 189\%\% \\ + \; & 2 \cdot (3/4) \cdot (1/4) \cdot 45\%\% = 79.3125\%\%\end{aligned}$$

question

In Section **??**, you learned how risk grows with time—roughly with the square-root of the number of time periods. Armed with the covariance formula, you can actually work this out for yourself. Let's consider a stock market index, such as the S&P 500. It had a historical average rate of return of about 12% per annum, and a historical standard deviation of about 20% per annum. Assume for the moment: X

1. **Known statistical distributions:** You know the expected reward and risk. In our example, we assume that they are the historical averages and risks. This is convenient.
2. **Independent stock returns:** Stock returns are (mostly) uncorrelated over time periods. This is reasonable because if this were not so, you could earn money purchasing stocks based on their prior performance in a perfect market. (This will be the subject of Chapter **??**.)
3. **No compounding:** The rate of return over X years is the simple sum of X annual rates of return. (That is, we ignore the cross-product terms that are rates of return on rates of return.) This is problematic over decades, but not over just a few months or even years.

Our goal is to work out how asset risk grows with time under these assumptions.

1. Write down the formula for the total rate of return over 2 years.
2. What is the expected total rate of return over 2 years?
3. Write down the formula for the variance over 2 years.
4. What is the specific risk here (variance and standard deviation) over 2 years?

5. The **Sharpe ratio** is a common (though flawed) measure of portfolio performance. It is usually computed as the expected rate of return above the risk-free rate, then divided by the standard deviation. Assume that the risk-free rate is 6%. Thus, the 1-year Sharpe ratio is $(12\%-6\%)/20\% \approx 0.3$. What is the 2-year Sharpe ratio?
6. What are the expected rate of return and risk (variance and standard deviation) over 4 years? What is the 4-year Sharpe ratio?
7. What are the expected rate of return and risk (variance and standard deviation) over 16 years? What is the 16-year Sharpe ratio?
8. What are the expected rate of return and risk (variance and standard deviation) over T years? What is the T-year Sharpe ratio?
9. What are the expected rate of return and risk (variance and standard deviation) over 1 month? What is the 1-month Sharpe ratio?
10. What are the expected rate of return and risk (variance and standard deviation) over 1 trading day? What is the 1-day Sharpe ratio? Assume 250 trading days per year.

answer

This is an important question. In fact, you may even want remember Formula 8.4 that states that risk grows over time with the square-root. The assumption that there is no compounding (that you can ignore the cross-product) and that risk is roughly constant per period is reasonable over periods that are not more than a few years long.

1. If we can ignore the cross-products, then we are using a simple weighted-average formula with weights of 1 on each term: $r_{0,2} \approx 1 \cdot r_{0,1} + 1 \cdot r_{1,2}$. (The exact formula would have been $r_{0,2} = r_{0,1} + r_{1,2} + r_{0,1} \cdot r_{1,2}$.)
2. The expected rate of return over 2 years is $\mathrm{E}\left(r_{0,2}\right) \approx \mathrm{E}\left(r_{0,1}\right) + \mathrm{E}\left(r_{1,2}\right) = 12\% + 12\% = 24\%$.
3. The variance of the rate of return over 2 years is $\mathrm{Var}\left(r_{0,2}\right) \approx 1 \cdot \mathrm{Var}\left(r_{0,1}\right) + 1 \cdot \mathrm{Var}\left(r_{1,2}\right) + 2 \cdot 1 \cdot 1 \cdot \mathrm{Cov}\left(r_{0,1}, r_{0,2}\right)$. In a perfect market, the last term should be approximately zero.
4. The variance over 2 years for our specific example is

$$\begin{aligned} \mathrm{Var}\left(r_{0,2}\right) &\approx 1 \cdot \mathrm{Var}\left(r_{0,1}\right) + 1 \cdot \mathrm{Var}\left(r_{1,2}\right) + 0 \\ &= (20\%)^2 + (20\%)^2 = 2 \cdot (20\%)^2 \\ &= 800\%\% \end{aligned}$$

   Therefore, the standard deviation is $\sqrt{2} \cdot 20\% \approx 28\%$.
5. The Sharpe ratio is $2 \cdot (12\%-6\%)/28\% \approx 0.43$.
6. The variance is $4 \cdot (20\%)^2 = 1600\%\%$. The standard deviation is $20\% \cdot \sqrt{4} = 40\%$. The Sharpe ratio is $(6\% \cdot 4)/(20\% \cdot \sqrt{4}) = 0.3 \cdot \sqrt{4} = 0.6$.

Figure 8.1: The Risk-Reward Trade-Off between H and I: More Portfolios

—These are the portfolios from Table 8.1, and then some more in gray that I computed—a hobby.
Figure frontier-theory-c1 with width 0.75*fullwidth

7. The variance is $16 \cdot (20\%)^2 = 6400\%$. The standard deviation is $20\% \cdot \sqrt{16} = 80\%$. The Sharpe ratio is $0.3 \cdot \sqrt{16} \approx 1.2$.
8. The variance is $T \cdot (20\%)^2$. The standard deviation is $20\% \cdot \sqrt{T}$. In other words, the standard deviation grows with the square root of the number of time periods:

$$\mathrm{Sdv}\left(r_{0,T}\right) \approx \sqrt{T} \cdot \mathrm{Sdv}\left(r_{0,1}\right) \tag{8.4}$$

   If the rates of return on an asset are approximately uncorrelated over time (a perfect market consequence), if the risk in different time periods remains constant, and ignoring all cross-product terms. The Sharpe ratio is $0.3 \cdot \sqrt{T}$.
9. The formulas also work with fractions. The variance is therefore $1/12 \cdot (20\%)^2 \approx 33.3\%\%$. The standard deviation is therefore $\sqrt{1/12} \cdot 20\% \approx 5.8\%$. The monthly Sharpe ratio is $\sqrt{1/12} \cdot 30\% \approx 0.09$.
10. The variance is $1/250 \cdot (20\%)^2 = 1.6\%\%$. The standard deviation is $\sqrt{1/250} \cdot 20\% \approx 1.3\%$. The daily Sharpe ratio is about 0.019.

A.8.C Graphing the Mean-Variance Efficient Frontier

x

Let's now graph the portfolio risk on the x-axis and the portfolio reward on the y-axis for each portfolio from Table 8.1 on page 38. Figure 8.1 does it for you. Can you see a pattern? To make it easier, I have taken the liberty of adding a few more portfolios. (You can confirm that I have computed the risk and reward of one of these portfolios in Q A.8.C.)

x

If you picked many more portfolios with portfolio weights on H between 0 and 100%, you would eventually end up with Figure 8.2. The curve is called the **mean-variance efficient frontier** (**MVE frontier**), and it is the region where the best risk-reward portfolios lie. There must not be any portfolios to the northwest of this frontier—they would have a higher expected rate of return for a given risk, or lower risk for a given expected rate of return. If these existed, they would themselves be the MVE frontier. (The shape of the mean-variance efficient frontier is a so-called hyperbola when the x-axis is the standard deviation.)

x

Figure 8.2: The Risk-Reward Trade-Off between H and I: Sets

—This connects the points on the efficient frontier to Figure 8.1. Additionally, it completes the efficient frontier beyond interior portfolios, that is, allowing for portfolios that short one or the other portfolio.
Figure frontier-theory-c3 with width 0.75*fullwidth

The west-most portfolio on the efficient frontier is called the **minimum-variance portfolio** because you cannot create a portfolio with lower risk. You need a lot of algebra to find it, so I have worked this out for you. In our example, the minimum-variance portfolio has a weight of 76.191% on H and 23.809% on I, and it achieves as low a risk as 8.9%. Although the graph's scale is too small for you to check this graphically, you can compute the risk of this minimum-variance portfolio that I gave you and compare it to the risk of two portfolios that invest either a little more or a little less into H.

$$\begin{aligned} w_H = 76.0\% \;:\; \mathrm{Sdv}(r_P) &\approx 8.9042911\% \\ w_H = 76.2\% \;:\; \mathrm{Sdv}(r_P) &\approx 8.9042526\% \quad \longleftarrow \text{ I claimed lowest risk} \\ w_H = 76.4\% \;:\; \mathrm{Sdv}(r_P) &\approx 8.9042992\% \end{aligned} \tag{8.5}$$

$$\mathrm{Sdv}(r_P) = \sqrt{\mathrm{Var}(r_P)} = \mathrm{Var}(w_H \cdot r_H + (1 - w_H) \cdot r_I) \tag{8.5}$$

If there are assets that can be combined to construct a risk-free asset, then the minimum-variance portfolio will touch the y-axis at 0. If there are only two assets, this means their correlation would have to be -1. More commonly, the
x minimum-variance portfolio does not touch the y-axis and still has positive risk.

There is one feature of a more general mean-variance graph that this particular graph cannot illustrate. If you had started with more than two base portfolios H and I, you could have found many combination portfolios that would have been outright inferior. They would have been a cloud of points inside and southeast of the efficient frontier. However, the efficient frontier itself would still look very similar to what is in Figure 8.2—a hyperbola on the upper northwest frontier.

Allowing Shorted Positions

x

Each point on the mean-variance frontier represents one set of investment weights. Interestingly, the relevant formulas work just as well with negative weights as they do with positive weights. For example, if $w_H = (-0.1)$ and $w_I = 1.1$, then the sum of your individual investments is still 100%, and

$$\mathrm{E}(r_P) = (-0.1)\cdot 6\% + (1.1)\cdot 9\% = 9.3\%$$
$$\mathrm{E}(r_P) = w_H \cdot \mathrm{E}(r_H) + w_I \cdot \mathrm{E}(r_I)$$

and

$$\mathrm{Sdv}(r_P) = \sqrt{(-0.1)^2\cdot 90\%\% + (1.1)^2\cdot 189\%\% + 2\cdot(-0.1)\cdot(1.1)\cdot 45\%\%} \approx 14.82\%$$
$$\mathrm{Sdv}(r_P) = \sqrt{w_H^2\cdot \mathrm{Var}(r_H) + w_I^2\cdot \mathrm{Var}(r_I) + 2\cdot w_H\cdot w_I\cdot \mathrm{Cov}(r_I,r_H)}$$

(If you wish, you can first confirm this: This portfolio would return –12.6% ([club]), 18.6% ([diamond]), 26.4% ([heart]), or 4.8% ([spade]). Therefore, the expected rate of return is 9.3%, and the standard deviation is 14.82%.) This portfolio is marked at the top in Figure 8.2. It is on the continuation of the hyperbola. Actually, I have done more, drawing the rest of the hyperbola in magenta. These are portfolios that contain shorted assets. x

But what is the meaning of an investment with negative weight? It was explained in Section **??**: It is shorting a stock. In brief, perfect shorting works as X follows: If you short a security, you promise to provide the appropriate returns, rather than earn them. For example, say you want to go short $200 in H and I want to go long $200 in H. I would purchase H from you. This would work as follows:

- I must give you $200 today. (If you want, you can invest this to earn interest.)
- Next year, you must give me exactly what I would get if I had purchased H, not from you, but from someone else who really would have given me the security. That is, if [club]comes about, you must pay me $188; if [diamond]comes about, you must pay me $224; if [heart]comes about, you must pay me $200; and if [spade]comes about, you must pay me $236.

In other words, I won't notice whether you sold me the security or someone else (who had it) sold me the security. This is simple ownership—a 100% investment ownership. Your own rate of return is the exact opposite of my return. For example, if I earn –6%, you would gain +6%. After all, you received $200 from me (at time 0) and are only returning $188 to me (at time 1). What would your return be if you sold $200 of H to me, thereby going short, and then used the $200 to purchase H from someone else in the market? It would always be zero—going long and short by the same amount cancels out perfectly. In a perfect market, you would not earn any money or lose any money.

question

Compute the risk and reward of the portfolio $w_H = 0.1, w_I = 0.9$, as in Table 8.1 on Page 38. Confirm that this portfolio is drawn correctly in Figure 8.1.

answer

The mean rate of return for portfolio ($w_H = 0.1, w_I = 0.9$) is $0.1 \cdot 6\% + 0.9 \cdot 9\% = 8.7\%$. You can also compute this from the rates of return in the 4 states –11.4%, 17.4%, 21.6%, and 7.2%. Demeaned, these returns are –20.1%, 8.7%, 12.9%, and –1.5%. The variance is therefore $(404.01\%\% + 75.69\%\% + 166.41\%\% + 2.25\%\%)/4 = 162.09\%\% = 0.016209$. Therefore, the standard deviation (risk) is $\sqrt{162.09\%\%} \approx 12.7\%$.

question

If there are two risky portfolios that have a correlation of –1 with positive investment weights, what would the expected rate of return on this portfolio be?

answer

Two risky portfolios with a correlation of –1 can be combined into an asset that has no risk. Thus, its expected rate of return has to be the same as that on the risk-free asset—or you could get rich in a perfect market.

question

If H and I were more correlated, what would the efficient frontier between them look like? If H and I were less (or more negatively) correlated, what would the efficient frontier between them look like? (Hint: Think about the variance of the combination portfolio that invests half in each.)

answer

If the correlation was higher, diversification would help less, so the risk would be higher. Therefore, the efficient frontier would not bend as far toward the west (a risk of 0). An easy way to check this is to rearrange the returns so that they correlate more positively, as you will do in the next question. If the correlation was lower, diversification would help more, so the risk would be lower. Therefore, the efficient frontier would bend closer toward the west (a risk of 0).

question

Draw the efficient frontier for the following two base assets, H and Z:

	In Scenario			
Base	**S1 [club]**	**S2 [diamond]**	**S3 [heart]**	**S4 [spade]**
H	–6%	+12%	0%	+18%
Z	–12%	+18%	+15%	+15%

Also, compute the covariance between H and Z. Is it higher or lower than what you computed in the text for H and I? How does the efficient frontier compare to what you have drawn in this chapter?

answer
The covariance between H and Z is 85.5%%, which is much higher than the 45%% covariance between H and I from Formula 8.2 on Page 40. This means that the correlation between H and Z shoots up to 74% (from 35% for the correlation between H and I). This means that the efficient frontier is less dented toward the west. Put differently, the minimum-variance portfolio moves toward the east.

A.8.D Adding a Risk-Free Asset

x

In the real world, you usually have access to a risk-free Treasury. It turns out that the presence of a risk-free asset plays an important role, not only in the model of the next chapter (the CAPM), but also in these mean-variance graphs. So let us now add a risk-free rate ("F") of 4%. Start with the following three basis portfolios:

Future	**H**	**I**	**F**
In Scenario S1 [club]	–6.0%	–12.0%	4.00%
In Scenario S2 [diamond]	+12.0%	+18.0%	4.00%
In Scenario S3 [heart]	0.0%	+24.0%	4.00%
In Scenario S4 [spade]	+18.0%	+6.0%	4.00%
"Reward" $(\mathrm{E}(r))$	6.00%	9.00%	4.00%
"Variance" $(\mathrm{Var}(r))$	90.0%%	189.0%%	0.0%%
"Risk" $(\mathrm{Sdv}(r))$	9.49%	13.75%	0.00%

Begin by determining the risk and reward of a portfolio S that invests $1/2$ in H and $1/2$ in F: Its rate of return is defined as $r_S = w_H \cdot r_H + w_F \cdot r_F = 1/2 \cdot r_H + 1/2 \cdot 4\%$. The expected reward of this portfolio is

$$\begin{aligned} \mathrm{E}(r_S) &= 1/2 \cdot 6\% + (1 - 1/2) \cdot 4\% = 5\% \\ \mathrm{E}(r_S) &= w_H \cdot \mathrm{E}(r_H) + (1 - w_H) \cdot r_F \end{aligned} \tag{8.6}$$

For the risk component, use Formula 8.3. A risk-free rate, such as the 4% Treasury rate, has neither a variance nor a covariance with anything else. (Makes sense that a fixed constant number that is always the same has no variance, doesn't it?) For portfolio S, use $(1 - w_H) = w_F$ and you get

X

$$\mathrm{Var}(r_S) = (1/2)^2 \cdot 90\%\% + (1-1/2)^2 \cdot 0\% + 2 \cdot 1/2 \cdot (1-1/2) \cdot 0\% = 1/4 \cdot 90\%\%$$

$$\mathrm{Var}(r_S) = w_H^2 \cdot \mathrm{Var}(r_H) + w_F^2 \cdot \mathrm{Var}(r_F) + 2 \cdot w_H \cdot w_F \cdot \mathrm{Cov}(r_H, r_F) = (w_H)^2 \cdot \mathrm{Var}(r_H)$$

This formula is a lot simpler than the typical variance formula, with its second variance term and its covariance term. It also means that we can compute the standard deviation more easily:

$$\mathrm{Sdv}(r_S) = \sqrt{(1/2)^2 \cdot 90\%\%} = 1/2 \cdot \sqrt{90\%\%} \approx 1/2 \cdot 9.49\% \approx 4.74\%$$

$$\mathrm{Sdv}(r_S) = \sqrt{(w_H)^2 \cdot \mathrm{Var}(r_H)} = w_H \cdot \sqrt{\mathrm{Var}(r_H)} = w_H \cdot \mathrm{Sdv}(r_H) \quad (8.7)$$

This states that the risk of your overall portfolio is proportional to the risk of your investment in asset H, with your investment weight being the proportionality factor.

x

You can repeat this for many different portfolio weights:

Weight w_H	**0.0**	**0.2**	**0.4**	**0.6**	**0.8**	**1.0**
Expected Return	4.0%	4.4%	4.8%	5.2%	5.6%	6.0%
Standard Deviation	0.000%	1.898%	3.796%	5.694%	7.592%	9.490%

If you plot these points into the figure, you will immediately notice that the relationship between risk and reward is now a line. Figure 8.3 does it for you.

x

To see this algebraically, rearrange Formula 8.7 into $w_H = \mathrm{Sdv}(r_S)/\mathrm{Sdv}(r_H) = \mathrm{Sdv}(r_S)/9.49\%$. Then use this to substitute out w_H in Formula 8.6:

$$\begin{aligned}
\mathrm{E}(r_S) &= w_H \cdot 6\% + (1-w_H) \cdot 4\% = w_H \cdot (6\% - 4\%) + 4\% \\
&= \left[\frac{\mathrm{Sdv}(r_S)}{9.49\%}\right] \cdot (6\% - 4\%) + 4\% = 4\% + 0.21 \cdot \mathrm{Sdv}(r_S) \\
\mathrm{E}(r_S) &= w_H \cdot \mathrm{E}(r_H) + (1-w_H) \cdot r_F = w_H \cdot (\mathrm{E}(r_H) - r_F) + r_F \\
&= \left[\frac{\mathrm{Sdv}(r_S)}{\mathrm{Sdv}(r_H)}\right] \cdot [\mathrm{E}(r_H) - r_F] + r_F = r_F + \left[\frac{\mathrm{E}(r_H) - r_F}{\mathrm{Sdv}(r_H)}\right] \cdot \mathrm{Sdv}(r_S)
\end{aligned}$$

This is the formula for a line relating the risk and reward of portfolio S: r_F is the intercept and $\left[(\mathrm{E}(r_H) - r_F)/(\mathrm{Sdv}(r_H))\right]$ is the slope.

important

When you plot the portfolio mean versus the portfolio standard deviation for combination portfolios of a risk-free asset F with any risky portfolio P, they lie on the straight line between F and P.

Figure 8.3: The Risk-Reward Trade-Off between H and F

—This adds a risk-free rate of 4% to Figure 8.1. The line represents risks and rewards for portfolios that combine portfolio H and the risk-free rate F. Please note that this line is not the security markets line (the CAPM). Here, the x-axis is the standard deviation (of the overall portfolio rate of return). In the security market line (SML) explained in chapter **??**, the x-axis is the market beta (of individual assets).
Figure frontier-theory-c-1 with width 0.75*fullwidth

Figure 8.4: The Risk-Reward Trade-Off between L and F

—Adding to Figure 8.3, the new line represents risks and rewards for portfolios that combine portfolio L and the risk-free asset F.
Figure frontier-theory-c-2 with width 0.75*fullwidth

Figure 8.5: The Risk-Reward Trade-Off between T and F

— The capital market line represents risks and rewards for portfolios that combine the tangency portfolio T and the risk-free rate F. It represents the best opportunities available.
Figure frontier-theory-c-3 with width 0.75*fullwidth

But would you really want to purchase such a combination of H and F? Could you purchase a different portfolio in combination with F that would do better? Would the combination of L and F not perform better?

Figure 8.4 draws combinations of the risk-free asset and portfolio L. This combination of F and L indeed does a lot better—but you can do even better yet. Can you guess what portfolio you would purchase? x

The answer is drawn in Figure 8.5—you would purchase a combination portfolio of the risk-free asset and whatever portfolio on the previous efficient frontier would be tangent—you tilt the line up until it just touches the mean-variance frontier among the risky assets. This line is called the **capital market line**. Here, the exact investment proportions in the risky assets are difficult to see, but if you could blow up the figure, you would see that this is the portfolio that invests about 30% in H and 70% in I. Let's call it T, for tangency portfolio. x

Who would want to purchase a portfolio combination that invests more or less than 30% in H and 70% in I? Nobody! Each and every smart investor would purchase only a combination of F and T, regardless of risk aversion. (This is called the **two-fund separation theorem**.) Different risk tolerances would lead them to allocate different sums to the tangency portfolio and the risk-free asset, but no

investor would purchase a risky portfolio with investment weights different from those in the tangency portfolio T.

important
In the presence of a risk-free asset, all smart investors purchase combinations of the tangency portfolio and the risk-free asset.

CAPM Preview

x

Chapter **??** explains the most common model of security pricing, the CAPM. In brief, it states that the market portfolio is mean-variance efficient—and nothing else. How can this happen? Well, if every investor is smart and all the various CAPM assumptions and conditions are satisfied (explained soon), then each investor holds only a combination of T and the risk-free asset. Math dictates that this means that the value-weighted market portfolio of all investors' holdings is therefore also a combination of T and the risk-free asset. Therefore, it is also mean-variance efficient.

important
In the CAPM, the market portfolio of risky claims is the tangency portfolio.

(Of course, conversely, if some investors do not hold the market tangency portfolio,
x then the overall market portfolio [could but] need not be the tangency portfolio.)

If the CAPM holds, that is, if T is the market portfolio, then portfolio optimization is beautifully easy for any investor—just purchase a combination of the market portfolio and the risk-free asset. You never even need to compute an efficient frontier. Of course, in the real world, the market portfolio may not be the tangency portfolio—but then, this is the same as stating that the CAPM does not hold. In fact, the CAPM is nothing more and nothing less than the statement that the market portfolio is the tangency portfolio.

---

question
What kind of portfolios are the points to the right of H on the line itself in Figure 8.3?

answer
Portfolios to the right of H on the line have a negative weight in F and a weight above 1 in H. (The portfolio weights must add to 100%!) This means that they would borrow money at a 4% annual interest rate to purchase more of portfolio H. (Purchasing stocks with money borrowed at an interest rate is called on margin.)

question
Compute the covariance of H and F.

answer

Because the net-of-mean F is always 0, so is its coproduct with anything else. This means that the covariance of the risk-free asset with any risky asset is zero, too.

question

Formula 8.5 noted that the minimum-variance portfolio without a risk-free asset invests about 76.2% in H and about 24.8% in I. (Work with the rounded numbers to make your life easier.) With the risk-free asset offering 4%, what portfolio would you purchase that has the same risk, and what would its improvement in reward be? First think about how to solve this. However, this is a difficult question, so we will go through it step by step.

1. Copy down the risk of this minimum-variance portfolio when there is no risk-free asset.
2. What is the reward of this minimum-variance portfolio?
3. With a risk-free rate of 4%, it turns out that the tangency portfolio invests 30% in H and 70% in I. What are its returns in each of the four scenarios?
4. What is its reward? (Check this visually in the graph!)
5. What is its risk? (Check this visually in the graph!)
6. Using the analog of Formula 8.7, what investment weight w_T in T would give you the same risk as the minimum-variance portfolio? (If you had \$100, how much would you put into T, and how much would you put into a risk-free savings account?)
7. Given this weight w_T, what is the reward of this combination portfolio? How much better is this than the situation where no risk-free asset was available?

answer

This question asks you to show how much better off you are with this particular risk-free asset for a particular risk choice.

1. In Formula 8.5 on Page 46, we showed that this no-risk-free minimum-variance portfolio with an investment weight of 76.2% in H and 24.8% in I has a risk of about 8.90%.
2. The reward of this no-risk-free-asset-available, minimum-variance portfolio is $\mathrm{E}\left(r\right) = 76.2\% \cdot 6\% + 24.8\% \cdot 9\% \approx 6.8\%$.
3. With a weight of 30% in H and 70% in I, the rates of return in the four scenarios for the tangency portfolio T are as follows:

$$\begin{aligned}
\text{In Scenario [club]:} \quad & 0.3 \cdot (-6\%) + 0.7 \cdot (-12\%) = -10.2\% \\
\text{In Scenario [diamond]:} \quad & 0.3 \cdot (12\%) + 0.7 \cdot (18\%) = +16.2\% \\
\text{In Scenario [heart]:} \quad & 0.3 \cdot (0\%) + 0.7 \cdot (24\%) = +16.8\% \\
\text{In Scenario [spade]:} \quad & 0.3 \cdot (18\%) + 0.7 \cdot (6\%) = +9.6\%
\end{aligned}$$

(These calculations will reappear later in Table 9.1 on page 73.)

4. The reward of the tangency portfolio is $\mathrm{E}(r_T) = (-10.2\% + 16.2\% + 16.8\% + 9.6\%)/4 = 8.1\%$.
5. Its variance is $[(-18.3\%)^2 + (8.1\%)^2 + (8.7\%)^2 + (1.5\%)^2]/4 \approx 119.6$. Thus, the risk is $\mathrm{Sdv}(r_T) = \sqrt{119.6} \approx 10.94\%$.
6. You want the expected rate of return of a portfolio that uses the risk-free asset and that has a risk of 10.94% (i.e., the same that the no-risk minimum-variance portfolio had). Solve

$$\begin{aligned} 8.9\% &= w_T \cdot 10.94\% \\ \mathrm{Sdv}(r) &= w_T \cdot \mathrm{Sdv}(r_T) \end{aligned}$$

   Therefore, $w_T \approx 81.35\%$. In words, a portfolio of 81.35% in the tangency portfolio T and 18.65% in the risk-free asset F has the same risk of 10.94%.
7. You now want to know the expected rate of return on the portfolio $(w_T, w_F) = (81.35\%, 18.65\%)$:

$$\begin{aligned} \mathrm{E}(r) &\approx 81.35\% \cdot 8.1\% + 18.65\% \cdot 4\% \approx 7.33\% \\ \mathrm{E}(r) &= w_T \cdot \mathrm{E}(r_T) + w_F \cdot r_F \end{aligned}$$

   You therefore would expect to receive a $7.33\% - 6.71\% \approx 62$ basis points higher expected rate of return if you have access to this risk-free rate.

question

Would the tangency portfolio invest in more or less H if the risk-free rate were 3% instead of 4%? (Hint: Think visually.)

answer

If the risk-free rate were lower, then the tangency line would become steeper. The tangency portfolio would shift from around K to around L. Therefore, it would involve more H.

A.8.E Some Other Implications of Beta

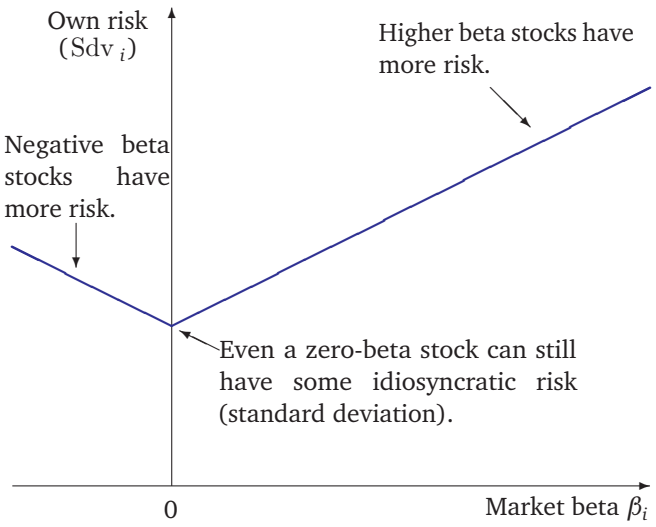
Sometimes you can gain some additional intuition about a project beta by thinking about how beta affects your idiosyncratic risk, and how beta affects your conditional rates of return.

x

Figure **??** shows that, everything else equal, assets that have betas close to 0 tend to have less risk than other assets. Assets that have either very high or very negative market betas are more subject to the ups and downs of the stock market

Figure 8.6: Beta and Firm Risk

—Everything else equal, a stock with a zero market-beta has the lowest standard deviation. This is because market volatility would not transmit into such assets' own rates of return (through their market betas).

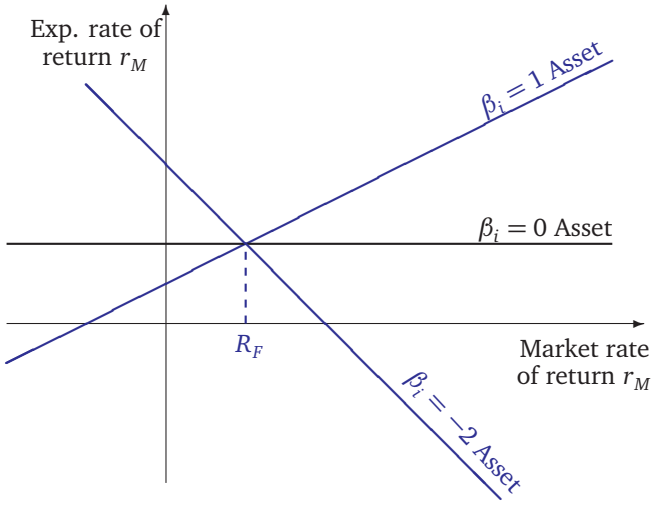


overall. For example, in a CAPM world with a risk-free rate of 3% and an equity premium of 5%, a stock with a market beta of zero would be expected to earn about 3% on average, regardless whether the stock market went up or down by 20% this month. In contrast, a stock with a market beta of –3 would be expected to earn $3\% + (20\% - 3\%) \cdot (-3) = -48\%$ if the stock market went up by 20%, and $3\% + (-20\% - 3\%) \cdot (-3) = 72\%$ if the stock market went down by 20%. This cofluctuation induces extra standard deviation in addition to whatever the firm's own risk may have been. x

Figure 8.7 shows conditional rates of return. It changes the x-axis to the actually experienced future rate of return on the stock market. Note that the y-axis is not the actual rate of return on a stock, but still just its expected rate of return. (The actual rate of return will be some number centered around the graphed expected rate of return.) Assets with positive betas have higher expected rates of return when the market does better. Assets with negative betas have higher expected rates of return when the market does worse. If the stock market turns in the same rate of return as the risk-free asset, beta does not matter. The graph also shows that stocks with negative betas tend to offer lower expected rates of return than stocks with positive betas. After all, low-beta stocks effectively serve

Figure 8.7: Assets with a positive market beta do better when the market rate of return is high, while assets with a negative market beta do better when the market rate of return is low. If the market performs as well as the risk-free rate, all assets should do about the same in a CAPM world. (On average, positive beta stocks need to offer higher expected rates of return because outcomes to the right of the risk-free rate are more likely than outcomes to the left of the risk-free rate.)

—



as insurance against overall market movements. (A lower expected rate of return is also synonymous with a higher price today.)

EOC MATTER

eocproblems

question

Recompute the portfolio variance if you invest in a portfolio O with $w_H = 90\%$ and $w_I = 10\%$ in Table 8.1.

1. Compute the rates of return on the portfolio in each scenario, and then treat the resulting portfolio as one asset. What is portfolio O's risk and reward?
2. Compute the same variance with the shortcut Formula 8.3 on Page 41.

answer

1. Net-of-mean: –12.9%, 6.3%, –3.9% and 10.5%. Squared: 166.41%%, 39.69%%, 15.21%%, 110.25%%. The mean of these is the variance, which comes to 82.89%%. The standard deviation is 9.104%.
2. The covariance between H and I is 45%%. The variance of H is 90%%, the variance of I is 189%%. $\mathrm{Var}\left(r_M\right) = (0.9)^2 \cdot 90\%\% + (.1)^2 \cdot 189\%\% + 2 \cdot (.9) \cdot (.1) \cdot 45\%\% \approx 82.89\%\%$. The covariance is computed as in Formula 8.2.

question

An asset has an annual mean of 12% and standard deviation of 30% per year. What would you expect its monthly mean and standard deviation to be?

answer

The asset's monthly mean would be $12\%/12 = 1\%$. Its standard deviation would be $30\%/\sqrt{12} \approx 8.7\%$.

question

Mathematically and based on Figure 8.2 on Page 46, compute the risk and reward of the portfolio $w_H = -0.2$, $w_I = 1.2$.

answer

The mean is 9.6%. The standard deviation (risk) is 15.94%.

question

In the absence of a risk-free asset, would anyone buy the portfolio $w_H = 110\%, w_I = -10\%$?

answer

No. Although the portfolio $w_H = 110\%, w_I = -10\%$ is on the hyperbola, only its upper part counts.

question

The Vanguard European stock fund, Pacific stock fund, and Exxon Mobil reported the following historical dividend-adjusted prices:

Year	1991	1992	1993	1994	1995	1996
VEURX	6.53	7.15	6.91	9.34	9.03	11.17
VPACX	7.18	7.41	6.30	9.52	9.08	9.97
XOM	9.57	10.07	10.88	10.97	15.29	19.18

Year	1997	1998	1999	2000	2001
VEURX	13.50	17.45	21.42	23.38	23.13
VPACX	8.39	7.17	7.01	10.41	8.10
XOM	24.63	30.14	33.94	37.42	34.57

Year	2002	2003	2004	2005	2006
VEURX	17.50	14.42	21.22	24.87	29.53
VPACX	5.64	5.42	7.94	9.08	11.93
XOM	31.50	38.01	48.67	54.41	75.67

1. Compute the year-to-year rates of returns for each of these assets.
2. Compute the means and covariances of the rates of return on these three assets.
3. Draw the efficient frontier if you can only invest in VEURX and VPACX.
4. Now add Exxon Mobil. Use Excel to draw 1,000 random numbers in two columns, called wE and wP. (Create one formula, and copy it into all of the cells.) Each of these 2,000 cells should use the formula 'rand()*3-1'. Create a new column that is 1.0 minus wE and wP, and call it wX. Now consider these random numbers as investment weights in VEURX, VPACX, and XOM. Compute the risk and reward for each of these portfolios (one portfolio is three numbers: one wE, one wP, and one wX), using the standard deviation and expected rate of return formulas. Finally, create an x-y plot that shows, for each of your wE, wP, and wX portfolios, the risk-reward combinations. What does the plot look like?
5. If the risk-free rate stood at 5% per annum, what would be the tangency portfolio?

answer

1. $E(r_{VEURX}) \approx 12.25\%$, $E(r_{VPACX}) \approx 6.41\%$, and $E(r_{XOM}) \approx 15.71\%$. $Cov_{VEURX,VPACX} \approx 3.1740\%$, $Cov_{VEURX,XOM} \approx 0.9876\%$, and $Cov_{VPACX,XOM} \approx 0.8903\%$. Covariances were computed using Excel's **covar** function, which uses "n-1", rather than "n", as the denominator.
2. there should be a graph here
   If you can only invest in VEURX and VPACX, the efficient frontier would pass through the portfolio with investment weights of 160% in VEURX and –60% in VPACX.
3. there should be a graph here
   The plot looks like a cloud.
4. Look at the graph above if there is one
   The tangency portfolio has the following investment weights: $\omega_{VEURX} \approx 35\%$, $\omega_{PACX} \approx -22\%$, and $\omega_{XOM} \approx 87\%$.

question

Return to the example with a risk-free asset in Formula 8.7 on Page 50. What are the risk and reward of a portfolio that invests $w_H = 150\%$? (This means that if you have $100, you would borrow $50 at the 4%

annual interest rate to purchase \$150 of H—more than your portfolio wealth itself.)

answer

Reward: $E(r_p) = 1.50 \times 6\% + (-0.5) \times 4\% = 7\%$. Risk: $Sdv(r_p) = 1.50 \times 9.49\% \approx 14.2\%$.

A.8.F Other Aspects of Partial Portfolio Choice Not Yet Covered In My Book

Subjects that are worthwhile covering, but have not been covered either in my main text or here.

- Catastrophe risk not captured by historical realized sd estimates.
- Skewness preferences—show two distributions with equal mean and sd
- Graph from CRSP, MSCI, and Global Financial Data from Bhagwan Chowdhry, unless it is sourced from another textbook.

  Figure stocks-plot with width 0.5*fullwidth
- Bhagwan does nice two-asset optimization examples; risk-free risky first. then risky, risky.
- Add L8b graph of how portfolio sigma declines with n. maybe some more real-world graphs.
- Explain how it is not possible with 100 years of data to estimate N*(N-1)/2 covariances when N is large. Historical numbers suck.

  Assume 7,000 listed stocks. Mean-Variance analysis requires 24.5 million numbers (7,000 variances, 24,496,500 covariances). With 1 factor, you need only 14,001 numbers (7,000 betas, 7,000 residual variances) You get a more robust estimate of covariance matrix *if* the model is right. All risk management tools use factor approaches. There is no alternative.
  E.g, King's oudated study (1966) on the proportion of variance explained: Market factor = 31%, Industry factors = 12%, Other common factors = 37%, Idiosyncratic returns = 20%
- Explain that mean-variance optimization is very sensitive to inputs.
- Explain that the Excel Solver can do optimization with portfolio constraints.

Chapter 9

The Capital Asset Pricing Model

A.9.A Application: Certainty Equivalence

x

CAPM is an abbreviation for capital asset pricing model—but then the model is presented in terms of rates of return, not in terms of prices. Huh? So, how do you find out the price of an investment asset with an uncertain rate of return? What is today's value of a gift expected to return $100 next year? Clearly, this price should depend on the covariance of this asset with the market. How would you use the CAPM to determine me its appropriate price today? (This price is called the **certainty equivalent**.)

Valuing Goods Not Priced at Fair Value

x

It's a bit of a puzzle: How do you even compute the beta of the gift's rate of return with the rate of return on the stock market? The price is $0 today, which means that your actual rate of return would be infinite! But you clearly should be able to put a value on this gift. Indeed, your intuition should tell you that this cash flow is most likely worth about $100 discounted by the risk-free rate, and then adjusted for how the gift's cash flow covaries with the stock market. But, how do you compute the value in the first place? The solution to this puzzle is that the price of the gift may be $0 today, but its present value today (PV) is not—and it is the latter (i.e., the fair value) that is used to compute returns and betas in the CAPM, not the former.

x

Of course, in a perfect and efficient market, what you get is what you pay for ($P = PV$), so this issue would never arise. But, if you buy an asset at a better or worse deal ($P < PV$ or $P > PV$), for example, from a benevolent or malevolent friend, then you can absolutely not use such a price to compute the expected rate of return in the CAPM formula. The same applies to $\mathrm{E}\big(P\big)$: The expected

value tomorrow must be the true expected value, not a sweetheart deal value at which you may let go of the asset, nor an excessive price at which you can find a desperate buyer. If it is, you cannot use the CAPM formula.

important

- The CAPM works only with expected rates of return that are computed from the fair perfect market asset values today and the fair perfect market expected value tomorrow.
- If either the price today or the value next period is not fair (e.g., because it is subsidized), then you cannot compute a rate of return from such prices and assume that it should satisfy the standard CAPM formula.

x

Now, return to the question of how to value a gift. The specific computational problem is tricky: If you knew the present value today, you could compute a rate of return for the cash flow. Then, from the rate of return, you could compute the project beta, which you could use to find the discount rate to translate the expected cash flow back into the present value (supposedly the price) today. Alas, you do not know the price, so you cannot compute a rate of return. To solve this dilemma, you must use an alternative form of the CAPM formula.

important

The **certainty equivalence form** rearranges the CAPM formula into

$$PV = \frac{\mathrm{E}(P) - \lambda \cdot \mathrm{Cov}(P, r_M)}{1 + r_F} \quad \text{where } \lambda = \frac{\mathrm{E}(r_M - r_F)}{\mathrm{Var}(r_M)} \tag{9.1}$$

where PV is the price today and P is the price next period.

An Example Use of the CEV Formula

x

If there is only one future cash flow at time 1, then P is this cash flow, and the rates of return are from time 0 to time 1. As before, we need the risk-free rate and an estimate of the equity premium. Let's work with a risk-free rate of 3% and an expected equity premium of 5%. In addition, we need the volatility of the stock market. Let's assume for our example's sake that the standard deviation is 20%. This means that the variance is $20\% \cdot 20\% = 0.04$, and therefore that lambda is $0.05/0.04 = 1.25$. You could now value projects as:

$$PV = \frac{\mathrm{E}(P) - 1.25 \cdot \mathrm{Cov}((P, r_M)}{1 + 3\%} = \underbrace{\frac{\mathrm{E}(P)}{1 + 3\%}}_{\text{as-if-risk-free}} \underbrace{- \left(\frac{1.25}{1 + 3\%}\right) \cdot \mathrm{Cov}((P, r_M)}_{\text{risk discount}} \quad (9.2)$$

The name "certainty equivalence" is apt. The first form in Formula 9.1 shows that, after you have reduced the expected value of the future cash flow ($\mathrm{E}(P)$) by some number that relates to the cash flow's covariance with the market, you can then treat this reduced value as if it were a perfectly certain future cash flow and discount it with the risk-free rate. The second form in Formula 9.2 shows that you can decompose the price (present value) today into an "as-if-risk-free" value that is discounted only by the time premium (with the risk-free rate), and an additional risk premium (discount) that adjusts for any covariance risk with the stock market. x

The covariance between the future value P and the rate of return on the market is related—but not identical to—the project's market beta. It is not the covariance of the project's rate of return with the market rate of return, either. It is the covariance of the project's cash flow with the market rate of return, instead. x

With the certainty equivalence formula, you can now begin thinking about how to value your $100 expected gift. Assuming that the risk-free rate is 3% per annum, and that the lambda is the aforementioned 1.25,

$$\begin{aligned} PV &= \frac{\$100 - 1.25 \cdot \mathrm{Cov}((P, r_M)}{1 + 3\%} \\ &= \frac{\mathrm{E}(P) - \lambda \cdot \mathrm{Cov}((P, r_M)}{1 + r_F} \end{aligned}$$

If you believe that the gift's payout does not covary with the rate of return on the market, then $\mathrm{Cov}((P, r_M) = 0$, and

$$\begin{aligned} PV &= \frac{\$100 - 1.25 \cdot 0}{1 + 3\%} = \frac{\$100}{1 + 3\%} \approx \$97.09 \\ &= \frac{\mathrm{E}(P) - \lambda \cdot \mathrm{Cov}((P, r_M)}{1 + r_F} \end{aligned}$$

x

Now let's see what the value is if you believe that your windfall does covary with the market. How can you estimate your cash flows' covariance with the rate of return of the stock market? You need to write down some scenarios and then compute the covariance. This is easiest to understand in an example. Let's assume that you believe that if the market goes up by 28%, your gift will be $200; if the market goes down by 12%, your gift will be $0. Further, you also believe these two outcomes are equally likely.

	$p = 1/2$ **Bad**	$p = 1/2$ **Good**	E	Var	Sdv
Stock Market	–12%	+28%	8%	400%%	20%
Our Windfall	\$0	\$200	\$100	\$\$10,000	\$100

I have chosen the stock market characteristics to match the example above. That is, the expected rate of return on the market is 8%, and its variance is $[(28\% - 8\%)^2 + (-12\% - 8\%)^2]/2 = 0.04$. Now you can use the covariance formula to compute the average product of deviations from the means. This is

$$\begin{aligned} \mathrm{Cov}\big((P, r_M\big) &= \frac{(\$200 - \$100) \cdot (28\% - 8\%) + (\$0 - \$100) \cdot (-12\% - 8\%)}{2} = \$20 \\ &= \frac{\text{Sum of all}[P_{\text{outcome j}} - \mathrm{E}(P_{\text{outcome j}})] \cdot [r_{M\,\text{outcome j}} - \mathrm{E}(r_M)]}{N} \end{aligned}$$

Lambda is still 1.25, and you can now use the certainty equivalence formula to value your expected windfall of \$100 next year. The gift is worth

$$\begin{aligned} PV &= \frac{\$100 - 1.25 \cdot \$20}{1 + 3\%} = \frac{\$75}{1 + 3\%} \approx \$72.82 \\ &= \frac{\mathrm{E}(P) - \lambda \cdot \mathrm{Cov}\big((P, r_M\big)}{1 + r_F} \end{aligned}$$

This is a lot less than the \$97.09 it would be worth if it did not covary with the market.

Checking The CEV Formula

With a fair value of \$72.82 today, you can compute the rates of return in both states

Bad State, Market –12%, Gift=\$0	\$0/\$72.82 − 1	$= -100\%$
Good State, Market +28%, Gift=\$200	\$200/\$72.82 − 1	$\approx 174.6\%$

You can now compute the market-beta of your gift. In the good state, the market returns +28% and you get +174.6%. In the bad state, the market returns –12% and you get –100%. You can draw a coordinate system and measure the slope of the line connecting these two points, or compute the covariance ($[28\% \cdot 174.6\% + (-12\%) \cdot (-100\%)]/2 \approx 0.5493$ and divide it by the variance of the market (0.08). Either way, you should find that your beta is about 6.87. Using the original CAPM formula, your expected rate of return should be

$$\mathrm{E}(r) \;=\; r_F + [\mathrm{E}(r_M) - r_f] \cdot \beta_i \;=\; 3\% + 5\% \cdot 6.87 \;\approx\; 37.3\%$$

This is exactly what a price of \$72.82 and an expected payoff of \$100 give you, $\$100/\$72.82 - 1 \approx 37.32\%$.

Alternative Forms of The CEV Formula

x

There are two more ways to rearrange the certainty equivalence formula. The first changes the cash flow covariance into a cash flow regression beta. You can do this by using the formula

$$b_{P,r_M} \;=\; \frac{\$20}{0.04} \;=\; \$500$$
$$= \frac{\mathrm{Cov}\big((P_1, r_M\big)}{\mathrm{Var}\big(r_M\big)}$$

This b_{P,r_M} is the slope of a regression line in which the future cash value (not the rate of return) is the dependent variable. You can now use a third certainty equivalence form, which gives the same result:

$$PV \;=\; \frac{\$100}{1+3\%} - \left[\frac{5\%}{1+3\%}\right] \cdot \$500 \;\approx\; \$72.82$$
$$PV \;=\; \frac{\mathrm{E}(P)}{1+r_F} - \left[\frac{\mathrm{E}(r_M) - r_F}{1+r_F}\right] \cdot b_{P,r_M}$$

A final form is really more like the original CAPM. It translates the cash flow regression beta back into the ordinary CAPM beta, which we all love. To do this, use the formula

$$\beta_P \;\approx\; \frac{\$500}{\$72.82} \;\approx\; 6.867 \tag{9.3}$$
$$\beta_P \;=\; \frac{b_{P,r_M}}{PV}$$

Of course, you usually do not know the \$72.82 price to begin with, which is why this is a less useful form (though you might start with a beta from comparables). You can now compute the value as

$$PV = \frac{\$100/1.03}{1+\left(\frac{8\%-3\%}{1.03}\right)\cdot 6.867} \approx \$72.82$$

$$PV = \frac{P_1/(1+R_F)}{1+\left[\frac{\mathrm{E}(r_M)-r_F}{1+r_F}\right]\cdot\beta_i}$$

I find this CAPM form rather useful. It says that after you have discounted the project by the risk-free rate, you discount it a second time using $\{[\mathrm{E}(r_M)-r_F]/(1+r_F)\}\cdot\beta_i$ as your second interest rate. If you can find a good comparable market-beta, you are home free!

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question

Although you are a millionaire, keeping all your money in the market, you have managed to secure a great deal: If you promise to go to school (which costs you a net disutility worth $10,000 today), then your even richer Uncle Vinny will buy you a Ferrari (expected to be worth $200,000), provided his business can afford it. He has bet heavily on the S&P500 going down (which one can do in the real world), so his business will have the money if the stock market drops, but not if it increases. For simplicity, assume that the stock market drops in 1 year out of every 4 years. When it does, it goes down by –10%; when it does not, it goes up by 18%. (Write it out as four separate possible state outcomes to make your life simpler.) The risk-free rate is 6%. What is your uncle's deal worth to you?

answer

This is a certainty equivalence question. Although it is not a gift per se, you cannot assume that $10,000 is a fair market value, so that you can compute a rate of return of 1,900%—after all, it is your uncle trying to do something nice for you. There are four outcomes:

	Probability				
	¼	¼	¼	¼	
	Drop	**No**	**No**	**No**	**Mean**
Stock Market	–10%	+18%	+18%	+18%	11%
Ferrari	$200,000	$0	$0	$0	$50,000

Plug this into the formula and find $\mathrm{Cov}\big((P, r_M\big) = ¼\cdot[\$150{,}000\cdot(-21\%)+(-\$50{,}000)\cdot(7\%)+(-\$50{,}000)\cdot(7\%)+(-\$50{,}000)\cdot(7\%)] = -\$10{,}500$. We also need to determine the variance of the market. It is $\mathrm{Cov}\big((r_M, r_M\big) = [(-21\%)^2+(7\%)^2+(7\%)^2+(7\%)^2]/4 = 147\%\%$ (which incidentally comes to a standard deviation of 12% per annum—a bit low.) With the risk-free rate of 6%, lambda (λ) in Formula 9.1 is $(11\%-6\%)/147\%\% \approx 3.4$. You can now use the certainty equivalence formula: The expected value of the Ferrari gift is $50,000. If it were a

safe payoff, it would be worth \$50,000/1.06 ≈ \$47,169.81. Because you get more if the rest of your portfolio goes down, the Ferrari gift is actually great insurance for you. You value it 3.4 · (\$10,500)/1.06 ≈ \$33,679.25 above its risk-free equivalent of \$47,169.81: This Ferrari is therefore worth \$80,849.06. You have to pay \$10,000 today, of course, so you have managed to secure a deal that is worth \$70,849.06.

Application: The CAPM Hurdle Rate for a Project With Cash Flow History Only

x

Here is your first professional consulting assignment: You are asked to advise a privately held firm on its appropriate cost of capital. The owners of this firm are very wealthy and widely diversified, so that their remaining portfolio is similar to the market portfolio. (Otherwise, your client's opportunity cost of capital may not be well represented by the CAPM to begin with—the calculations here are not relevant for a typical, cash-strapped entrepreneur, whose portfolio would not be similar to the market portfolio.) To make this a more realistic and difficult task, assume this firm is either privately held or only a division of a publicly held firm, so that you cannot find historical public market values and so that there are no obvious publicly traded comparable firms. Instead, the firm hands you its historical annual cash flows:

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**Average**
S&P 500	+21.4%	–5.7%	–12.8%	–21.9%	+26.4%	+9.0%	+2.7%
Cash flows	\$8,794	\$5,373	\$8,397	\$6,314	\$9,430	\$9,838	\$8,024

In an ideal world, this is an easy problem: You could compute the value of this firm every year, then compute the beta of the firm's rate of return with respect to the market rate of return, and plug this into the CAPM formula. Alas, assessing annual firm value changes from annual cash flows is beyond my capability. You can also not assume that percent changes in the firm's cash flows are percent changes in the firm's value—just consider what would happen to your estimates if the firm had earned zero in one year. All this does not let you off the hook: What cost of capital are you recommending? Having only a time series of historical cash flows (and no rates of return) is a very applied, and not simply an obscure, theoretical problem. You might first want to reflect on how difficult it is to solve this problem without the certainty equivalence formula.

x

First, we have to make our usual assumption that our historical cash flows and market rates of return are representative of the future. However, here we have to make a much bigger assumption. It could be that your cash flows in one year

are not a draw from the same distribution of cash flows, but that they also say a lot about your future cash flows. For example, a lousy year could induce the firm to make changes to raise cash flows. Or a great year could signal the beginning of more great years in the future. If either is the case, our naive application of the CEV method fails. (Instead of using a cash flow, you would have to use the expected value of the firm next year—a very difficult task in itself.) Let me repeat this:

> **Big Warning:** In the way we are now using our CEV approach on historical cash flow data, we are assuming that historical cash flows are independent draws that inform you about the distribution of future cash flows. This means that there should be no autocorrelation—any year's cash flow should not be any more indicative of next year's cash flow than any others. More sophisticated techniques could remedy this shortcoming, but we do not have the space to cover them.

x

Under this cash flow assumption, we begin by computing the beta of the firm's cash flows with respect to the S&P 500. This is easier if we work with differences from the mean:

wideonecolumn

	1999	2000	2001	2002	2003	2004	Average
De-meaned S&P 500	+18.7%	–8.4%	–15.5%	–24.6%	+23.7%	+6.3%	0%
De-meaned Cash Flows	+$770	−$2,651	+$373	−$1,710	+$1,406	+$1,814	$0

To compute the covariance of the S&P 500 returns with our cash flows, we multiply these and take the average (well, we divide by $N-1$, because this is a sample, not the population, but it won't matter much in the end),

$$\mathrm{Cov}\left(CF, r_M\right) = \frac{(+18.7\%)\cdot(+\$770) + (-8.4\%)\cdot(-\$2{,}651) + \cdots + (+6.3\%)\cdot(+\$1{,}814)}{5} \approx \$235.4$$

and compute the variance of the S&P 500 returns

$$\mathrm{Var}\left(r_M\right) = \frac{(+18.7\%)^2 + (-8.4\%)^2 + \cdots + (6.3\%)^2}{5} \approx 0.0374$$

The cash flow beta is the ratio of these,

$$b_{CF,M} = \frac{\mathrm{Cov}(CF, r_M)}{\mathrm{Var}(r_M)} = \frac{\$235.4}{0.03734} \approx \$6{,}304$$

The historical mean cash flow was \$8,024. We still need an assumption of a suitable equity premium and a suitable risk-free rate. Let's adopt 4% and 3%, respectively. In this case, the value of our firm would be

$$PV = \frac{\$8{,}024}{1+3\%} - \left[\frac{4\%}{1+3\%}\right] \cdot \$6{,}304 \approx \$7{,}790 - \$245 \approx \$7{,}545$$

$$= \frac{\mathrm{E}(CF)}{1+r_F} - \left[\frac{\mathrm{E}(r_M)-r_F}{1+r_F}\right] \cdot b_{CF,r_M}$$

The certainty equivalence formula tells us that because our firm's cash flows are correlated with the market, we shall impute an additional risk discount of \$245. We can translate this into a cost-of-capital estimate—at what discount rate would we arrive at a value of \$7,545?

$$\$7{,}545 = \frac{\$8{,}024}{1+\mathrm{E}(R)} \quad \Rightarrow \quad \mathrm{E}(R) \approx 6.3\%$$

$$PV = \frac{\mathrm{E}(CF)}{1+\mathrm{E}(R)}$$

We now have an estimate of the cost of capital for our cash flow for next year. We can also translate this into an equivalent returns-based market beta, which is

$$\mathrm{E}(R_P) = 3\% + 4\% \cdot \beta_{i,M} = 6.3\% \quad \Rightarrow \beta \approx 0.8$$

$$= r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_{i,M}$$

Of course, you could have used Formula 9.3 instead: With a present value of \$7,545, the cash flow beta of \$6,304 divided by \$7,545 would have yielded the same ordinary beta estimate of 0.8.

Now I can reveal who the firm in this example really was—it was IBM. Because it is publicly traded, we can see how our own estimate of IBM's cost of capital and market beta would have come out if we had computed it from IBM's annual market values. Its rates of return were as follows:

	1999	2000	2001	2002	2003	2004	Average
IBM's Rate of Return	+17.5%	–20.8%	+43.0%	–35.5%	+20.5%	+7.2%	+5.3%

If you compute the market beta of these annual returns, you will find an estimate of 0.7—very close to the estimate we obtained from our cash flow series. (For IBM, this is a fairly low estimate. If we used monthly cash flows or monthly stock returns, we would obtain a higher market beta estimate.)

question

A firm reported the following cash flows:

	1999	2000	2001	2002	2003	2004	Average
S&P 500	+21.4%	–5.7%	–12.8%	–21.9%	+26.4%	+9.0%	+2.7%
Cash Flows	+$2,864	+$1,666	−$1,040	+$52	+$1,478	−$962	+$676

(Note that the cash flows are close to nothing in 2002 and even negative in 2004, the latter preventing you from computing percent changes in cash flows.) Still assuming an equity premium of 4% and a risk-free rate of 3%, what cost of capital would you recommend for 1 year of this firm's cash flows?

answer

First, compute the de-meaned cash flows:

	1999	2000	2001
(a) S&P 500	+21.4%	–5.7%	–12.8%
(b) Cash Flows	+$2,864	+$1,666	–$1,040
(c) Demeaned S&P	+18.67%	–8.43%	–15.53%
(d) Demeaned CF's	+$2,188.67	+$990.67	–$1,716.33
(e) Cross-Product	$408.36	–$83.46	$266.60

	2002	2003	2004	Average	Variance
(a)	–21.9%	+26.4%	+9.0%	+2.7%	373.4%%*
(b)	+$52	+$1,478	–$962	+$676	
(c)	–24.63%	+23.67%	+6.27%	0%	
(d)	+$624.33	+$801.67	–$1,638.33	$0	
(e)	$153.79	$189.73	–$102.67	$166.47*	

(My cross-products carried full precision. Your's may be a little different if you worked with the de-meaned rounded values.) The asterisk reminds you that we divided both the average cross-product and the variance by 5 rather than 6 to reflect the fact that this is a sample and not the population. The cash flow beta is about $166.47/373.4%% ≈ $4,458.19. We now have the inputs to use our formula:

$$PV \approx \frac{\$676}{1+3\%} - \left[\frac{4\%}{1+3\%}\right] \cdot \$4{,}458.19 \approx \$657 - \$173$$

$$= \frac{\mathrm{E}(P)}{1+r_F} - \left[\frac{\mathrm{E}(r_M)-r_F}{1+r_F}\right] \cdot b_{P,r_M} \approx \$484$$

This suggests a cost of capital of about $\mathrm{E}(C_{1\,\mathrm{year}})/P_0 - 1 \approx \$676/\$484 - 1 \approx 40\%$. It turns out that this firm was Sony. This cost-of-capital estimate seems far too high. This is probably because the cash flow beta of Sony was way too high in relation to the ordinary CAPM market beta of Sony. Our CEV calculations did not do well in assessing value, probably because Sony's cash flows were far more volatile than its value.

A.9.B Theory: The CAPM Basis

This chapter has given you only a cookbook approach to the CAPM. There is usually not enough time to cover the art and science of investments in a corporate finance course. This appendix sketches some of the plumbing that goes into putting the CAPM together.

Math: Portfolio Separation

In our world of risk-free assets, the combination of two mean-variance efficient (MVE) portfolios is itself MVE. It may almost seem silly to emphasize this simple math fact, but it is extremely important to the CAPM derivation. If a risk-free asset is available (and, de facto, it is), the proof is simple. Every MVE portfolio is a simple combination of the tangency portfolio and the risk-free asset. There are no other assets that any other investor might hold instead. So, adding the next investor can add only more tangency portfolio and more risk-free asset to the market portfolio. And, therefore, if the two investors marry, their portfolio is still MVE.

important
Mathematics dictates that combining MVE portfolios yields an MVE portfolio.

The reverse does not hold. That is, combining portfolios that are not MVE could still yield an MVE portfolio—if only by accident. Incidentally, even if there is no risk-free asset, this still holds. That is, the combination of two MVE portfolios is itself MVE. This is not easy to see, but trust me that it can be proven.

No economics or behavior was involved in this mathematical proof. It is true no matter how investors behave. Later, we will add some economics: If all investors hold MVE portfolios, then portfolio separation will imply that the overall value-weighted stock market portfolio is also MVE. In turn, this means the market portfolio must be on the tangency line itself. Because there is only one risky portfolio that qualifies, the market portfolio of risky assets must be the tangency portfolio itself.

Math: The Mean-Variance Efficient Frontier and CAPM-Type Formulas

x
X

Now let's connect the mean-variance efficient frontier and the CAPM formula, $\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i$. This formula must hold for each and every security in the market. You can think of it as a relationship that relates the reward of each component of the market portfolio to its risk contribution. But why does the efficient frontier, which graphs only the overall portfolio risk (standard deviation) and reward, relate to a formula about each and every one of the portfolio's many individual constituents and their market betas? At first glance, the two do not even seem to play in the same ballpark. But there is a good connection. Intuitively, the CAPM formula states that in the portfolios on the MVE frontier, no component can offer too little or too much reward for its portfolio risk contribution. If it did, you could form a better portfolio by buying more or less of it, and therefore your overall original portfolio would not have been on the MVE frontier to begin with!

x

Here is my claim: If even a single stock does not follow the CAPM formula, then I can form a portfolio that has higher reward with lower risk. (Put differently, the stock market portfolio would not have been the efficient tangency portfolio.) Let me show you how this works. We recycle the portfolios from Section A.8.D. Take portfolio N, also in Table 9.1. It has 75% investment in H and 25% investment in I. It is not MVE if a risk-free security offers a 4% rate of return. Relative to the tangency portfolio T, N has too much H and too little I in it. (Recall that portfolio T invests about 30% in H and 70% in I.) Put differently, if you owned only N, then security H would be relatively too expensive and unattractive, and security I would be relatively too cheap and attractive. You could perform better than N if you sold some of the expensive H and bought more of the cheap I. In contrast, this logic should not apply for your tangency portfolio T. If you own T, you should not be able to do better. All securities should seem appropriately priced to you. This is the logic underlying the CAPM formula. It gives each security an appropriate reward, given this security's risk contribution (measured by beta with respect to the overall portfolio).

x

Let's confirm that the CAPM formula holds only for the tangency portfolio T, and not for portfolio N.

x

The risk-reward relationship in the tangency portfolio: Do we get a CAPM-type relationship between securities' expected rate of return and their betas if the efficient T is the market portfolio? Let's check. The CAPM-type relationship would be:

$$\mathrm{E}(r_i) \;=\; r_F + [\mathrm{E}(r_T) - r_F] \cdot \beta_{i,T}$$

The beta of security i with respect to portfolio T ($\beta_{i,T}$) is your measure of the

Table 9.1: Efficient and Inefficient Portfolios

—H and I are the two base assets that form the mean-variance efficient frontier of risky assets. F is the risk-free asset. N and T are combinations of the H and I assets that are used to illustrate the mean-variance frontier with a risk-free asset. The portfolio N appeared in Table 8.1 on Page 38 and invests 75% in H, 25% in I. It is not mean-variance efficient. Portfolio T invests about 30% in H, 70% in I. These assets were graphed in the companion, Figure 8.5 on Page 51.

		In S1 ([club])	**In S2 ([diamond])**	**In S3 ([heart])**	**In S4 ([spade])**	**Reward** $\mathrm{E}(r)$	**Variance** $\mathrm{Var}(r)$	**Risk** $\mathrm{Sdv}(r)$
Base Asset	H	–6.0%	+12.0%	0.0%	+18.0%	6.00%	90.0%%	9.49%
Base Asset	I	–12.0%	+18.0%	+24.0%	+6.0%	9.00%	189.0%%	13.75%
Risk-Free	F	4.0%	4.0%	4.0%	4.0%	4.00%	0.0%%	0.00%
Tangency	T	–10.2%	+16.2%	+16.8%	+9.6%	8.10%	119.6%%	10.94%
Inefficient	N	–7.5%	+13.5%	+6.0%	+15.0%	6.75%	79.3%%	8.91%

risk contribution of security i to portfolio T. You need to compute these betas (with respect to the overall portfolio T) for both securities H and I. This is the covariance of H and T, divided by the variance of T. I have worked this out for you, so trust me that this number is $\beta_{H,T} \approx 0.49$. Similarly, $\beta_{i,T} \approx 1.22$. Substitute these two betas into the relationship, and you find

$$\begin{aligned} \mathrm{E}(r_H) &\approx 4\% + [8.1\% - 4\%] \cdot 0.49 \approx 6\% \\ \mathrm{E}(r_i) &\approx 4\% + [8.1\% - 4\%] \cdot 1.22 \approx 9\% \\ \mathrm{E}(r_i) &= r_F + [\mathrm{E}(r_T) - r_F] \cdot \beta_{i,T} \end{aligned}$$

If you look at Table 9.1, you will see that this is exactly what these two securities offer, which is exactly as CAPM suggests: There is a linear relationship between each security's expected rate of return and beta with respect to the market. You cannot do better by either selling or buying more of H or I. You are already holding them in the best proportions. And, therefore, T is indeed mean-variance efficient.

x

The risk-reward relationship in any other portfolio: Is this also the case for another portfolio that is not mean-variance efficient (i.e., on the mean-variance efficient frontier)? Could we get a CAPM -like relationship between securities' expected rate of return and their betas if the inefficient N is the market portfolio? Let's check. The CAPM-type relationship would be

$$\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_N) - r_F] \cdot \beta_{i,N}$$

The beta of security i with respect to portfolio N ($\beta_{i,N}$) is your measure of the risk contribution of security i to portfolio N. Trust me again that $\beta_{H,N} \approx 0.99$ and $\beta_{i,N} \approx 1.02$. Substitute these two betas in, and you find

$$\begin{aligned}
\mathrm{E}(r_H) &\approx 4\% + [8.1\% - 4\%] \cdot 0.99 \approx 8.07\% \\
\mathrm{E}(r_i) &\approx 4\% + [8.1\% - 4\%] \cdot 1.02 \approx 8.19\% \\
\mathrm{E}(r_i) &= r_F + [\mathrm{E}(r_N) - r_F] \cdot \beta_{i,N}
\end{aligned}$$

But if you look at Table 9.1, you will see that portfolio H offers a reward of only 6% while portfolio I offers a reward of 9%. In this portfolio N, H is too expensive and I is too cheap. You would do better to get rid of some H and buy more I. Therefore, you have now confirmed that if the inefficient N were the market portfolio, a CAPM-type formula would not hold! H would be too expensive in the market, and I would be too cheap in the market. Therefore, N would not be a mean-variance efficient portfolio.

important

Mathematics dictates that if and only if a portfolio T is MVE, all assets must follow the linear relation,

$$r_i = r_F + [\mathrm{E}(r_T) - r_F] \cdot \beta_{i,T}$$

Therefore, if the market portfolio is MVE,

$$r_i = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i$$

Again, no economics was involved. The formulas are correct no matter how investors behave.

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question

This question asks you to confirm the beta computations. Work with the data from Table 9.1.

1. Compute the covariance between H and N.
2. Compute the covariance between I and N.

3. Compute the variance of N.
4. Compute the beta of H with respect to N.
5. Compute the beta of I with respect to N.

Repeat this for portfolio T as the reference portfolio instead of N. (Recall that T holds 30% in H and 70% in I.)

answer
Working off Table 9.1:

1. The covariance between H and N is 78.75%%.
2. The covariance between I and N is 81%%.
3. The variance of N is 79.31%%. Actually, this number was in the table itself.
4. The beta is the covariance divided by the variance: $\beta_{H,N} = 78.75\%\%/79.31\%\% \approx 0.993$.
5. This is $\beta_{i,N} = 81\%\%/79.31\%\% \approx 1.021$.

Repeating the exercise for portfolio T instead of N: The covariance of T and H is 58.5%%, between T and I is 145.8%%, and between T and itself is 119.6%% (the variance). Thus, the beta of H with respect to T is $\beta_{H,T} = 58.5\%\%/119.6\%\% \approx 0.49$. The beta of I with respect to T is $\beta_{i,T} = 145.8\%\%/119.6\%\% \approx 1.22$. This confirms the market betas I claimed in the text.

question

Confirm that the portfolio H is not mean-variance efficient if the risk-free rate of return is 4%.

answer
Recall the data from Table 9.1:

	[club]	[diamond]	[heart]	[spade]	Mean	Var
I	–6%	+12%	0%	18%	6%	90%%
H	–12%	+18%	+24%	+6%	9%	189%%

Now compute the beta of H and I with respect to portfolio H. The beta of H with respect to itself is 1. The beta of I with respect to H is $\beta_{i,H} = 45\%\%/90\%\% = 0.5$. For a CAPM formula to hold, you need $\mathrm{E}(r_H) = r_F + [\mathrm{E}(r_H) - r_F] \cdot \beta_{H,H} = 4\% + 5\% \cdot 1 = 9\%$. For H, the CAPM formula is okay. Now work I: $\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_H) - r_F] \cdot \beta_{i,H} = 4\% + 5\% \cdot 0.5 = 6.5\%$. Aha! The CAPM-type relationship is violated for I. It should offer 6.5%, but it offers 6% in real life. Therefore, you should purchase less of it.

Economics: The CAPM and Its Logic

Actually, you probably already understand how the previous chapter and this chapter fit together to produce the CAPM.

- The mean-variance efficient frontier plots the achievable combinations of overall portfolio risk and reward.
- With a risk-free security, the real efficient frontier becomes the line connecting the risk-free rate with the tangency portfolio from the efficient frontier, using only the risky securities.
- An investor who wishes to be on the mean-variance efficient frontier will purchase a combination of the tangency portfolio and the risk-free rate.
- Portfolios on the efficient frontier do not underinvest or overinvest in individual securities. Therefore, for portfolios on the efficient frontier, individual securities must follow the CAPM security market line (SML). If one security were to offer too much or too little reward (measured by expected rate of return) for its risk contribution (measured by portfolio beta), then this original portfolio could be improved upon by buying more or less of this one security—and therefore it would not have been mean-variance efficient to begin with.

You learned about the CAPM in this chapter. It gives you an appropriate hurdle rate (cost of capital) for corporate and other projects. But where does the CAPM and its formula really come from? It is put together in three steps:

1. **Mathematics** If all investors in the market buy a combination of the tangency portfolio and the risk-free rate, then their combined portfolio is also a combination of the tangency portfolio and the risk-free rate. (Duh!)
2. **Economics** The CAPM is only one economic statement: The market portfolio lies on the efficient frontier. If all investors buy mean-variance efficient portfolios, this is necessarily true. Indeed, the tangency portfolio must be the overall market portfolio. If it were not, it would make no sense: Investors would jointly seek to own more or less of some security than there would be available for purchase.
3. **Mathematics** The rest (the CAPM formula) is just a mathematical consequence. The previous subsection gave you a taste of the proof—that all securities in efficient frontier portfolios must follow a CAPM-type formula, that is, a security market line:

$$\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i$$

That was it—the logic of the CAPM. It was the famous Roll critique that originally explained how the CAPM is really only one economic statement, and that there was only one portfolio implication in the CAPM, and not one for every stock (i.e., thousands of relations predicted by the model). It has a number of other interesting consequences. Logically, if even one asset does not follow the CAPM relationship, then the market portfolio does not lie on the efficient frontier, and the CAPM is the wrong model. In turn, this means that it is sort of silly to use the CAPM for investment management performance evaluation. After all, if the CAPM holds, every asset must be properly priced. If one asset is not, then the CAPM does not hold. Put differently, no investment manager should be able to beat the CAPM. If one beats the CAPM, then the CAPM is the wrong model to use to begin with. Nevertheless, the CAPM is usually a reasonable basic benchmark for money managers—adjusting for market risk, do they outperform the average securities market line?

A.9.C Theory: CAPM Alternatives!?

In a survey in 2007, about 75% of all finance professors recommended the CAPM for use in a corporate capital budgeting context. About 5% recommended the so-called APT. And 10% recommended the so-called Fama-French factors. Not surprisingly, these two alternative models have not only some advantages but also big disadvantages relative to the CAPM from a capital budgeting perspective—if it were otherwise, we would have deserted the CAPM. (Forms of these models clearly work better for financial investment purposes, though.) It is impossible to explain these models fully in a first corporate finance course, but I want to give you at least a sketch. Moreover, I want to mention briefly another simpler alternative to the CAPM—a single factor model.

A Single-Factor Model

Explain how the historical alpha in a market model is an estimate of an expected rate of return, too. But, unfortunately, it says that firms with very high past returns have to have high returns in the future. It has no concept that high past returns may have been because the firm did well. Facebook may not have to require a 50% rate of return (cost of capital), just because this is what it has delivered in the past.

The Arbitrage Pricing Theory (APT) and Intertemporal CAPM (ICAPM)

x

The first alternative is an extension of the ordinary CAPM, called the **intertemporal CAPM** (**ICAPM**). The second is called the **arbitrage pricing theory** (**APT**). In practical use, the two are almost indistinguishable, so I will just treat them as one and the same model here. Let's think back as to how you would apply the CAPM:

1. The CAPM asks you to measure how each stock's rate of return moves together with the overall stock market rate of return. This is its market beta.

2. The model's intuition is that investors dislike stocks that move together with the stock market and like stocks that move against the stock market.

3. The CAPM tells you the exact formula by which you should receive a higher average rate of return for firms that expose you to a lot of covariation with the stock market. It may be

$$\mathrm{E}(r_i) = 4\% + 5\% \cdot \beta_{i,M}$$

   where the second subscript reminds you that this beta measures a stock's sensitivity with respect to the market.

x

Now let's assume that stocks differ not only in how they move with or against the stock market, but also in how they move with or against other economic factors, say, the oil price. You might care about oil price changes because your business may do poorly if energy costs rise. Therefore, if you can find a stock that increases in value when oil prices rise, you would consider this stock to be good insurance against bad business—just as you consider a stock that goes up when the market goes down to be good insurance against market downturns in the CAPM framework. (If you are in this situation, chances are that you would really like to hold stocks like Exxon or Chevron.)

x

How can you measure whether a stock goes up or down with the oil price? Simple—you get this measure the same way that you get a measure of whether a stock goes up or down with the stock market. For each stock, you run a time-series regression, in which the independent variable is not the rate of return on the stock market but the oil price change:

$$r_i = a + \beta_{i,\text{Oil Price Change}} \cdot (\text{Oil Price Change})$$

This gives you a beta for each stock that measures how its rate of return moves with oil price changes. A stock that has a very large $\beta_{i,\text{oil price change}}$ (say, 5) would go up a lot if the oil price increases—think Exxon. A stock that has a negative

$\beta_{i,\text{oil price change}}$ (say, –3) would go down when the oil price increases—think United Parcel Service (which has to pay more for gas when the oil price increases).

Would you be willing to pay more for a stock that acts as an insurance against oil price increases? If your livelihood is adversely affected by oil price changes, then the answer is probably yes. The more important question is whether this is also the attitude of most investors in the market. If it is, then a stock like Exxon, which has a high $\beta_{i,\text{oil price change}}$, would be more desirable. Such a stock would not have to offer as high a rate of return as another stock that has a low $\beta_{i,\text{oil price change}}$. The APT then gives you a formula that relates the oil-price-change beta (and other betas like it) to the expected rate of return on a stock—something like

$$\mathrm{E}(r_i) = 4\% + 5\% \cdot \beta_{i,M} - 3\% \cdot \beta_{i,\text{Oil Price Change}}$$

You can now use the formula the same way you used the CAPM formula. To recap, the APT works like the CAPM but allows more than just one beta (and just one risk premium):

1. The APT asks you to measure for each stock how it moves with respect to factors (like the oil price) that you decide on. This gives you, for each stock, a set of market betas—one exposure for each factor.

2. The intuition is that investors like stocks that have high or low betas with respect to these factors. (The sign depends on investors' preferences.)

3. The APT tells you the exact formula by which you should receive a higher average rate of return for firms that expose you to bad covariation with respect to the factors that matter.

What Are the APT Factors?

Common APT models use as factors interest rate changes, GDP changes, bankruptcy risk, the returns of growth stocks, and the returns of small firms. Each stock then has a beta with respect to these factors. And an APT formula relates the average rate of return to these betas. x

Unfortunately, the APT is even harder to use than the CAPM. The good news is that it allows you to specify that investors care about factors other than the overall stock market. You then use the beta of your project with respect to the market to determine the appropriate expected rate of return. The bad news is that it allows you to specify that investors care about factors other than the overall stock market. The problem is that the APT does not give you any guidance on what these factors should be. What factors do academics recommend? Sorry, there is no consensus

of what the best APT factors are. So the APT's flexibility is both a blessing and a curse. x

Most commonly, corporations rely on third-party vendors who have developed such APT models. This way, they get at least a second opinion on their average cost of capital. (This is rarely done for individual projects, even though we know that costs of capital should be computed project by project.) The APT vendor reports APT factors (the market beta and the oil price change in our example) and the "premiums" (4%, 5%, –3% in our example) and then estimates your firm's betas with respect to these premiums. You can then multiply the factors with the premiums to obtain an alternative measure for the cost of capital. Alas, there is no guarantee that any one particular APT model is the right model. In fact, two APT vendors can easily derive completely different cost-of-capital estimates. You have to judge which one is better. In other words, use the APT at your own risk.

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question
Explain how the APT model is similar to, but more general than, the CAPM.

answer
The APT is almost like a multifactor version of the CAPM. Whereas in the CAPM, everything depends on one factor (that is, the rate of return on the stock market), in the APT there can be multiple factors (such as the rate of return on the stock market, the rate of return from investing in oil, and so on). Both models then say that assets that are more exposed to these risks have to offer higher expected rates of return. Unlike the CAPM, the APT does not necessarily assume that the rate of return on the stock market is one factor. It also does not assume that there is an optimal market portfolio, in which all investors should invest.

The Fama-French-Momentum (-And-More) Model

x

While the ICAPM and APT developed out of a tradition of theoretical models with empirical applications, another set of models has come out of a tradition of empirical research. The most prominent empirical regularities right now seem to be the following:

1. **Momentum:** Stocks tend to perform better if they have had high stock returns over the previous 12 months, not including the most recent month. (Omitting this last month is very important.) The firm's own momentum is a very robust positive predictor, except in January (where it reverses).

2. **Value:** Stocks tend to perform better if they have high accounting book value of equity divided by the market value of equity. Firms that fit this criterion are called **value firms**, while firms that have higher market values than accounting book values are called **growth firms**. A typical value firm is "boring," like the diaper vendor Procter & Gamble. A typical growth firm is "exciting," like Google or Apple. In the long run, the superior stock return performance of value firms relative to growth firms has been a very robust relationship, too—even though there were some periods when it did not hold—first and foremost during the dot com bubble of late 1990s. X

3. **Size:** There is some evidence that smaller firms perform better than larger firms. The role of firm size is not as strong and robust as the two preceding effects.

The latter two regularities are usually called the **Fama-French factors** because it was Eugene Fama and Ken French who investigated them most thoroughly. The first regularity was suggested as an addition by Mark Carhart. Please don't think that these three empirical regularities are the only ones. There are literally dozens more (accounting accruals and net issuing activity are particularly noteworthy). However, these three factors are perhaps the most prominent. (For more determinants of average rates of return, you really have to read an investments textbook.)

Use of the Model in a Corporate Context

x

How can you use this model in a corporate context? Let me sketch how one version would work. Ken French posts the historical rates of return for the equity premium (which he calls XMKT) and the three other factors on his website at Dartmouth. Here they are.

XMKT: The equity premium is the average rate of return on the stock market net of the risk-free rate. The average rate of return on XMKT (from 1927 to 2006) was about 8.5%.

UMD (up-minus-down): The momentum net portfolio is the average rate of return on firms having done well over the last 12 months ("winners") minus the average rate of return on firms having done poorly ("loosers"). It is logged to omit the last month. The average rate of return on this portfolio was about 8.9%.

HML (high-minus-low): The high "value" portfolio is the average rate of return on stocks with high accounting book value relative to market value. The

"low" portfolio is the same for stocks with the opposite characteristics (i.e., "growth"). The average rate of return on the net portfolio was about 4.6%.

SMB (small-minus-big): The "small firm" portfolio is the average rate of return on stocks of small firms. The "big firm" portfolio is the same for large firms. The average rate of return on the net portfolio was about 3.8%.

You would first run a time-series regression of your own project's (i) historical rates of return net of the risk-free rate on the four time-series:

$$r_i - r_F = a_i + b_i \cdot XMKT + c_i \cdot UMD + d_i \cdot HML + e_i \cdot SMB + \text{noise}$$

xnopar

Now let's say that your regression package estimated your project's coefficients to be $a = 3\%$, $b = 2$, $c = 0$, $d = 0$, and $e = 0$. Well, then your particular stock behaves almost like a CAPM stock with a market beta of 2, because your model would reduce to

$$\mathrm{E}(r_i) - r_F = 3\% + 2 \cdot \mathrm{E}(XMKT) = 3\% + 2 \cdot [\mathrm{E}(r_M) - r_F] \qquad (9.4)$$

Note that the risk-free rate intercept is already on the left-hand side, so your 3% estimated intercept would be an excess rate of return that your stock has earned historically, above and beyond what the model would have suggested. You would

x

therefore also not expect this extra 3% rate of return to repeat.

What would be a good hurdle rate for your project? If you believe the future equity premium to be 5% and the Treasury risk-free rate to be 4%, then you would expect your stock's rate of return to be

$$\begin{aligned} \mathrm{E}(r_i) - 4\% &= 2 \cdot 5\% \\ \mathrm{E}(r_i) - r_F &= \beta_{i,XMKT} \cdot \mathrm{E}(XMKT) \end{aligned}$$

The model suggests an expected rate of return of $\mathrm{E}(r_i) = 4\% + 2 \cdot 5\% = 14\%$ for your project. Note how the application omits the 3% from Formula 9.4 here—the reason, as just noted, is that the 3% was an unusual rate of return that you would not expect to repeat. Note that instead of using your 5% guess about the future equity premium, you could have used the historical average rate of return on XMKT. From 1927 to 2006, it was 8.5%. In this case, you would have required

x

your project to earn a rate of return of $4\% + 2 \cdot 8.5\% \approx 21\%$.

Now let's choose another project. Let's say you estimate coefficients $a = 3\%$, $b = 0.5$, $c = -1$, $d = 2$, and $e = -2$ for this one. Again, you would need some estimates of the future average rate of return for the four factors, just as you needed an estimate for the future average rate of return for the equity premium. Remember how we agonized about the equity premium? You really should agonize

equally about all four risk premium estimates now. However, for lack of a good source and great intuition, most people just use the historical average rates of return, mentioned above. If you buy into the hypothesis that the historical averages are good predictors of the future premiums, you would then estimate your project's appropriate expected rate of return to be

$$\begin{aligned} \mathrm{E}(r_i) - r_F &= 0.5 \cdot \mathrm{E}(XMKT) + (-1) \cdot \mathrm{E}(UMD) + 2 \cdot \mathrm{E}(HML) + (-2) \cdot \mathrm{E}(SMB) \\ &= 0.5 \cdot 8.5\% + (-1) \cdot 8.9\% + 2 \cdot 4.6\% + (-2) \cdot 3.8\% \\ &= -3.05\% \end{aligned}$$

With a risk-free rate of return of 5%, you would set your project hurdle rate to be about $5\% - 3\% = 2\%$. x

Some final notes: Often, one would use only a two factor model—based on value/growth and either beta or size—for capital budgeting. Firm size and firm market beta are sufficiently highly correlated that in most practical capital budgeting applications, you can ignore firm size and rely on market beta alone (or the opposite). Moreover, momentum is such a short-term phenomenon that it is usually irrelevant for long-term capital budgeting purposes. Relying on 1-year momentum for cost-of-capital estimates for 10-year investments in a corporate context does not make sense. This is why UMD is often excluded from this model in a corporate context. Moreover, this form of the model does not do justice, especially to momentum, which is more of an idiosyncratic effect than a factor exposure to UMD. A better model would work with firms' own momentum rather than these factor betas. (In an APT context, one could then view these characteristics of stocks as picking up firms' betas to some factors. Of course, other researchers believe that these are not really betas, but more a reflection of market inefficiencies, the subject of Chapter **??**.) x

My model description was too telegraphic, of course. You should really consult an investments text if you want to learn how to use the Fama-French model.

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question

Assume that you ran a time-series regression with your project on the Fama-French factors and found the following:

$$\mathrm{E}(r_i) - r_F = (-2\%) + (1.3) \cdot XMKT + (0.1) \cdot UMD + (-1) \cdot HML + (-0.1) \cdot SMB$$

What would the Fama-French-Momentum model suggest you use as the hurdle rate for this project? Recall that $\mathrm{E}(XMKT) \approx 8.5\%$, $\mathrm{E}(UMD) \approx 8.9\%$, $\mathrm{E}(HML) \approx 4.6\%$, and $\mathrm{E}(SMB) \approx 3.8\%$. Assume that the prevailing risk-free Treasury offers 3%.

answer

The Fama-French-Momentum model suggests

$$\begin{aligned}
\mathrm{E}(r_i) - r_F &= (1.3)\cdot \mathrm{E}(XMKT) + (0.1)\cdot \mathrm{E}(UMD) \\
&\quad + (-1)\cdot \mathrm{E}(HML) + (-0.1)\cdot \mathrm{E}(SMB) \\
&\approx (1.3)\cdot 8.5\% + (0.1)\cdot 8.9\% \\
&\quad + (-1)\cdot 4.6\% + (-0.1)\cdot 3.8\% \\
&\approx 6.96\% \approx 7\%
\end{aligned}$$

This is a rate quoted above the risk-free rate. Thus, your appropriate cost of capital (hurdle rate) would be $3\% + 7\% = 10\%$.

EOC MATTER

eocproblems

question

Although you are a millionaire, keeping all your money in the market, you have managed to secure a great deal: If you give your even richer Uncle Vinny $20,000 today, he will help you buy a house, expected to be worth $1,000,000—if his business can afford it. He is a stockbroker by profession, so his business will have the money if the stock market increases, but not if it drops. For simplicity, assume that the stock market drops in 1 year out of every 4 years. When it does, it goes down by –10%; when it does not, it goes up by 18%. (Write it out as four separate possible state outcomes to make your life simpler.) The risk-free rate is 5%. What is your uncle's promise worth at market value?

answer

This is a variant of the solve-now question with different parameters. There are four outcomes:

Prob :	1/4	1/4	1/4	1/4	
	Crash	No-Crash	No-Crash	No-Crash	Mean
Stock Market	–10%	+18%	+18%	+18%	11%
House (000's)	$0	$1,000	$1,000	$1,000	$750

Plug this into the formula and find $\mathrm{Cov}\left(P, r_M\right) = 1/4 \cdot \left[-\$750 \cdot (-21\%) + (\$250)\cdot(+7\%) + (\$250)\cdot(+7\%) + (\$250)\cdot(+7\%)\right] =$ $5,250 thousand. We also need to determine the variance of the market. It is $\mathrm{Cov}\left(r_M, r_M\right) = [(-21\%)^2 + (+7\%)^2 + (+7\%)^2 + (+7\%)^4]/4 \approx$ 147%% (which incidentally comes to a standard deviation of 12% per annum, a bit low.) With the risk-free rate of 5%, lambda (λ) is $(11\% - 5\%)/147\%\% \approx 4.082$. You can now use the certainty equivalence formula: the expected value of

the house is \$750 thousand. If it were a safe payoff, it would be worth \$\$750/1.05 ≈ \$714.29 thousand. Because you get more if the rest of your portfolio goes up, this must be reduced. You value it $4.082 \cdot (+\$5{,}250)/1.05 \approx \$20{,}410$ lower than \$714,300: the house is therefore worth approximately \$694,000.

question

Your corporate division had the following net cash flows:

	1999	2000	2001	2002
S&P 500	+21.4%	−5.7%	−12.8%	−21.9%
Cash Flows	+\$2,000	\$0	\$0	\$0

	2003	2004	2005
S&P 500	+26.4%	+9.0%	+3.0%
Cash Flows	+\$2,500	+\$1,000	+\$500

Assume that the risk-free rate is 1% per annum and the equity premium is 3%. Use the certainty equivalence concept to answer the following questions:

- What should be a reasonable value approximation for this corporate division?
- What should be the cost of capital for this corporate division?

answer

First, calculate the mean of the two series. The first mean is 2.77%, the second is \$857. Then calculate deviations from the mean:

	1999	2000	2001	2002	2003	2004	2005	Average
S&P 500	+18.6%	−8.5%	−15.6%	−24.7%	+23.6%	+6.2%	0.2%	0%
Cash Flows	+\$1,143	−\$857	−\$857	−\$857	+\$1,643	+\$143	−\$357	\$0
Cross-Product	\$212.90	\$72.61	\$133.47	\$211.47	\$388.18	\$8.90	\$-0.82	\$171.12

We need to divide the averge cross-product and the variance by 6 rather than 7 to reflect the fact that this is a sample and not the population. The cash flow beta is aboue 171.12/311.2%% ≈ \$5,499. We can now value our corporation division at:

$$PV \approx \$857/(1+1\%) - [3\%/(1+1\%)] \times \$5{,}499 \approx \$685$$

This suggest a cost of capital of about $\$857/\$685 - 1 \approx 25\%$.

Second Answer, reconcile

First, calculate the mean of the two series. The first mean is 2.73%, the second is $857. Then calculate deviations from the mean:

	1999	2000	2001	2002	2003	2004	2005	
S&P 500	+18.7%	–8.4%	–15.5%	–24.6%	+23.7%	+6.3%	0%	0%
Cash Flows	+$1,143	−$857	−$857	−$857	+$1,643	+$143	−$357	$0
Cross-Product	$213.4	$72.24	$133.10	$211.10	$388.89	$8.96	$10.20	$171.3

The sample covariance is $171.3. The variance of the market is 3.11% and its mean is 2.7%. The cash-flow-beta is therefore $171.3/0.0311 ≈ $5,508.04. (If you run a regression, you find that $CF \approx \$707 + \$5{,}505 \cdot \text{S\&P500}$.) Assume that the market has a rate of return of 3.11%, the risk-free rate is 1%. Assume you expect to earn $857. The risk-free part becomes around $857/1.01 ≈ $848.51. The remainder (the reduction for market covariance risk) becomes about $2\% \cdot \$5{,}500 \approx \$110.16$. Thus, this division is worth about $738.35 in value today. With a price of $739 for expected cash flows of $857, your appropriate cost of capital should be about 16%.

question

Confirm that the portfolio L that invests 50% in H and 50% in I is not mean-variance efficient. If the risk-free rate of return is 4%, confirm that the CAPM relationship does not hold for L.

answer

We need to first compute the beta of H and I with respect to portfolio L. If L is mean-variance efficient, then the expected returns on these securities should be predicted by the security market line equation:

$$\mathrm{E}(r_i) \approx 4\% + (7.5\% - 4\%) \times 0.73 \approx 6.6\%$$
$$\mathrm{E}(r_H) \approx 4\% + (7.5\% - 4\%) \times 1.27 \approx 8.4\%$$

The expected return of I is 6%, but that of H is 9%. Therefore, CAPM-type relationship is violated. Therefore, you would be better off selling some of I and buying more of H, which indicates that L is not mean-variance efficient.

Reconcile:

You need to compute the beta of H and I with respect to portfolio H. The beta of H with respect to itself is 1. The beta of I with respect to H is 0.5. For a CAPM formula to hold, you need $\mathrm{E}(r_H) = r_F + [\mathrm{E}(r_H) - r_F] \cdot \beta_{H,H} = 4\% + 2\% \cdot 1 = 6\%$. This is ok. $\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_H) - r_F] \cdot \beta_{i,H} = 4\% + 2\% \cdot 0.5 = 5\%$. Aha! The CAPM-type relationship is violated. This security should offer 5%, but it offers 9% in real life. Therefore, you should purchase more of it.

question
Outline the logic that leads to the CAPM. What is mathematics? What is economics?

answer
Math: The combination of MVE portfolios is MVE. Math: An MVE portfolio means that all assets must follow a linear risk versus reward relationship, according to their betas. Economics: Every investor holds an MVE portfolio. Train of thought: Because investors hold MVE portfolios, the combination is mean-variance efficient, and therefore all assets follow the linear relationship.

question
What are the APT factors?

answer
No one really knows what the correct APT factors are. You can choose your own favorite factors, and hope you get it right.

question
What are the Fama-French-Momentum factors?

answer
The two Fama-French factors are firm size and firm type (value versus growth). The momentum factor measures whether firms had a recent good 12 months, omitting the most recent month.

question
Assume that you ran a time-series regression with your project on the Fama-French factors and found the following:

$$\begin{aligned}\mathrm{E}(r_i) - r_F &= (12\%) + (0.3)\cdot XMKT + (0.3)\cdot UMD \\ &\quad + (-0.5)\cdot HML + (-0.5)\cdot SMB\end{aligned}$$

If the risk-free rate is 4%, what would the Fama-French-Momentum model suggest you use as the hurdle rate for this project?

answer

$$\begin{aligned}\mathrm{E}(r_i) - r_F &= 0.3\cdot\mathrm{E}(XMKT) + (0.3)\cdot\mathrm{E}(UMD) + (-0.5)\cdot\mathrm{E}(HML) + (-0.5)\cdot\mathrm{E}(SMB) \\ &= 1.02\% \approx 1\%\end{aligned}$$

Thus, your hurdle rate would be $1\% + 4\% = 5\%$.

Chapter 11

Perfect and Efficient Markets, and Classical and Behavioral Finance

A.11.A An Event Study

This appendix shows an example of an **event study**. Chapter 23 has examples of the results of a number of event studies, too. There, we look at the evidence because we want to determine how stock prices respond to capital structure changes and payouts.

An Example: The Congressional Midterm Election of 2006

x

In the congressional midterm election of 2006, the Democratic Party ran on a six-point platform. Two of these points concerned specific industries: energy ("energy independence") and health care ("a health care system that works for everyone"). Having been in power for many years, the Republican Party had aligned itself closely with the oil industry and the pharmaceutical industry. For example, the GOP had written into its Medicare drug plan that the government could not use its buying power to negotiate for lower drug prices. In contrast, the Democrats were expected to allow the government to negotiate prices with drug companies more aggressively, or even to institute price controls on some of the more expensive drug regimens.

x

What if you were hired as a consultant to assess the value effect of a Democratic victory? Would there really be something that Democrats were likely to do differently that would harm companies in the oil and gas and health care sectors?

You could do this the traditional way: Estimate what the Democrats would likely do, project how it would affect the earnings of drug companies, forecast how long the Democrats would stay in power, and so on. This is a very difficult task. However, if you are willing to accept that financial markets are efficient, and that the election was the only value-relevant event during the night of the election from Tuesday to Wednesday, then you can use the market stock price reaction to the election as your measure of the value effect of legislative branch control. Here is how.

The Resolution of Uncertainty during Election Night

x

Prior to the election on November 7, 2006, opinion polls had projected that the Democrats would win the House of Representatives but not the Senate. However, during the last few days before the election, the Republicans had seemed to narrow the gap. But exactly what was expected? Different forecasters published different polls, and they did not all agree. Where could you learn authoritative probabilities
x that either party would win?

If you believe in reasonable market efficiency, the best information source would be a financial market, in which bettors place their money where their mouths are. Fortunately, such an "election market" indeed exists at the University of Iowa (and Thomas Rietz and Joyce Berg kindly shared their intraday data with me). In this market, investors could bet that either party would win. On election night, Tuesday, November 7, 2006, at the market closing time of 4 p.m. EST, speculators had placed the probabilities of wins (based on last trading quotes of the hour) as follows:

	House Republican	**House Democrat**	**Total Senate**
Senate Republican	12%	54%	66%
Senate Democrat	0%	34%	34%
Total House	12%	88%	

Thus, investors believed that the House would go Democrat (with 88% probability) and that the Senate would go Republican (with 66% probability). The probability that the Senate would be Republican and the House would be Democrat
x was around 54%.

By the time the NYSE reopened (i.e., on Wednesday, November 8, at 9:30 a.m. EST), many but not all election results had been posted. The probabilities had thus adjusted as follows:

Figure 11.1: Index Stock Price, Bond, and Gold Reactions around the 2006 Midterm Election

—Most of the election results materialized into stock prices from the night of Tuesday, November 7, to Wednesday, November 8. The S&P 500 dropped from 1,383 to 1,378 (a 35 bp loss).

Natural Width Figure wel11f04

	House Republican	**House Democrat**	**Total Senate**
Senate Republican	0%	17%	17%
Senate Democrat	0%	82%	82%
Total House	0%	100%	

The middle column shows that the Democrat takeover of the House of Representatives was fully known by the opening of the stock exchange, and although votes were still being counted, it had also become clear that even the Senate may have gone Democrat. By 11 a.m., the probability had already reached 97%. The Democrats had won both chambers!

To assess the value effect of this Democratic win, we only need to determine how stocks were affected by the overnight probability change from 34% to 82% of a complete Democratic victory.

The Effect on the Overall Stock Market

x

As usual, our stock price information comes from Yahoo!Finance. The graph in Figure 11.1 shows that the S&P 500 had risen prior to the election but then dropped 35 basis points during election night. x

How much money did the S&P 500 companies bleed? The S&P 500 represented about $12.6 trillion in market capitalization on election night. Thus, the 35 bp loss corresponded to a value loss of about $44 billion. It is important that you realize that this $44 billion is not the entire value loss that a Democratic Congress would inflict on the S&P 500 companies. The reason is that the $44 billion reflects only the shift in the probability that the House would go Democrat (from 88% to 100%) and the probability that the Senate would go Democrat (from 34% to 82%). In the extreme, if the S&P 500 investors had known the election outcome fully and with certainty on Tuesday afternoon, then the market should not have fallen at all. No new information would have been revealed by the actual election results. (This was obviously not the case here.) x

How do we work with those partial probability changes? Let me make up a new example. Let's say the market was worth $200, and you knew that Republicans would transfer $100 to corporate America that Democrats would not. However, the day before the election, the market believed that Democrats would win with 98% probability. In this case, you would see the corporate sector be valued by investors at $98\% \cdot \$200 + 2\% \cdot \$300 = \$202$ just before the election. If the Democrats win, the market would be worth $200 after the election. It is not this $2 difference that is of interest to you, but the $100 difference number that you want to learn about.

How can you infer the full $100 effect if all you see is the $2 change? You need to divide the stock value change of $2 by the change in probability from 2% to 0%:

$$\$100 = \frac{\$2}{2\% - 0\%}$$

$$\text{Full Value if Event Takes Place versus Event Does Not Take Place} = \frac{\text{Value if Probability is 2\%} - \text{Value if Probability is 0\%}}{\text{Probability 2\%} - \text{Probability 0\%}}$$

We need to use this insight to assess the full effect of the Democratic victory in the 2006 election. Let's assume that the important event was the joint loss of the House and Senate to the Democrats. Define the following event:

Event	Pre-Election	Post-Election	Change
Democrats win House and Senate	34%	82%	48%

Then apply the formula. The full corporate value loss to S&P 500 companies that was caused by the Democratic takeover of House and Senate was

$$\text{Full Value if Democrats Win Both Chambers versus They Do Not Win Both Chambers} = \frac{35bp}{82\% - 34\%} \approx 73bp$$

Not surprisingly, with a probability change of about 50%, any value change just about doubles—here the 35-bp drop becomes 73 bp. Thus, if this probability change from 34% to 82% for a full Democratic victory was the value-relevant overnight event, then you can conclude that the full effect of the Democratic victory over the Republicans cost the corporate sector around $73\,\text{bp} \cdot \$12.6\text{trillion} \approx \$92$ billion. Interestingly, if you repeat the same exercise for oil and gas firms and for health care firms, you will find that oil and gas companies were not affected by the electoral change, but health care plans, drugs, and hospital chains dropped significantly. The market considered the Democrats' claims that they would take on oil and gas as empty posturing (or preventable by the Republican administration), but believed the Democrats' platform claims about health care reform.

Important Event Study Limitations

Event studies are not without drawbacks. There are usually three important problems that you have to deal with.

x

Event importance: Event studies work well only if the event is significant enough to influence the overall stock market valuation: If a $1 billion stock fluctuates on average by $10 million a day, it is practically impossible to use an event study to determine the value of a project worth $100,000. To use our physics analogy, the noise would drown out the signal. A reasonable rule of thumb is to take the ratio of the typical daily stock market value fluctuation (here, $10 million) divided by the order of magnitude of the value consequence (here, $100,000, so the ratio is $10,000,000/$100,000 = 100), and then require 50 times as many event observations (firms) as this ratio. For the example, this would require 5,000 event observations—which is likely too many to make such a study feasible for all but the most frequent events.

In our November election event study, we knew we had a potentially important value-relevant event, especially for oil and gas and health care companies.

x

Event anticipation: Event studies rely on the fact that stock markets react only to news—that is, the unanticipated component of an information release. There must be a clear event date. But many events are anticipated, announced over a period of time, or never formally announced. For example, if a company was expected with 80% probability to win a contract worth $1,000,000, the stock price would have already reflected $800,000. The news that the company actually won the contract would raise the stock price by only $200,000, not by $1,000,000. The news that the company would not have won the contract would drop the stock price by $800,000, however. Isolating market expectations can be very difficult. More than likely, the analyst would not know after the fact how expected the event was by the market at the time. (And, worse: Insider trading before the event may have already moved the stock price to the $1,000,000 before the public announcement.) Therefore, in many cases, the event study technique is better at helping to determine whether an event is good or bad for a company than it is in helping to compute an exact value gain.

I selected this particular election event study, because we knew both the prior probability and the posterior probability. This allowed us to compute the full-value effect of the election. Usually, we are not so lucky, which means it is much more difficult to translate stock price reactions into exact

value figures. If you do not know the ex-ante probabilities, you can assume how anticipated an event was, or try to estimate an ex-ante probability from the data, or merely use the event study technique to determine whether an event is beneficial or detrimental.

x

Simultaneous events (contamination): The event study technique relies on the fact that the event can be precisely isolated from other events. If other events occur in the same time window, any value consequence may stem from these other events, and not from the event that is being examined. Unfortunately, many events occur at the same time. For example, at annual shareholders' meetings, there are often simultaneous announcements of dividend changes, corporate charter changes, institutional votes, information about successions, tough questions from shareholders, and so on. There is always the danger that what a study may attribute to dividend changes is due really to simultaneous announcements of, say, a corporate charter change instead. You can only hope that the content in these other simultaneous value events is nonsystematic, so that it only adds noise that will average out over many different firms.

In our November election event study, we knew that the election was the dominant event of the night. Few other value-relevant news stories came out.

x

In sum, event studies can be very powerful tools to measure the value effects of many changes. The usual problems of finding appropriate expected rates of return (or trusting the CAPM) matter little when it comes to 1- to 3-day events, because the average CAPM return is only around 5 basis points for a stock per day. Whether the true expected rate of return is closer to 4 or to 6 basis points is really irrelevant. Such small differences in mean expected returns are hopefully small compared with the signal that you expect from the event.

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question
Is the average value change on the announcement date a good measure of the average value consequence of an event?

answer
No. The average value change on the announcement date is only a good measure of the unexpected average value consequence of an event.

question
Are event studies better suited to events that occur on the same day for all companies, or better suited to events that occur on a different day for every single company?

answer

Event studies are better suited to studying events that occur on different days for different companies. This reduces the probability of "event contamination." For example, let's presume that you are interested in the effect of a low inflation announcement on September 12, 2005. Your evidence shows that stock prices went up on this day. Therefore, you might be tempted to conclude that the inflation announcement had a positive stock price influence. However, this overlooks an important problem. On this day, a million other things may have happened: the President coughed, the Congress squabbled, the Fed grumbled, the FDA changed its mind on genetic engineering, investors grew colder on mining stocks and hotter on game stocks, OPEC met, the Europeans demonstrated against U.S. policy, and so on. Are you really sure that it was the inflation announcement that made stocks go up and none of the other events? In contrast, if the event day is different for every firm, sometimes these other events will positively influence the market, sometimes negatively. Net in net, this other-events contamination is more likely different on different days and thus it will more likely wash out. Of course, if your event is on different days but still always on firms' annual meetings, then you have the different problem that there could be a lot of other value-relevant news that is being disclosed simultaneously. In this case, you are likely to have more noise, uncertainty, and contamination to deal with than in the case where event days occurred randomly for different firms.

question

How sensitive are event study results to the use of the CAPM?

answer

The CAPM is practically irrelevant. Over a 1-, 2-, or 3-day window, the expected rate of return does not matter much.

question

What are the factors that make an event study more likely to be informative?

answer

An event study is likely to be more informative if the value impact of the event is big and unanticipated, and if you can study many companies that have had such events in the past.

EOC MATTER

eocproblems

question

At http://biz.yahoo.com/p/510mktd.html, Yahoo!Finance classifies "Drug Manufacturers—Major." Compute the average rate of return of 10 of these firms from the day before to the day after the 2006 election (November 7, 2006). How were your 10 stocks influenced by the Democratic election win?

answer

Results will vary depending on drug companies chosen. However, based on the first ten "Drug Manufacturers–Major" that had available historical prices, the average rate of return was computed from the 10 rates of return based on the following formula:

$$\text{Rate of Return} = (\text{Closing Price}_{\text{November 8}}/\text{Opening Price}_{\text{November 6}}) - 1$$

The drug manufacturers' stock appear to be slightly negatively influeced by the Democratic election victory.

question

Which of the following are good candidates for ascertaining the value effects with an event study, and why?

1. An acquirer wants to buy the firm.
2. The CEO dies.
3. The CEO ages.
4. Positive earnings surprise at the annual meetings.
5. Purchase of a new machine.
6. A law is passed to force the company to reduce its emissions.
7. An ad campaign.

answer

1. An acquirer wants to buy the firm: Super. Usually unannounced and big event.
2. The CEO dies: Maybe. Depends on suddenness (anticipation) and replace-ability of CEO.
3. The CEO ages: Bad. No sudden information release. Value effect not big enough.
4. Positive earnings surprise at the annual meetings: Maybe. Problem is many other things may happen at the same time.

5. Purchase of a new machine: Probably Bad. Problem is that one machine is usually too small to make a big value difference.
6. A law is passed to force the company to reduce its emissions: Maybe. The value consequences could be large enough, but by the time the law passes, it has long since been anticipated.
7. An ad campaign: Bad. First, there is no unique date on which to pin down the information release, and the value effects are often not too overwhelming, either.

question

Use a financial website to conduct an event study of big corporate acquisitions over the last 12 months. How did their announcements impact the value of the acquirer and the value of the target? Was there a relationship between the announcement response and acquirer/target size?

answer

Results will vary.

Chapter 12

Capital Budgeting Applications and Pitfalls

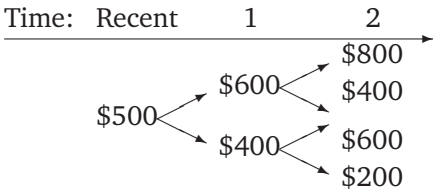
x

This appendix demonstrates how to work out the value of different types of [pl]real option. By assuming the world is risk neutral, the appendix ignores the fact that discount rates can be higher when there are more real options. (Depending on the context, not fretting too much about the correct discount rate can be forgivable or deadly.) Real options are tough enough to value even without this added complication. This is not an easy appendix!

A.12.A Decision Trees: One Set of Parameters

x

Assume that you own a firm that can produce 150,000 units of a good at a cost of $100/unit. The retail price of your good was $500/unit recently, but you now expect it to go up or down by $100/unit this year, that is, either to $400/unit or $600/unit. The year thereafter, you expect it to go up or down by $200/unit. These price scenarios can be shown in a simple tree:



All price changes are equally likely. The fixed costs of running the plant are $50 million, and rent (regardless of whether you run the plant or not) is $10 million. x

The world is risk neutral and the prevailing interest rate is 10% per year, which applies to this coming year's cash flows and which will be twice compounded when applied to the following year's cash flows. Moreover, assume that you know at the beginning of each year what the price over the whole year will be, because you receive customer orders at this point. (To model intrayear uncertainty more realistically, you would have to deal with more periods—not any more difficult in concept but much more tedious.)

As an example, compute the firm value if you know that the price will go to \$600/unit and then to \$400/unit, and if you know that you will operate the plant this year but not the following year. The first year, you would earn revenues of 150,000 units $\cdot$ (\$600/$unit$ − \$100/$unit$) = \$75 million, pay fixed costs of \$50 million, and rent of \$10 million. Your net profits would be \$15 million, which discounts to \$13.64 million at 10% if you use the present value formula. The second year, you would earn no revenues and pay no fixed costs, but you would still pay rent of \$10 million. This discounts to $\$10/1.1^2 \approx \$8.26$ million. In sum, under this price path and with this operating policy, your firm would have an NPV of \$13.64 − \$8.26 = \$5.38 million.

Let's take the same project and consider its value in a number of scenarios, which differ in the assumption of what you know and how you can respond to the prevailing environment. All real options are ultimately value to **flexibility**:

No flexibility—all choices made up front: First, let's compute the value under inflexible behavior. This is one extreme benchmark. What is the value if you have to make your decision today of whether to operate or not in all future scenarios? That is, the firm would either have to operate or not operate in both future periods with the \$600/unit and \$400/unit scenarios.

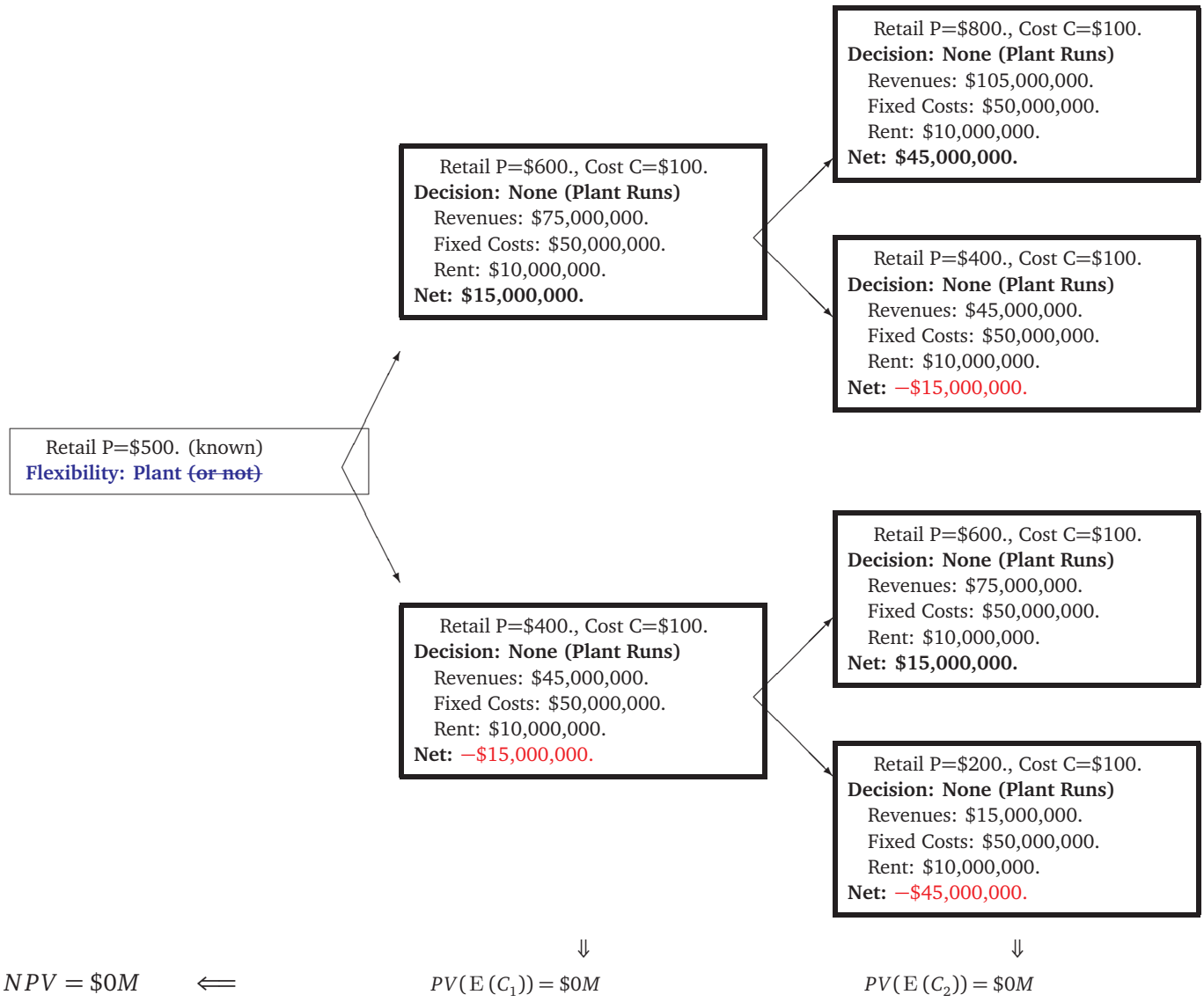
- If you do not start the plant, you would simply value the firm at \$0.
- If you do start the plant, then you must make the calculations that the tree in Figure 12.1 shows. If the price increases to \$600, you earn \$75 − \$50 − \$10 = \$15 million. If it decreases to \$400, you earn \$45 − \$10 − \$50 = −\$15 million. Therefore, your expected revenues are \$0. The following year, you earn +\$45 million, −\$15 million, +\$15 million, or −\$45 million. This again comes to an expected \$0.

In this example, it really does not matter whether you start the plant or not—your firm value is always \$0.

Importantly, this \$0 is also the value if you work with expected outcomes instead of the tree. The expected price in both future years is \$500/unit. At the expected price, your \$100/unit production cost translates into expected

Figure 12.1: Value Under No Flexibility—Always Operate the Plant

—Always work a decision tree from the right (final period) to the left (first period).



revenues of $60 million. You would still have to pay for rent and fixed costs, at $60 million per year. Indeed, working with expected values is the same as assuming that you do not have the ability to make strategic choices in the future (discussed next)—a common source of underestimated project values in practice.

All real options—the fully flexible choice: Now assume the opposite extreme benchmark: You know each year what the price is and you have perfect flexibility to shut down and reopen the plant in response to market conditions. This option is called the "timing option." Here, if the retail price is above $500/unit, you would operate. For example, if the retail price is $600/unit, your marginal revenues are $150,000·($600/$unit$−$100/$unit$)− $50,000,000 = $25,000,000. Subtract $10 million in sunk rent cost, and you end up with revenues of $15 million. If the retail price is $400/unit, you earn $45 million, which is not enough to cover the $50 million fixed operating costs, so you are better off not operating and just paying the rent of $10 million.

x

Figure 12.2 shows your valuation and optimal decision tree now. Again, the figure highlights important flexibility-related choices in blue. The heavy boxes indicate that you operate the plant; the other boxes indicate that you do not. You earn +$15 million or −$10 million in the first year. The expected value is $2.5 million, which discounts to $2.3 million (indicated at the bottom of the figure). The final year, you earn +$45 million, −$10 million, +$15 million, or −$10 million, which is an expected value of $10 million and a discounted value of $8.3 million. Therefore, this firm is worth about +$10.5 million.

The value to having knowledge and the flexibility to act on it (knowledge without flexibility is useless!) has transformed this firm from a nothing into a gem. It is this value-through-flexibility that your "strategic option to respond" has created. Put differently, the value of your real option is +$10.5 million.

The option to delay choice: Often, you do not have full flexibility. Instead, you have some real options, but not perfect flexibility. For example, what would happen if you had the option to delay your decision by 1 year, more specifically, to run the plant only if the price appreciates to $600/unit, but not if it depreciates to $400/unit? If you run the plant next year, you have to run it the following year. If you do not run the plant next year, you cannot run it the following year, either.

Figure 12.2: Value Under Perfect Flexibility—Full Knowledge and Choice

—Always work a decision tree from the right (final period) to the left (first period).

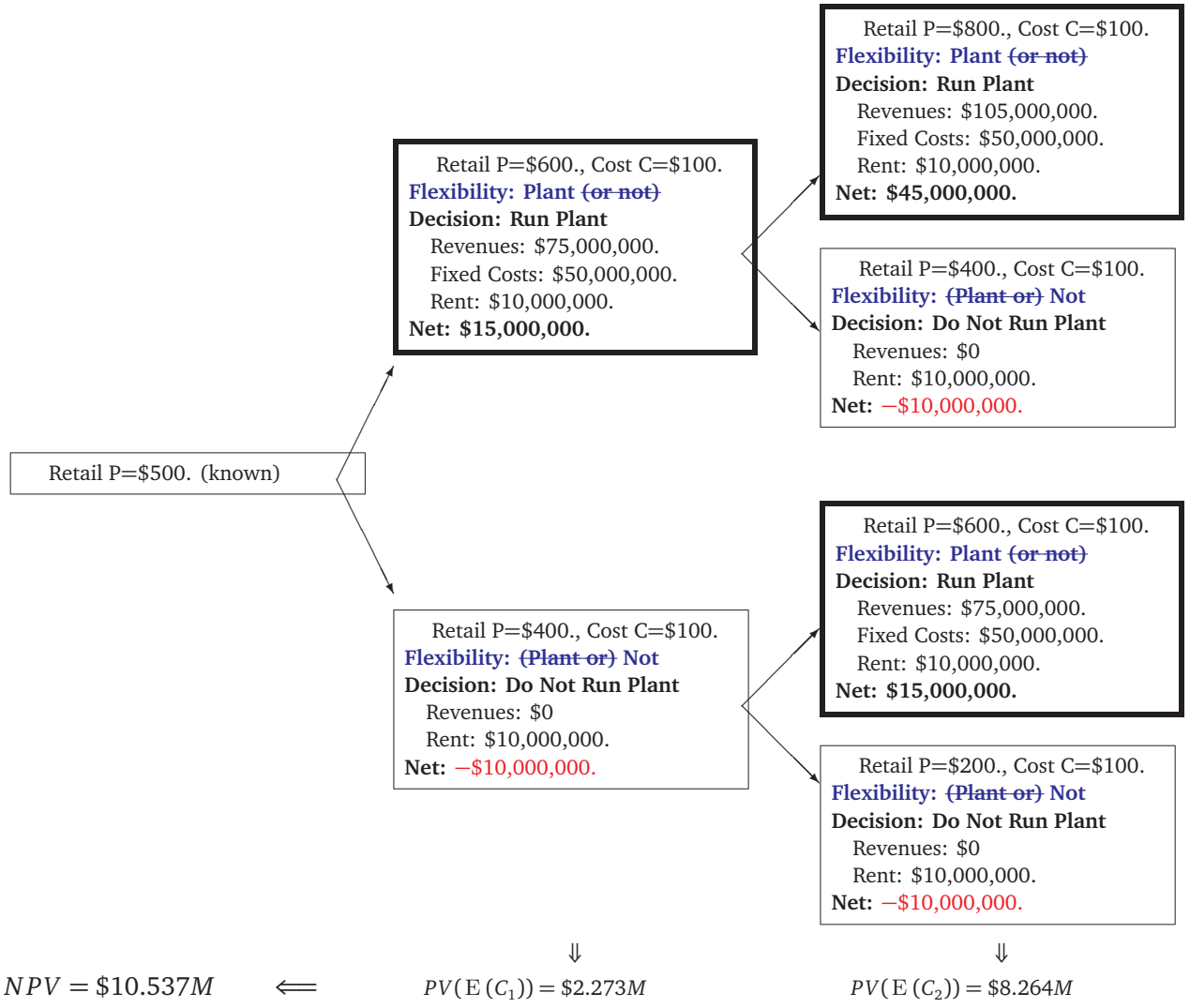


Figure 12.3 shows your revised decision tree. The average outcome is \$5 million divided by 2 in the first year, and \$10 million divided by 4 in the second year. Discount the first by 10% and the second by 21%, and you find the net of $\$2.5/1.1 + \$2.5/1.1^2 \approx \$4.3$ million. You can come to the same \$4.3 million solution by following your decisions in time:

- If the retail price increases to \$600/unit, your best decision is to operate the plant. You will earn \$15 million in the first year, and either gain \$45 million or lose \$15 million the second year. Your net is $\$15/1.10 \approx$ \$13.6 million plus $(0.5 \cdot \$45 + 0.5 \cdot [-\$15])/1.10^2 \approx \$12.4$ million. The total is \$26 million in expected present value.
- If the retail price falls to \$400, you commit to shuttering the plant. Your net is a sure loss of \$10 million in each of the 2 years. In present value, this is −\$9.1 million followed by −\$8.3 million. Your total is a loss of \$17.4 million in expected present value.

Both price paths are equally likely, so the plant is worth about $0.5 \cdot (-\$17.4) + 0.5 \cdot \$26 \approx \$4.3$ million.

Intuitively, the reason why a plant with this more limited real option does not reach +\$10.5 million under the full flexibility real option is that you would still have to operate the plant in the final period if the price is \$400/unit (which you would rather not do), and you would fail to run the plant in the final period if the price is \$600/unit (which you would rather do).

The option to start later: An alternative scenario would allow you to start the plant anytime you wish, but once you start the plant, you cannot stop it. Figure 12.4 shows the tree for this scenario—the plant value now comes to +\$9.5 million. This is more than you get from the option to delay in this scenario, because there is one node (where the price hits \$600/unit) where you now could make money where previously you had to have already committed yourself not to operate. (The relevant box that is different is the one with the red box.) But this is less than what you get under perfect flexibility, because you are still robbed of the option to shut down if the retail price is \$400/unit in the final period.

The option to stop later: Yet another alternative scenario would force you to keep a once-closed plant stopped. That is, you cannot restart a plant once you have shut the burners off and allowed your skilled workers to leave. This is called the "abandonment option."

Figure 12.3: Value to 1-Year-Ahead Information (or Ability to Delay Choice until Year 1)

—Always work a decision tree from the right (final period) to the left (first period).

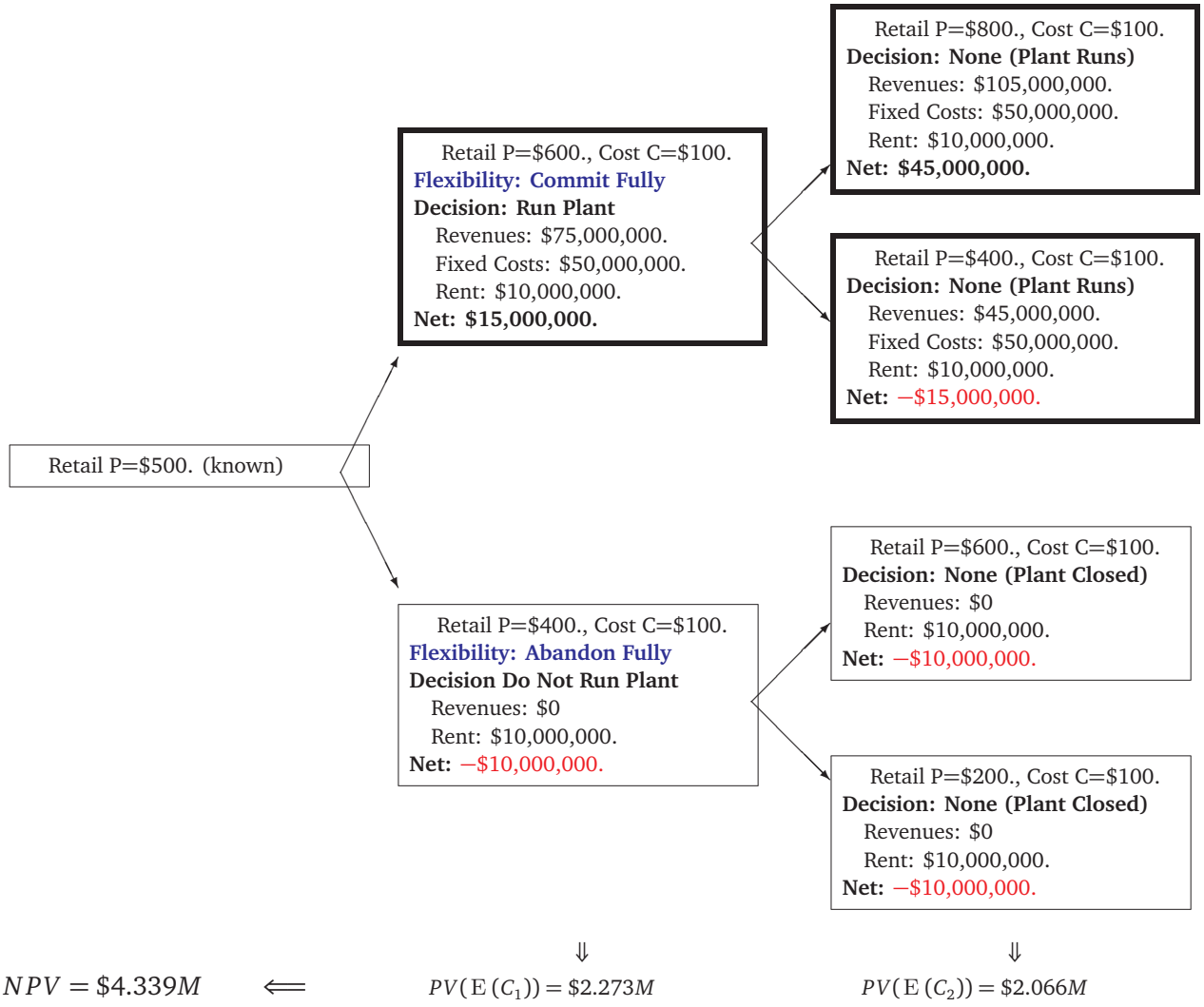
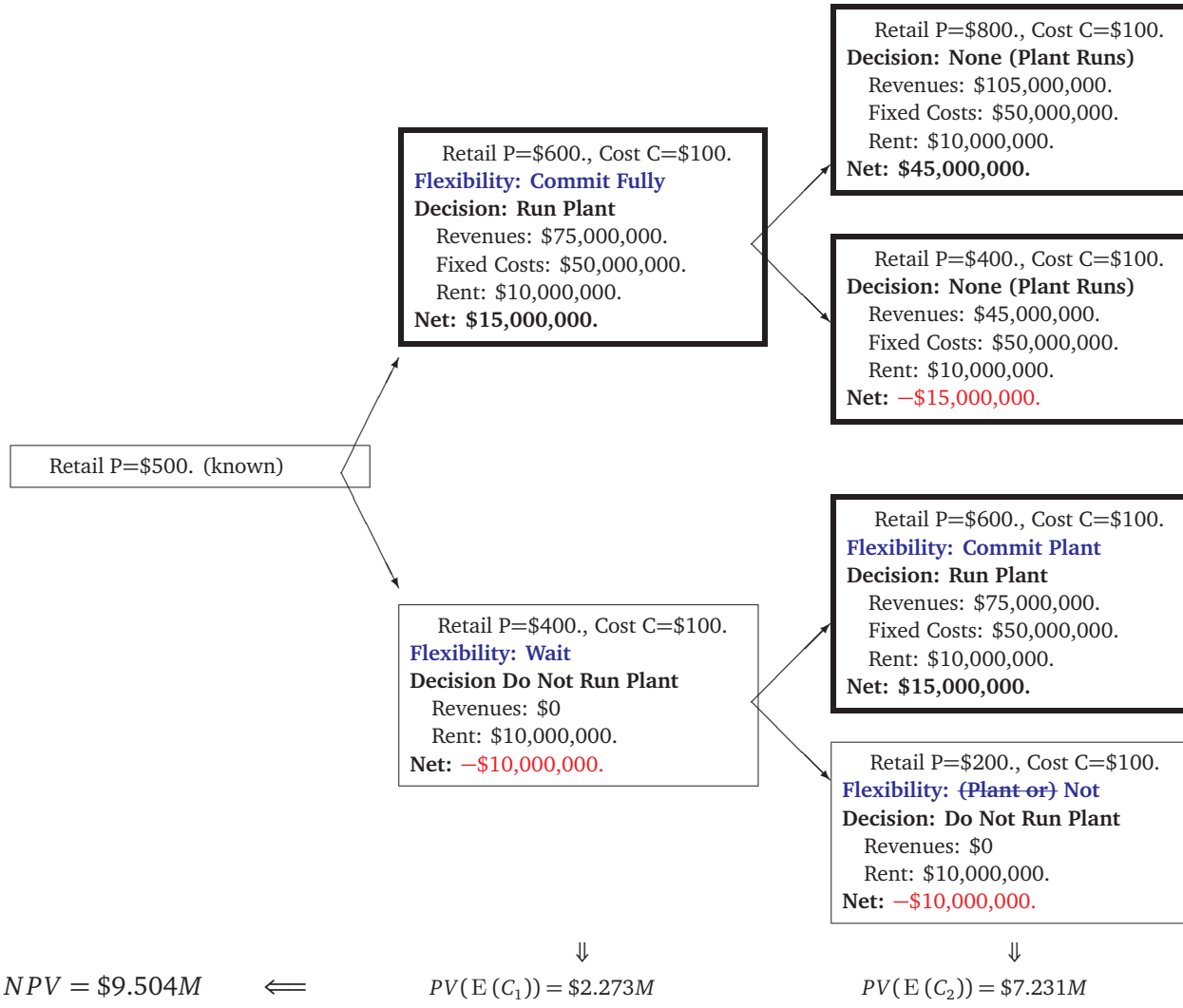


Figure 12.4: Value to Flexible Plant Starting (But Not Stopping)

—Always work a decision tree from the right (final period) to the left (first period).



This case also illustrates that decision trees can become complex. If the price falls to $400/unit at first, should you run the plant or not? If you do not run the plant, you save money but you lose the real option to operate if the price then appreciates to $600/unit. Actually, you have no choice but to compute the best value both ways. Figure 12.5 and Figure 12.6 show the two decision trees. If you close the plant, your firm would be worth $5.4 million (Figure 12.5). If you keep the plant open—eating a loss of $15 million rather than just $10 million that first year—your firm would be worth $8.3M, because you keep the real option to operate if the retail price were to increase again to $600/unit. Therefore, keeping the plant open is the better strategy. x

Solving such trees is a difficult problem, because your optimal strategy next year does not just depend on that year but also on future years. In fact, in our previous examples, I have cheated in making it easy for you: I had told you the strategy at each node. Real option problems are difficult to value, precisely because your optimal strategy at any node can depend both on the current state of your firm and on all future possible scenarios.

The web chapter on real options explains how you can solve such problems more systematically. Decisions are often worked out "backwards": You start with the final year and work your way toward today. Another important tool is the aforementioned scenario analysis, which simply means trying out different input values—some more pessimistic—to see how they impact the estimated value of a project. (Scenario analysis and sensitivity analysis are very similar. The former is sometimes used as the name if more than one input value is changed; the latter if only one input value is changed.) Finally, also explained in the web chapter, there is a form of automated scenario analysis (called Monte Carlo simulation), in which you can specify a whole range of possible future scenarios. The spreadsheet itself can then compute the expected outcomes in many different scenarios using different decision-making strategies that you would specify.

A.12.B Projects with Different Parameters

x

This example was a little artificial, because it kept the same parameters throughout. This symmetry made it easy to explain and compare options. More commonly, the parameters themselves will change and determine the extent of your flexibility (and thus the value of your real option). This is best explained by example.

Fixed versus flexible technology choice: Let's assume that you have a factory

Figure 12.5: Value to Flexible Plant Stopping (But Not Starting)—Strategy 1: Close at $400

—Always work a decision tree from the right (final period) to the left (first period).

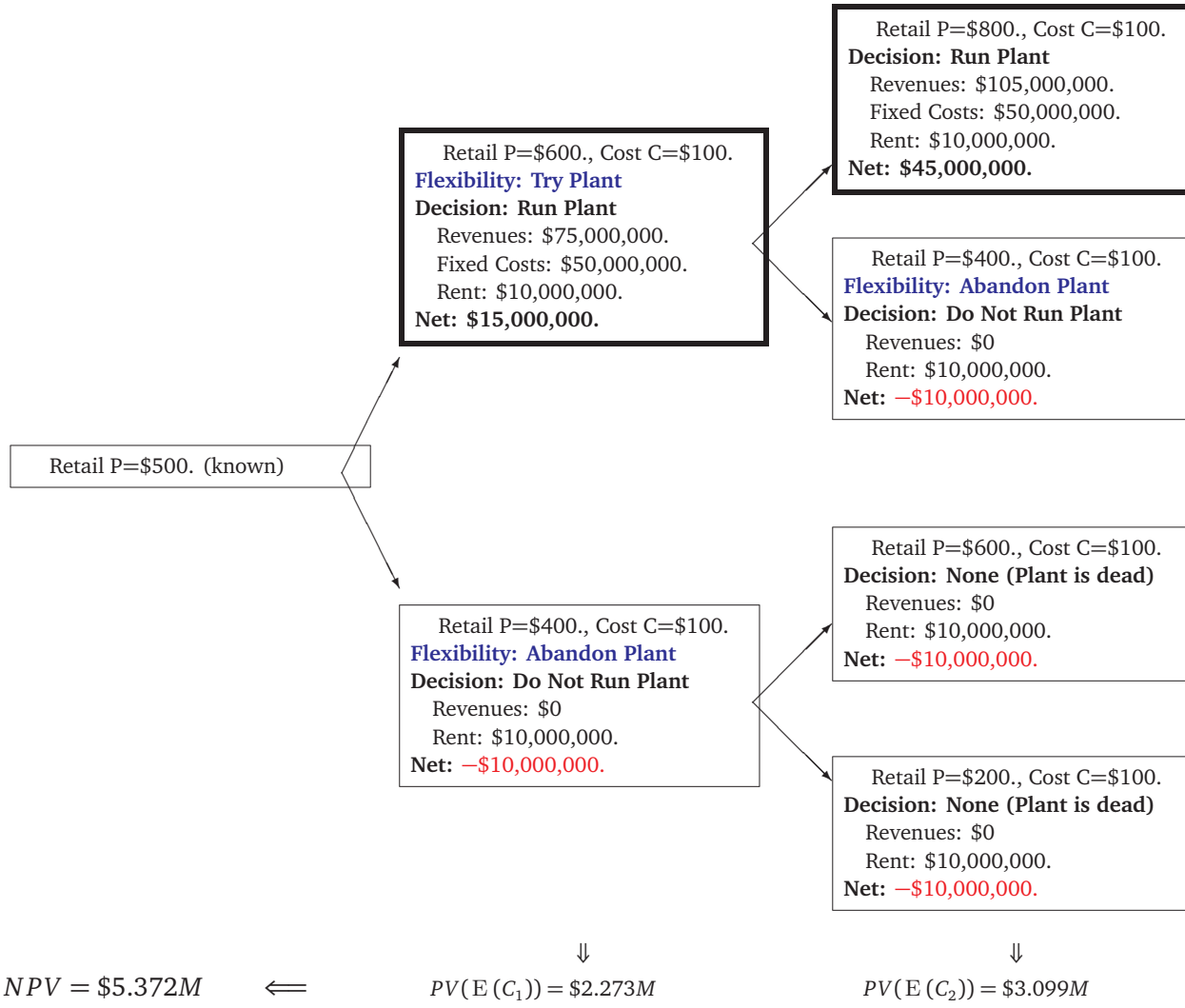
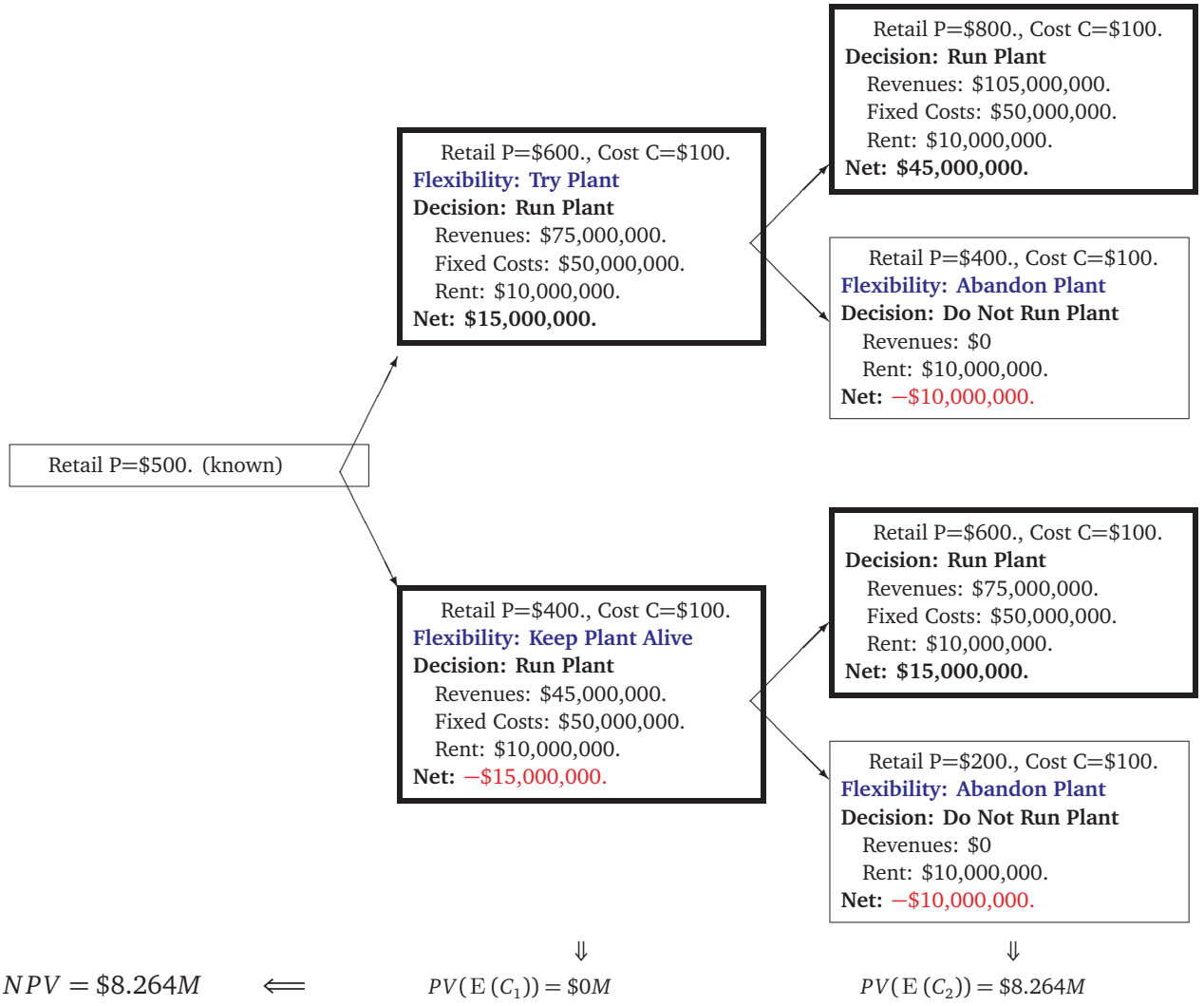


Figure 12.6: Value to Flexible Plant Stopping (But Not Starting)—Strategy 2: Run at $400

—Always work a decision tree from the right (final period) to the left (first period).



with a fully flexible technology, as illustrated in Figure 12.2. I am now offering you an alternative technology, which eliminates your fixed operating costs of $50 million per year but requires a one-time upfront $80 million investment. (You are installing robots that will replace expensive manpower.) At first blush, this seems like a great idea—you no longer have to spend $100 million, which discounts to $\$50/1.1 + \$50/1.1^2 \approx \$86.777$ million today. But is this really a savings of $6.777 million for you? No. It ignores the real option of flexibility that human workers have over robots: They can be hired and fired. Once purchased, robots cannot be laid off depending on demand. Figure 12.7 shows that with the robots you would have, you end up with $6.777 million, rather than $10.537 million. Robots, therefore, are not a great idea. Incidentally, it is often suggested that the value of smart employees is not their initial or even expected value, but the fact that smart people have the flexibility to attack novel problems for which they are not initially hired. Think about it—your value may be primarily that of a real option!

Adding plant capacity: Another interesting real option is the option to expand. You can view this as the choice to build currently unused capacity.

For example, say you can choose between two options:

- Your current fully flexible production technology that allows you to produce 150,000 units at $100/unit (as in Figure 12.2).
- Another production technology that builds the following extra capacity: You can still produce 150,000 units at $100/unit, but you can also double your production with 300,000 units at a cost of $200/unit, though with higher machine costs of $100,000.

Note that doubling increases the cost of all goods, not just the cost of the extra 150,000 units. It would cost you $60 million in variable production costs rather than just $15 million, and $100 million in fixed costs rather than just $50 million—that is, almost $95 million more if you ever wanted to use such extra capacity! Would you be willing to pay $3 million to upgrade your plant to such a technology?

Figure 12.8 shows you the firm value with the option to expand. If the retail price hits its all-time high of $800/unit, the unused capacity is worth a tremendous amount. Therefore, the value of the firm increases to $15.7 million from your earlier optimal value of $10.5 million, easily enough to justify a $3 million expenditure.

Figure 12.7: Value of a One-Time $80 Million Fixed-Cost Technology with Different Parameters (no more fixed costs per period, but a one-time upfront expense)

—Note that the present value is $86.777M, while the NPV is $6.77M.

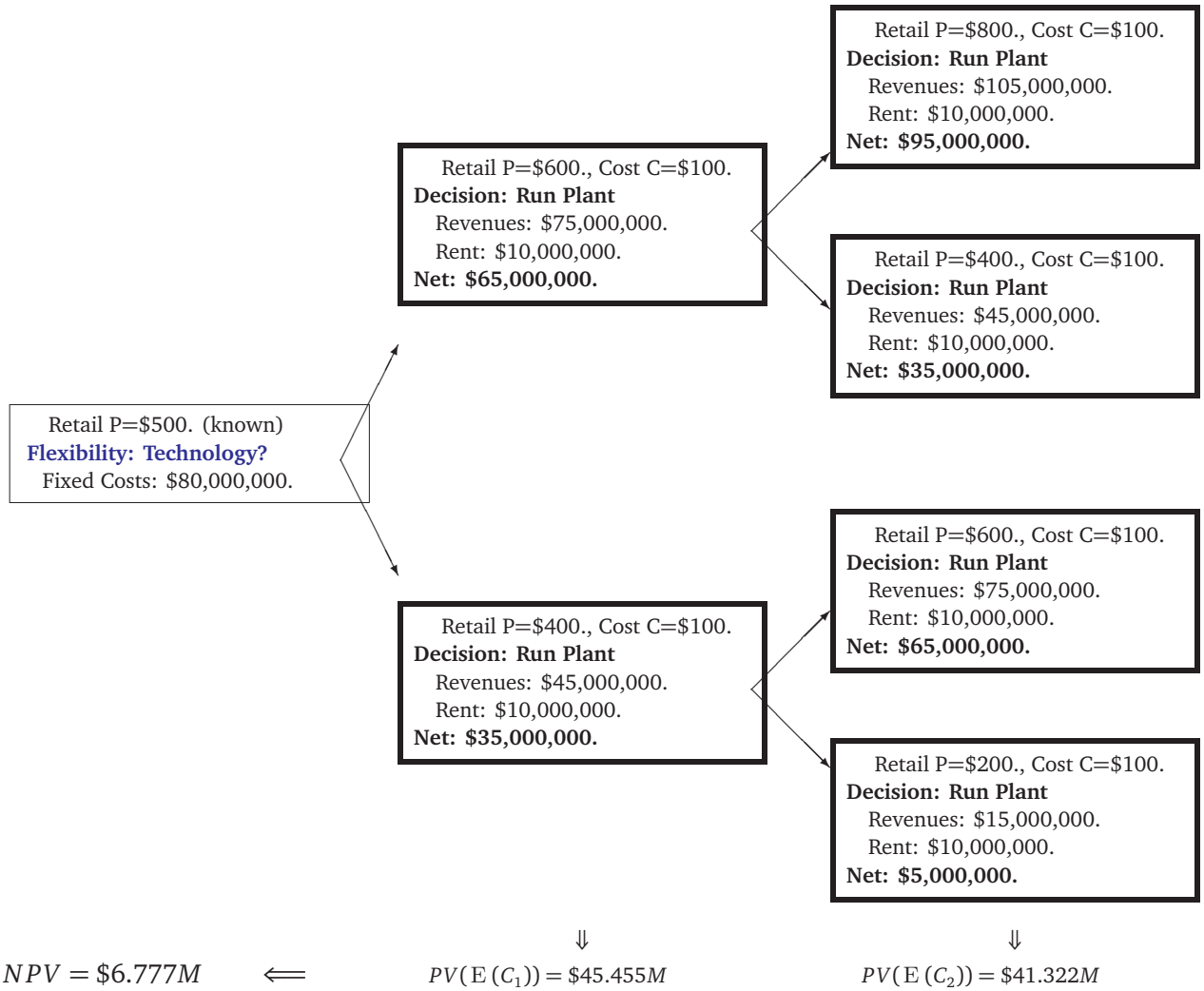
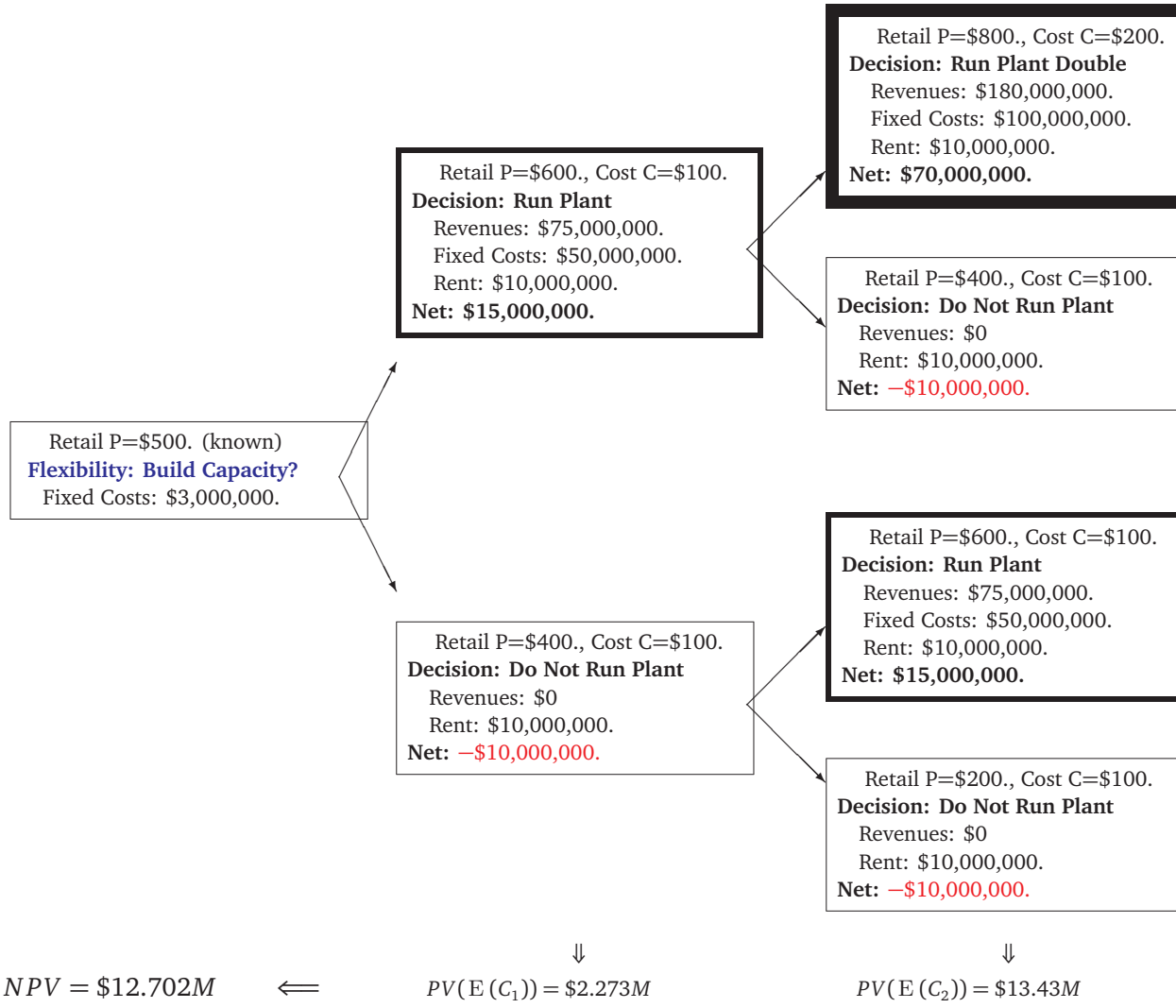


Figure 12.8: Value of an Expansion Technology with Different Parameters (relative to Figure 12.3)

—Note that the present value is \$15.703M, while the NPV is \$12.703M.



question

A business produces 100,000 gadgets that cost $1 each to produce and sell for $1.80 each (last year and just now). To produce another 100,000 gadgets requires running the machine at night, which increases production costs from $1 to $2. The business can last for up to 2 years (but think about how you would solve this for 5 years). In every year, with 10% probability, the output price doubles; with 10% probability, the output price halves; and with 80% probability, the price stays the same as in the previous year. Shutting down the factory for 1 year costs $9,000. Reopening it costs $10,000. The cost of capital is a constant 5% per year. What is the value of this factory? (This is a difficult problem, but unfortunately not an unrealistic one.)

answer

Tree problems like this one need to be solved "backwards." You can start in year 2 with a prevailing price of $0.45, $0.90, $1.80, $3.60, or $7.20, and your factory can be either open or closed. In this final period:

- If the price is $0.90 or lower, you definitely want to close the factory, because a $9,000 loss is better than a $10,000 loss. If the factory is already closed, lucky you.
- If the price is $1.80 or higher, you definitely want the factory to be open, because an $80,000 profit fortunately outweighs all opening and closing costs. If the factory is already open, lucky you.

Now consider what to do in year 1. If the price drops to $0.90, you have a decision to make: Operate the factory for a year, hoping that the future will be better, or close the factory. Operating losses would be $10,000. Closing immediately would cost only $9,000. If you operate today, you incur an extra $1,000 loss. In exchange, there is a 10% chance that the price will go back up, in which case you got lucky. In this case, you will have saved $10,000 in reopening costs. Thus, you are exactly indifferent between closing and operating if the price has dropped. (Of course, if the price is higher today, operating today is the correct choice.) The problem of determining optimal choices as a function of environmental variables can get incredibly complex very easily. Scenario analysis (or just plain real-world experience and intuition) is really the only analysis method. This goes beyond the scope of an introductory textbook.

EOC MATTER

eocproblems

question

You own a plant that has $90 of production costs. To close an open plant costs $0. To open a closed plant costs $0. The production can be sold for $100 in year 0 (now). Next year, the selling value will be either 25% higher or 20% lower. (This is called a recombining tree, which makes computations easier. You will see what I mean.) These two cases happen with equal probability. For simplicity, assume a zero cost of capital, so dollars next year are just as valuable as dollars this year.

1. What is the present value of this plant if it exists for 3 years?
2. What is the present value of this plant if it exists for 4 years?
3. What is the present value of this plant if it exists for 5 years?

Change the following two parameters: To close an open plant costs $5. To open a closed plant costs $20. (Hint: I want you to learn how the decisions in such trees can become more difficult when the plant can be in different states at each node. Therefore, consider putting each of the following phrases at each decision node: "if I come in already operating the plant, then…," and "if I come in with a closed plant, then…." Consider working the tree backward.)

4. What is the present value of this plant if it exists for 3 years?
5. What is the present value of this plant if it exists for 4 years?
6. What is the present value of this plant if it exists for 5 years?

Note: This is a long question—and questions like it can easily become even more difficult. For example, it could be that the costs of closing or opening itself depend on what you did in the previous periods or what the price was in the previous period.

answer

See File

Chapter 13

From Financial Statements to Economic Cash F

A.13.A Supplementary Financials—Coca-Cola

The following two pages contain the financials for Coca-Cola from 1999 – 2001—the same three years that we are using in this chapter to analyze PepsiCo. Note that all of the financials in this chapter are a little dated. In Chapter 20, we will produce a pro-forma projection, which we can then begin in 2002. Because it is 2008 as I am writing this, we can then in turn compare our predicted pro-forma performance against actual outcomes. Are you missing anything important because the financials are dated? The answer is no, because their format has not changed at all since 2002. Everything you can learn from analyzing 2001 financials remains applicable as of 2008.

Now, in this appendix, I am showing you two versions of Coca-Cola's financials: a restated version in Table 13.11 and an original version in Table 13.12. When firms undergo dramatic changes, such as when they acquire another firm, it becomes impossible to compare the current financials to previous financials. You could learn very little if Coca-Cola reported $20 billion in sales in 2001, purchased PepsiCo in 2002, and reported $50 billion in sales in 2002. Did sales increase or decrease for the combined PepsiCo-Coca-Cola from 2001 and 2002? (In this case, you could piece it together yourself, but if the acquired company had been private, you could not.) To provide investors with this information, Coca-Cola would also report in 2002 what its sales would have been if PepsiCo had already been a part of it in 2001. This would be called "2001 (restated)." Of course, only the original, unrestated information would truly have been known by an investor in December 2001—unless this investor would have known in advance that Coca-Cola would purchase PepsiCo.

As far as the Coca-Cola in 2001 was concerned, it seems to have divested some

assets during fiscal year 2001. It originally reported sales of $20,458 million for 2000, but later restated them to $19,889 million. If you want to learn more about what other firms Coca-Cola sold or purchased, you would have to read the entire financials.

Table 13.1: CocaCola 's Financials from EdgarScan, Restated (Quoted in Million Dollars)

—Restated numbers alter past financials to reflect the composition of a firm as if its main divisions were the same in the past as they are today. Therefore, when a large division is sold, its contribution to past financials is removed; and when another firm is acquired, its contribution to past financials is merged as if the two firms had always been joined. The next table shows the original financials for comparison.

	Income Statement	**December**		
		2001	**2000**	**1999**
=	**Revenues**	20,092	19,889	19,284
	COGS	6,044	6,204	6,009
	+ SG&A (incl. Depreciation)	8,696	8,551	8,480
	+ Other Expenses	0	1,443	813
–	= **Total Operating Expenses**	14,740	16,198	15,302
=	**Operating Income**	5,352	3,691	3,982
	+ Other Net Income	607	155	174
=	**EBIT**	5,959	3,846	4,156
+	Interest Expense	289	447	337
=	**Income before Tax**	5,670	3,399	3,819
–	Income Tax	1,691	1,222	1,388
=	**Income after Tax**	3,979	2,177	2,431
–	Extraordinary Items	10	0	0
=	**Net Income**	3,969	2,177	2,431

	Cash Flow Statement	**December**		
		2001	**2000**	**1999**
	Net Income	3,969	2,177	2,431
+	Depreciation and Depletion	803	773	792
+	Deferred Taxes	56	3	97
+	Noncash Items	−256	1,484	1,120
+	Changes in Working Capital	−462	−852	−557
=	**Total Operating Activity**	4,110	3,585	3,883
	Capital Expenditures	−769	−733	−1,069
+	Investments	−1	−218	−342
+	Other Investing	−418	−214	−2,010
=	**Total Investing Activity**	−1,188	−1,165	−3,421
	Dividends	−1,791	−1,685	−1,580
+	Net Issuance of Stock	−113	−198	−153
+	Net Issuance of Debt	−926	−585	+956
=	**Total Financing Activity**	−2,830	−2,072	−471
–	Foreign Exchange Effects	−45	−140	−28
=	**Net Change in Cash**	47	208	−37

Table 13.2: CocaCola Financial Statements from Yahoo!Finance, Not Restated (Quoted in Million Dollars)

—

	Income Statement	**December 2001**	**2000**	**1999**
=	Revenues	20,092	20,458	19,805
	COGS	6,044	6,204	6,009
	+ SG&A	8,696	10,563	9,814
	+ Depreciation and Amortization			
	+ Unusual Expenses			
–	= **Total Operating Expenses**			
=	**Operating Income**	5,352	3,691	3,982
	+ Other Net Income	607	155	174
=	**EBIT**	5,959	3,846	4,156
–	Interest Expense	289	447	337
=	**Income before Tax**	5,670	3,399	3,819
–	Income Tax	1,691	1,222	1,388
=	**Income after Tax**	3,979	2,177	2,431
–	Extraordinary Items	10	0	0
=	**Net Income**	3,969	2,177	2,431

	Cash Flow Statement	**December 2001**	**2000**	**1999**
	Net Income	3,969	773	792
+	Depreciation and Depletion	803	773	792
+	Deferred Taxes			
+	Non-Cash Items			
+	Changes in Working Capital			
=	**Total Operating Activity**	4,110	3,585	3,883
	Capital Expenditures	−769	−733	−1,069
+	Investments	−1	−218	−518
+	Other Investing	−418	−214	−1,834
=	**Total Investing Activity**	−1,188	−1,165	−3,421
	Financing Cash Flow Items			
+	Dividends	−1,791	−1,685	−1,580
+	Net Issuance of Stock	−113	−198	−153
+	Net Issuance of Debt	−926	−585	+956
=	**Total Financing Activity**	−2,830	−2,072	−471
–	Foreign Exchange Effects	−45	−140	−28
=	**Net Change in Cash**	47	208	−37

Chapter 16

Capital Structure in a Perfect Market

A.16.A The CAPM, WACC, and NPV—A Seamless Fit

x

Are you scratching your head? How can this all fit together so seamlessly? How can the expected rate of return on equity have been tied down by the expected rate of return on the projects and the expected rate of return on the debt? Should the expected rate of return on any project be determined by its risk (market beta), instead? Another interesting observation is that the 6% on debt and the 11.95% on levered equity must have been determined by the supply and demand of investors. Why did supply and demand meet at these points? This must come from a model such as the CAPM. In the end, the theories better fit one another, or else you could be in big trouble. One theory might give a different answer than the other.

If you are sufficiently nerdy, you may be interested in the answers. This is purely for curiosity, and not important for a manager. Thus, skipping this appendix is quite safe.

x

It turns out that you can combine NPV, WACC, and the CAPM. They work well with one another. It is common to use the CAPM to provide appropriate expected rates of return on debt and equity, compute the weighted average to obtain a WACC, and then use this WACC as the denominator in the NPV formula. Let's see how this works. Switch to a different project so that we can start with the CAPM right off the bat. Consider a project that can be financed with low-risk debt with a market beta of 0.1, worth $Debt = \$400$ today; and with high-risk equity with a market beta of 2.5, worth $Equity = \$250$ today. The risk-free rate of return is 4%; the equity premium is 3%. What is the cost of capital of the overall project

(Firm)?

The standard method is to compute first the appropriate expected rates of return for the debt and the equity. Use the CAPM to find the expected rates of return:

$$\begin{aligned} \mathrm{E}(r_{Debt}) &= 4\% + 3\% \cdot 0.1 = 4.3\% \\ \mathrm{E}(r_{\text{Equity}}) &= 4\% + 3\% \cdot 2.5 = 11.5\% \end{aligned}$$

$$\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i$$

Second, compute the weights of each claim in the capital structure:

$$\begin{aligned} w_{Debt} &= \left(\frac{\$400}{\$400 + \$250}\right) \approx 61.5\% \\ w_{\text{Equity}} &= \left(\frac{\$250}{\$400 + \$250}\right) \approx 38.5\% \end{aligned}$$

Third, compute the weighted average cost of capital:

$$WACC \approx 61.5\% \cdot 4.3\% + 38.5\% \cdot 11.5\% \approx 7.1\%$$

$$w_{Debt} \cdot \mathrm{E}(r_{Debt}) + w_{\text{Equity}} \cdot \mathrm{E}(r_{\text{Equity}}) = \mathrm{E}(r_{Firm})$$

An alternative method relies on the weighted-average project beta,

$$\beta_{Firm} = \left(\frac{\$400}{\$400 + \$250}\right) \cdot 0.1 + \left(\frac{\$250}{\$400 + \$250}\right) \cdot 2.5 \approx 1.023$$

$$\beta_{Firm} = w_{Debt} \cdot \beta_{Debt} + w_{\text{Equity}} \cdot \beta_{\text{Equity}}$$

This means that the project's cost of capital is

$$\mathrm{E}(r_{Firm}) = 4\% + 3\% \cdot 1.023 \approx 7.1\%$$

$$\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i$$

This is the same 7.1% as the cost-of-capital estimate you computed with the standard method.

You can now use this 7.1% cost-of-capital estimate as the hurdle rate for firm-type projects, or use it to discount the project's expected cash flows to obtain a present value estimate. For example, if the project earns \$800 with probability 48% and \$600 with probability 52%, then

$$PV = \frac{48\% \cdot \$800 + 52\% \cdot \$600}{1 + 7.1\%} \approx \$650$$

(Of course, I had to make up the expected cash flows so that the debt and equity indeed could add up to \$650.) x

Is the WACC the weighted average of the interest rate that the firm pays to the bank and the expected rate of return on equity? Definitely not. The bank's quoted interest rate is the promised rate of return to debt. This is higher than the expected interest rate that goes into the WACC formula. (It is higher because of the default premium). How do you find the expected rate of return on the financial debt? Pretty much the same way as you find the expected rate of return on equity or other financial claims: Use a model like the CAPM, which provides the expected rates of return. Indeed, we just used it for this purpose above. (The CAPM cost of capital is the sum of the time premium and the systematic risk premium, and it appropriately ignores the debt's idiosyncratic risk and default premium.) You can estimate the beta from the debt's historical monthly rates of return, and then substitute it into the CAPM formula. Sometimes it can be even easier: If the debt is short-term and investment-grade, then the debt beta is likely very small. In this case, and only in this case, you can work with an $\mathrm{E}\left(r_{Debt}\right)$ that is reasonably close to the risk-free rate (and/or the rate that the firm is paying to the bank).

Debt-Adjustment and WACC

Let's show that the "debt ratio adjustment for beta" formula (Formula **??** on Page **??**), the WACC (Formula **??** on Page **??**), and the CAPM (Formula **??** on Page **??**) are mutually compatible in the perfect-markets scenario.

Recall that chapter **??** developed the basic WACC formula (the cost of capital for the overall "$Firm$"—not to be confused with F, the subscript for the risk-free security):

$$\mathrm{E}\left(r_{Firm}\right) = w_{Debt} \cdot \mathrm{E}\left(r_{Debt}\right) + w_{\text{Equity}} \cdot \mathrm{E}\left(r_{\text{Equity}}\right)$$

Substitute the CAPM Formula **??** into the three expected rates of return in the WACC formula:

$$\begin{aligned} r_F + \left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{Firm} &= w_{Debt} \cdot \left\{r_F + \left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{Debt}\right\} \\ &+ w_{\text{Equity}} \cdot \left\{r_F + \left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{\text{Equity}}\right\} \end{aligned}$$

Pull out the risk-free rates of return and reorder the terms,

$$= w_{Debt} \cdot r_F + w_{\text{Equity}} \cdot r_F + w_{Debt} \cdot \left\{\left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{Debt}\right\} + w_{\text{Equity}} \cdot \left\{\left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{\text{Equity}}\right\}$$

Recognize that $(w_{Equity} + w_{Debt}) = 1$, so $(w_{Equity} + w_{Debt}) \cdot r_F = r_F$:

$$\left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{Firm} = w_{Debt} \cdot \left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{Debt} + w_{\text{Equity}} \cdot \left[\mathrm{E}\left(r_M\right) - r_F\right] \cdot \beta_{\text{Equity}}$$

Divide by $\left[\mathrm{E}\left(r_M\right) - r_F\right]$:

$$\beta_{Firm} = w_{Debt} \cdot \beta_{Debt} + w_{\text{Equity}} \cdot \beta_{\text{Equity}}$$

X This is exactly the beta relationship among components from Section **??**. Indeed, all three formulas share the same intuition: Firms and claims with higher betas are riskier and thus have to offer higher expected rates of return.

---

question

Assume the risk-free rate of return is 3% and the equity premium is 4%. A firm worth \$100 million has a market beta of 3. A new project that costs \$10 million appears. It is expected to pay off \$11 million next year. The beta of this new project is 0.5.

1. If the firm does everything right, what is the NPV of the project? Should the firm take it?
2. However, the firm evaluates all projects by its overall cost of capital. Would this firm take the project?
3. What is the value of a firm that undertakes this new project?
4. What fraction of the equity would the old shareholders have to give up from a combined firm in order to raise the \$10 million to undertake the project?
5. What fraction of the firm value today would be the old projects, what fraction would be the new project?
6. How would the beta of the firm change?
7. How would the firm's average cost of capital change?

answer

The solution proceeds the same way as in the text on Page **??** (Chapter **??**):

1. The project should have an appropriate rate of return of $\mathrm{E}\left(R\right) = 3\% + 4\% \cdot 0.5 = 5\%$. It is immediately obvious that the project's cost of capital of 5% is below its internal rate of return of $\$11/\$10 - 1 = 10\%$. The net present value of the project is $-\$10 + \$11/1.05 \approx \$0.48$ million. Yes, the firm should take it.
2. If the firm uses a cost of capital based on its beta of 3, it would conclude that the value is $\mathrm{E}\left(R\right) = 3\% + 4\% \cdot 3 = 15\%$. Thus, with its 10% expected rate of return as its internal hurdle rate, a misguided firm would not take this project. This means that the firm loses \$0.48 million in value it could have otherwise gained, simply because the firm managers are making the mistake of not taking the positive-NPV project. This is because they do not understand that projects should be evaluated by the projects' own costs of capital, not the firm's cost of capital.

3. The value of the new project today is $\$11/1.05 \approx \$10.48$ million. The value of the old projects was given as \$100 million. Thus, the value of a combined firm with all projects would be about \$110.48 million.
4. To raise \$10 million, the firm needs to give up $\$10/\$110.48 \approx 9.05\%$ of the combined firm to new shareholders.
5. \$10.48 million would be from the new project. \$100 million would be from the old project. Thus, $\$10.48/110.48 \approx 9.49\%$ of the firm value would be in the new project. The remaining 90.51% would be in the old projects.
6. The market beta of the combined firm would be $90.51\% \cdot 3 + 9.49\% \cdot 0.5 \approx 2.763$.
7. The average cost of capital would now be $3\% + 4\% \cdot 2.763 \approx 14.05\%$.

In sum, the value of the firm would jump by the net present value of the new project, that is, by \$0.48 million. No more calculations are necessary. However, you can also do this by computing the discount on the entire firm. First, to be worth \$100 million at a cost of capital of 15%, the expected payoffs next year have to be \$115 million. The future value of the combined firm is therefore $\$115 + \$11 = \$126$ million, and its present value is $(\$115 + \$11)/(1 + 14.05\%) \approx \$110.48$ million.

EOC MATTER

eocproblems

question
For a firm without default, are the tax savings from debt a risky asset?

answer
No, for a firm without default, tax savings from debt are not risky. In fact, the tax savings are safer than the firm.

question
For a firm without default, are the tax obligations from debt a risky asset?

answer
Yes, the tax obligations are risky. They are as risky as the firm.

question
If you wanted to be more exact about the appropriate discount rate for the tax shelter in APV, what kind of discount rate would you apply to a firm with a decreasing debt target? What would you apply to a firm with an increasing debt target?

answer

Use a lower cost of capital for the decreasing debt target firm, say the rate you would use on your debt. Use a high cost of capital for the increasing debt target firm, say the rate you would use on your equity.

Chapter 17

Taxes and Capital Structure

A.17.A The Discount Factor on Tax Obligations and Tax Shelters

On Page **??**, I stated that it is common to use the firm's cost of capital in discounting the tax shelter. Let me explain why. Start with the firm in Table **??**. The example X
is rigged to make it simple. The debt is risk free. We need the equity to be risky, because we can get different appropriate discount rates only with different levels of risk. The firm's beta is assumed to be positive, so the firm's equity cost of capital exceeds its debt cost of capital. The revised scenario is in Table 17.1. x

What should you use as the appropriate discount rate (cost of capital) for the future tax obligation ($24 in EF, $17.40 in DF) or for the relative tax shelter (the difference of $6.60)? Assume that the value of the firm with $280 in expected profits will be either $250 (bad) or $310 (good) with equal probability. Therefore, the $200 debt at 11% interest is risk free. Because it is constructed in this way, you know that you can use the debt's (risk-free) cost of capital of 11% for any cash flow that does not covary with the firm's outcome. And you would use a higher discount rate for any cash flow that covaries positively with the firm's outcome. x

The bottom panel in Table 17.1 shows that the income tax obligation is risky and covaries with the firm's return under either financing scenario. Uncle Sam is basically a co-owner, partaking in the good and the bad times. Consequently, you should intuitively know that you need to use a discount rate on the tax obligation that is higher than the risk-free rate. x

But what is the cost of capital for the tax shelter? Table 17.1 shows that the tax shelter (because of the debt) remains the same $6.60, regardless of the firm's performance. Indeed, the example was constructed so that it would be easy to see that the debt payment, and with it the tax shelter that the owners get from the presence of debt, does not depend on the firm's fortunes. The tax shelter is as safe

Table 17.1: Two Financing Scenarios for a Risky 1-Year Firm

—

Scenario EF: All-equity financing.

	E (Value)	Bad	Good
Before-Tax Return Next Year	$280.00	$250.00	$310.00
Taxable Profits Next Year	$80.00	$50.00	$110.00
Corporate Income Taxes ($\tau = 30\%$) Next Year	$24.00	$15.00	$33.00
Owners Will Keep Next Year	$56.00	$35.00	$77.00

Scenario DF: $200 debt today at 11% for promised repayment of $222. The remainder is lever

	E (Value)	Bad	Good
Before-Tax Return Next Year	$280.00	$250.00	$310.00
Interest Payments	$22.00	$22.00	$22.00
Taxable Profits Next Year	$58.00	$28.00	$88.00
Corporate Income Taxes ($\tau = 30\%$) Next Year	$17.40	$8.40	$26.40
Equity Owners Will Keep Next Year	$40.60	$19.60	$61.60
Equity+Debt Owners Will Keep Next Year	$62.60	$41.60	$83.60

Tax Savings (scenario EF versus scenario DF):

	E (Value)	Bad	Good	
Before-Tax Return Next Year	$280.00	$250.00	$310.00	$\leftrightarrow$ Risky
Scenario 1 Corporate Income Taxes	$24.00	$15.00	$33.00	$\leftrightarrow$ Risky
Scenario 2 Corporate Income Taxes	$17.40	$8.40	$26.40	$\leftrightarrow$ Risky
Relative Net Tax Savings Next Year	$6.60	$6.60	$6.60	$\leftrightarrow$ Safe

as the firm's debt. Thus, you should use a discount rate on the tax shelter that is the same as the one you use on the firm's debt.

Nevertheless, it is common practice to apply the firm's cost of capital and not the debt's cost of capital to the firm's tax obligation. Is this an invitation to deliberately use incorrect discount factors in general? No, but it is a good and convenient working assumption in this particular context of discounting the tax shelter. Let me explain why.

1. In general, it is more important to get the discount rate right on larger amounts. If you wanted to get discount rates on individual component cash flows 100% right, why stop with the corporate tax shelter? Why not also determine individual discount rates for every other component of the company (taxes, depreciation, SG&A, marketing, advertising, furniture, paper clips, and so on)? This is not only impractical but also beyond anyone's capabilities. More importantly, if you want to allow yourself to use a possibly incorrect discount factor, you have to convince yourself that any added valuation precision would be very modest.

   How big is the tax shelter relative to the cash flows? The cash flows are $280, the debt is $200. (This is unusually large. More typically, firms have debt ratios around 30%.) The interest paid is 11% thereof, or $22. You need to multiply this further by your corporate income tax rate of 30% to obtain the tax shelter of $6.60. And now your "big" question is whether to discount this by the firm's cost of capital (say, 15%) or by the firm's debt cost of capital (say, 11%). This makes the difference between $5.95 and $5.74, which is only 21 cents today on cash flows of $280 next year.

   Yes, you should definitely worry about the correct discount rate for the project's cash flows of $280. Yes, the presence and amount of the tax shelter are important. Yes, it would be nice to use the correct discount factor on the tax shelter, too. But, no, it does not make much difference whether you apply the firm's cost of capital or the debt cost of capital to the tax shelter.

2. The firm's overall cost of capital may in fact be more correct than the debt cost of capital, because the risk-free tax-shelter intuition does not easily generalize from the simple 1-period scenario to many periods. The reason is that if your firm value doubles by next year, you can probably borrow twice as much then and thus enjoy higher tax savings henceforth. If your firm follows such an intelligent dynamic borrowing strategy, the tax shelter obtained by debt financing will not remain constant but will increase with the firm value, too. To compute the lifetime tax shelter afforded to your firm by its ability to take on more debt, you must therefore realize that intelligent

capital structure policies will induce the dollar amount of debt (and thus the tax shelter) to also covary positively with firm value. This is why it is often sensible to discount the tax shelter not with the debt's cost of capital but
x with the firm's cost of capital (or a discount rate somewhere in between).

Because this is a nerd appendix, let's go through the argument with a numerical example. Think of a firm that operates for 1 year and either doubles or disappears in the following year. It follows a dynamic debt policy so that its 1-year debt and 1-year-ahead tax shelter is always risk free. Assume the risk-free rate on the debt is 10%. Further assume the firm's expected tax shelter is \$22 next year. If it doubles, both its risk-free debt and tax shelter will double, too. If it disappears, it will have no tax shelters.

How does the dynamic aspect influence the 2-year-ahead discount rate for the tax shelter? It would be wrong to discount the stream at the risk-free rate of 11% as $\$22/1.11 + \$22/1.11^2 \approx \$37.68$. Instead, the firm's stream of tax-shelter value today is

$$\frac{\$22}{(1+11\%)} + \left[\tfrac{1}{2} \cdot \frac{\$44}{(1+11\%)\cdot[1+\mathrm{E}(R)]} + \tfrac{1}{2} \cdot \frac{\$0}{(1+11\%)\cdot[1+\mathrm{E}(R)]} \right]$$

What is $\mathrm{E}(R)$? Because the shelter cash flows of \$0 or \$44 depend on the firm's performance in the first period, it cannot be the risk-free rate. Instead, $\mathrm{E}(R)$ must be related to the firm's cost of capital.

x

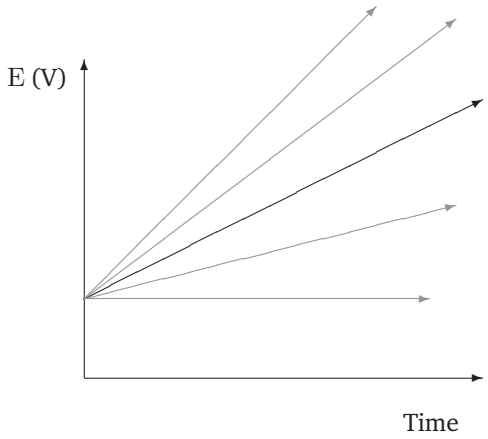
Figure 17.1 should help you to think about reasonable choices for the discount rate on the tax shelter. Assume that you are dealing with a typical firm, which tends to grow over time (upper-left graph).

A decreasing debt target: The upper-right graph shows a firm that plans to reduce its debt ratio over time. This is the case if a growing firm wants to retain the same absolute dollar interest payments. Such a firm would expect to save about the same dollar amount in taxes each year, regardless of firm performance. In this case, you should use some rate close to the debt cost of capital ($\mathrm{E}(r_{Debt})$).

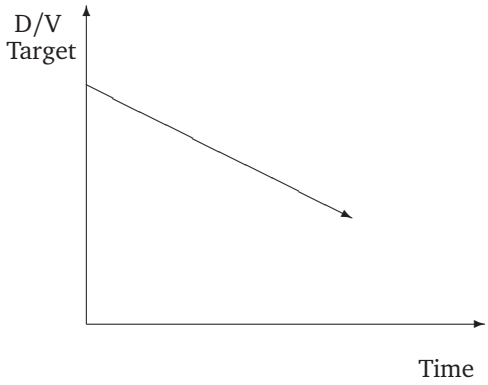
A constant debt target: The lower-left graph shows a firm that plans to keep a constant debt target. (Many CFOs pay lip service to targeting constant debt ratios.) Firm growth will translate into more and more debt and thus into higher and higher dollar interest payments. Consequently, the tax shelter will grow and shrink with the value of the firm, which means that it will be exposed to about the same risk as the firm overall. In turn, this means that you should use some rate close to the firm's overall cost of capital ($\mathrm{E}(r_{Firm})$).

Figure 17.1: Thinking about Proper Discount Rates for the Tax Shelter

—V is the firm's value. D is the firm's debt. D/V is the firm's debt ratio. These scenarios illustrate cases in which the firm's debt ratio changes over time, which in turn influences the discount rate that should be applied to the tax shelter. For example, if the firm wants to keep a constant debt ratio over the years, then it will have more debt and therefore a higher debt tax shelter if the firm experiences good times in the first year. This means that the value of the future tax shelter covaries positively with the firm value in the first year. It is therefore not close to risk free (as it was in our example in which the firm existed only for 1 year) but more risky (in fact, almost as risky as the firm is in its first year). Fortunately, although it would be a first-order error to compute the wrong tax shelter, it is often a second-order error to use the wrong discount factor on the tax shelter. Yes, you should try to get it right anyway, but realize that getting other quantities right is often more important than agonizing whether you should use $\mathrm{E}(r_{Firm})$, $\mathrm{E}(r_{Debt})$, or even $\mathrm{E}(r_{\text{Equity}})$.



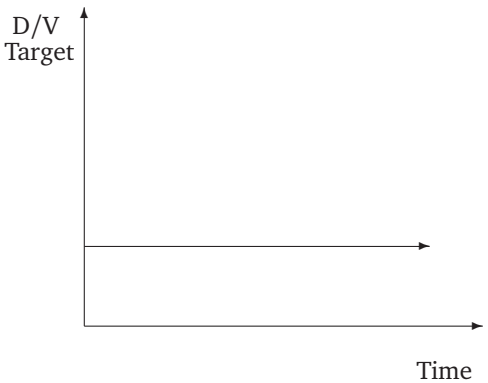
The background of the other three graphs: The typical firm value grows over time.

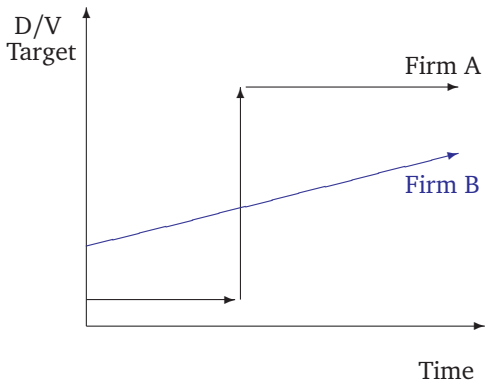


This firm plans to reduce its debt ratio over time, perhaps to keep its dollar debt and its interest payments constant.

$\Longrightarrow$

Use $\mathrm{E}(R_{DT})$ to discount the tax shelter.





An increasing debt target: The lower-right graph shows two firms with increasing debt targets. (This kind of debt policy is rare.) Firm A with a discontinuous debt target might be an R&D project, which will initially provide no debt capacity and thus no debt tax shelter. Thereafter, if the R&D pays off, the firm has positive cash flows and can take on debt financing. Firm B is a firm that wants to smoothly lever up with time. The values of these tax shelters are even more highly correlated with the value of the firm than if the target had been constant. Therefore, the tax shelter should be discounted even more aggressively. You should use some rate above the firm's overall cost of capital, perhaps something close to the equity cost of capital, $\mathrm{E}(r_{Equity})$.

x

In sum, I hope you are convinced that overall project valuations is robust with respect to moderate variations or errors in the choice of discount rate on the tax shelter. (I typically use whatever is most convenient, although I try to keep track of whether I think my assumptions overestimate or underestimate the true firm value.) You should worry primarily about the amount of the tax shelter, and only secondarily about whether the precise discount factor is the firm's cost of capital or the debt cost of capital. Give yourself a break!

important

- The discount rates on the tax obligations and on the tax shelters are usually not exact but just reasonable and convenient approximations. The value consequences of reasonable errors are minor.
- It is common and usually reasonable to value tax liabilities at a discount rate equal to the firm's overall cost of capital ($\mathrm{E}(r_{Firm})$).
- For the tax shelter, assuming that the firm will grow over time, it is common and usually reasonable to do the following:
  - Use the debt cost of capital if the firm plans on decreasing its debt ratio.
  - Use the firm's cost of capital if the firm plans on keeping its debt ratio constant.
  - Use the equity cost of capital if the firm plans on increasing its debt ratio.

x

Do not forget that this entire discussion—that you can allow yourself some latitude on errors—applied only to the discount factor. The (expected) amount of the tax shelter itself is not unimportant. This also applies to the idiosyncratic risk in the expected tax shelter, a quantity that figures into the present-value numerator of the tax shelter, not the denominator (the discount rate). For example, an R&D project may not generate any tax shelter half the time—in which case, the expected tax shelter (in the PV numerator) to be discounted would be something like

$$\text{Expected Tax Shelter} = 50\% \cdot \underbrace{\text{Tax Rate} \cdot \text{Interest Paid}}_{\text{Tax Shelter if R\&D is Successful}} + 50\% \cdot \$0$$

---

question

For a 1-year project that costs $100 and is financed with $50 in debt (which is more than the typical leverage ratio of U.S. corporations) at a 7% interest rate, what is the amount of the debt tax shield under different assumptions? Assume the firm is in a 40% tax bracket, and use reasonable assumptions on the firm's debt and equity cost of capital.

answer

For $50 in debt, the interest payment is $3.50. The tax shelter is $1.40. If you discount it by a cost of capital of 10%, it is worth $1.27. If you discount it by a cost of capital of 20%, it is $1.17. The difference is about 10 cents. For a $100 project, this level of uncertainty is unimportant.

EOC MATTER

eocproblems

question

For a firm without default, are the tax savings from debt a risky asset?

answer

No, for a firm without default, tax savings from debt are not risky.

question

For a firm without default, are the tax obligations from debt a risky asset?

answer

Yes, the tax obligations are risky.

question

If you wanted to be more exact about the appropriate discount rate for the tax shelter in APV, what kind of discount rate would you apply to a firm with a decreasing debt target? What would you apply to a firm with an increasing debt target?

answer

Use a lower cost of capital for the decreasing debt target firm, say the rate you would use on your debt. Use a high cost of capital for the increasing debt target firm, say the rate you would use on your equity.

Chapter 20

Pinch Advice: Sales-Dependence of Financial It

x

Is depreciation better modeled as consisting of both fixed and variable components, or is it better modeled as a fixed component only, or perhaps as a variable component only? Is COGS more sales-variable or more stable? What about dividends? Of course, every business is different, so there are no uniform answers here. Some firms rely more on fixed-cost technologies, others on variable-cost technologies. However, rather than not providing any guidance, I will now describe how corporate financials have evolved on average in publicly traded companies. Our specific interest is whether particular accounting items have been better explained by their own history or by sales growth. Although this knowledge (of how the average publicly traded firm has evolved in the past) can sometimes help you in a pinch (when you need something quickly and without much thought), it is generally better if you regard this section as a "jump start" to get you to do more economic thinking about, exploration of, and business modeling for your particular company.

> **important**
> If you can, please ignore the crutches provided for you in this section. Instead, execute your modeling based on specific and sound intelligence about your business.

x

Our basic public company financial item prediction model will be

$$\mathrm{E}\left(X_{t+1}\right) \approx \gamma_{\text{Fixed}} \cdot X_t + \gamma_{\text{Variable}} \cdot \left\{ X_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t} \right] \right\}$$

where X is a financial statement number, such as COGS or SG&A, and t is a year index. For example, statistical history suggests that

$$\begin{aligned} \mathrm{E}\left(\text{SG\&A}_{t+1}\right) &\approx 36\% \cdot \text{SG\&A}_t + 68\% \cdot \left\{ \text{SG\&A}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t} \right] \right\} \quad (20.1) \\ &= \gamma_{\text{Fixed}} \cdot \text{SG\&A}_t + \gamma_{\text{Variable}} \cdot \left\{ \text{SG\&A}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t} \right] \right\} \end{aligned}$$

This says that the typical firm's SG&A was about one-third related to its own past SG&A value and two-thirds related to SG&A adjusted for sales growth. How would you use this prediction in our PepsiCo pro forma? In 2001, PepsiCo had SG&A of \$11,608 million, and sales of \$26,935 million. Projected 2002 sales were \$27,906 million for a 3.6% increase. Thus, Formula 20.1 suggests (dollars are in millions)

$$\begin{aligned} \mathrm{E}(\mathrm{SG\&A}_{2002}) &\approx 36\% \cdot \$11{,}608 + 68\% \cdot \left[\$11{,}608 \cdot \left(\frac{\$27{,}906}{\$26{,}935}\right)\right] \qquad (20.2)\\ &\approx 36\% \cdot \$11{,}608 + 68\% \cdot [\$11{,}608 \cdot (1 + 3.6\%)] \\ &\approx 36\% \cdot \$11{,}608 + 68\% \cdot \$12{,}026 \approx \$12{,}357 \end{aligned}$$

The left part of the formula measures the "fixed effect," that is, the degree to which SG&A remains the same as last year's SG&A, independent of PepsiCo 's 2002 sales growth. The right part of the formula measures the "variable effect," that is, how SG&A has to increase with sales growth in 2002.

x

It is important that you do not believe that the precise coefficient estimates of 36% and 68% are applicable to your company. They are based on mechanical statistical models, which rely only on historical information for publicly traded companies that may be totally unrelated to your own and which depend on a time period that is ancient history. The coefficient estimates can serve only as "quick-and-dirty" stand-ins until you use your skills and smarts to produce something better. They are here only to help give you some initial guidance in your own economic exploration of whether a particular financial item in your firm tends to be more fixed or more variable.

x

Moreover, keep in mind that most of the time you will be asked to create a pro forma when the company contemplates a change in policy or when you want to propose a new project. The historical behavior of large publicly traded companies is unlikely to be a good representation of what will happen in such circumstances. Instead, your pro forma forecasts must be specific in addressing the contemplated policy changes. So, please do better than the formulas below.

Enough words of caution. Here are some nuggets of forecasting advice:

Sales: This is the most important variable. You must forecast this number as diligently as you possibly can. Other variables below can depend on this critical estimate. For illustration, let's forecast PepsiCo 's 2002 sales to

Sidenote: The reason why the coefficients in Formula 20.2 do not add up to 1 is that SG&A increased on average in the sample—perhaps due to inflation. If γ_{Fixed} is 1 and γ_{Variable} is 0, then the best prediction of X next year is the same as X this year. If γ_{Fixed} is 0 and γ_{Variable} is 1, then the best prediction of X next year is obtained by multiplying last year's X by the observed or predicted sales increase from this year to next year.

be \$27,906 million, which means that PepsiCo 's 2002 sales growth is \$27,906/\$26,935 − 1 ≈ 3.6%.

COGS: In our average publicly traded companies,

$$\mathrm{E}(COGS)_{t+1} \approx 6\% \cdot COGS_t + 95\% \cdot \left\{ COGS_t \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{t+1})}{\mathrm{Sales}_t} \right] \right\}$$

Coefficients so close to 0 and 1, respectively, suggest that cost of goods sold is best explained as a constant ratio of sales (unless the firm deliberately shifts production into different [fixed cost] production). Like all other formulas below, this formula is based on the history of reasonably large publicly traded U.S. firms (and thus is neither necessarily applicable to smaller firms nor to the future).

To use this formula to forecast PepsiCo 's COGS for 2002, you would compute (dollars are in millions)

$$\begin{aligned} \mathrm{E}(COGS)_{2002} &\approx 6\% \cdot COGS_{2001} + 95\% \cdot \left\{ COGS_{2001} \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{2002})}{\mathrm{Sales}_{2001}} \right] \right\} \\ &\approx 6\% \cdot \$10{,}754 + 95\% \cdot \{\$10{,}754 \cdot [1.036]\} \\ &\approx \$11{,}229 \end{aligned}$$

SG&A: Selling, general, and administrative expenses was used as an illustration earlier (Formula 20.1).

Unusual expenses: No particular advice.

Operating income: Either construct this from the items above (i.e., use the accounting identities), or forecast it as

$$\mathrm{E}(\text{Oper. Inc.}_{t+1}) \approx -41\% \cdot \text{Oper. Inc.}_t + 120\% \cdot \left\{ \text{Oper. Inc.}_t \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{t+1})}{\mathrm{Sales}_t} \right] \right\}$$

Note that operating income is extremely sensitive to sales growth: Any extra sales on the margin have more than a one-to-one effect on operating income. This is why the first coefficient is negative and the second is above 1. It makes economic sense: Operating income goes positive only above some break-even sales point. (A strong sensitivity to sales growth also appears in some other variables below.) However, there is one unusual feature of this formula that you should understand: The two coefficients sum up to considerably less than 100%. This means that the formula indicates a strong "drift" of operating income toward zero. For example, for PepsiCo,

$$\begin{aligned}
\mathrm{E}\left(\text{Oper. Inc.}_{2002}\right) &\approx -41\% \cdot \text{Oper. Inc.}_{2001} + 120\% \cdot \left\{\text{Oper. Inc.}_{t} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\
&\approx -41\% \cdot \$4{,}021 + 120\% \cdot \{\$4{,}021 \cdot [1.036]\} \\
&\approx \$3{,}350
\end{aligned}$$

You would estimate declining operating income even in the face of increasing sales! This also occurs in a number of formulas below. You must watch out for this—and think about whether such a drift toward zero would make sense for your particular company and pro forma!

Interest income/payments: Either construct these from debt and/or the previous year's interest payments, or forecast them as

$$\mathrm{E}\left(\text{Interest Inc.}_{t+1}\right) \approx 22\% \cdot \text{Interest Inc.}_{t} + 67\% \cdot \left\{\text{Interest Inc.}_{t} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_{t}}\right]\right\}$$

Remember: If a change in capital structure policy is contemplated, this item needs to reflect it. For PepsiCo,

$$\begin{aligned}
\mathrm{E}\left(\text{Interest Inc.}_{2002}\right) &\approx 22\% \cdot \text{Interest Inc.}_{2001} + 67\% \cdot \left\{\text{Interest Inc.}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\
&\approx 22\% \cdot \$8 + 67\% \cdot \{\$8 \cdot [1.036]\} \\
&\approx \$7
\end{aligned}$$

Income before tax: Either construct this from the items above, or forecast it as

$$\mathrm{E}\left(\text{Inc. bef. Tax}_{t+1}\right) \approx -32\% \cdot \text{Inc. bef. Tax}_{t} + 116\% \cdot \left\{\text{Inc. bef. Tax}_{t} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_{t}}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}
\mathrm{E}\left(\text{Inc. bef. Tax}_{2002}\right) &\approx -32\% \cdot \text{Inc. bef. Tax}_{2001} + 116\% \cdot \left\{\text{Inc. bef. Tax}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\
&\approx -32\% \cdot \$4{,}029 + 116\% \cdot \{\$4{,}029 \cdot [1.036]\} \\
&\approx \$3{,}553
\end{aligned}$$

Income tax: Either construct this from the items above, or forecast it as

$$\mathrm{E}\left(\text{Income Tax}_{t+1}\right) \approx -55\% \cdot \text{Income Tax}_t + 123\% \cdot \left\{\text{Income Tax}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}\mathrm{E}\left(\text{Income Tax}_{2002}\right) &\approx -55\% \cdot \text{Income Tax}_{2001} + 123\% \cdot \left\{\text{Income Tax}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\ &\approx -55\% \cdot \$1{,}367 + 123\% \cdot \{\$1{,}367 \cdot [1.036]\} \\ &\approx \$990\end{aligned}$$

Income after tax (but before extraordinary items): Either construct this from the items above, or forecast it as

$$\mathrm{E}\left(\text{Inc. aft. Tax}_{t+1}\right) \approx -30\% \cdot \text{Inc. aft. Tax}_t + 113\% \cdot \left\{\text{Inc. aft. Tax}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}\mathrm{E}\left(\text{Inc. aft. Tax}_{2002}\right) &\approx -30\% \cdot \text{Inc. aft. Tax}_{2001} + 113\% \cdot \left\{\text{Inc. aft. Tax}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\ &\approx -30\% \cdot \$2{,}662 + 113\% \cdot \{\$2{,}662 \cdot [1.036]\} \\ &\approx \$2{,}318\end{aligned}$$

Extraordinary items: No specific advice.

Net income: Either construct this from the items above, or forecast it as

$$\mathrm{E}\left(\text{Net Inc.}_{t+1}\right) \approx -42\% \cdot \text{Net Inc.}_t + 114\% \cdot \left\{\text{Net Inc.}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}\mathrm{E}\left(\text{Net Inc.}_{2002}\right) &\approx -42\% \cdot \text{Net Inc.}_{2001} + 114\% \cdot \left\{\text{Net Inc.}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\ &\approx -42\% \cdot \$2{,}662 + 114\% \cdot \{\$2{,}662 \cdot [1.036]\} \\ &\approx \$2{,}026\end{aligned}$$

Depreciation and depletion: Either construct this from the items above, or forecast it as

$$\mathrm{E}(DD_{t+1}) \approx 42\% \cdot DD_t + 62\% \cdot \left\{ DD_t \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{t+1})}{\mathrm{Sales}_t} \right] \right\}$$

For PepsiCo,

$$\begin{aligned} \mathrm{E}(DD_{2002}) &\approx 42\% \cdot DD_{2001} + 62\% \cdot \left\{ DD_{2001} \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{2002})}{\mathrm{Sales}_{2001}} \right] \right\} \\ &\approx 42\% \cdot \$1{,}082 + 62\% \cdot \{\$1{,}082 \cdot [1.036]\} \\ &\approx \$1{,}149 \end{aligned}$$

Deferred taxes: Very strongly related to sales growth and/or capital investment.

Noncash items: Very sticky, but negatively related to sales growth.

X **Changes in working capital:** In Section **??**, you learned that changes in working capital can use up cash quite quickly, especially when the firm is growing fast. Consequently, this is one of the cases where a negative coefficient on the sales growth–adjusted term makes sense. And, indeed, it seems that a halfway decent model for large firms is

$$\mathrm{E}(\Delta WC_{t+1}) \approx 46\% \cdot \Delta WC_t + (-43\%) \cdot \left\{ \Delta WC_t \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{t+1})}{\mathrm{Sales}_t} \right] \right\}$$

For PepsiCo,

$$\begin{aligned} \mathrm{E}(\Delta WC_{2002}) &\approx 46\% \cdot \Delta WC_{2001} + (-43\%) \cdot \left\{ \Delta WC_{2001} \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{2002})}{\mathrm{Sales}_{2001}} \right] \right\} \\ &\approx 46\% \cdot \$84 + (-43\%) \cdot \{\$84 \cdot [1.036]\} \\ &\approx \$1 \end{aligned}$$

Capital expenditures: Capital expenditures seem to be strongly related to sales growth:

$$\mathrm{E}(\mathrm{Cap.\ E}_{t+1}) \approx 0\% \cdot \mathrm{Cap.\ E}_t + 100\% \cdot \left\{ \mathrm{Cap.\ E}_t \cdot \left[\frac{\mathrm{E}(\mathrm{Sales}_{t+1})}{\mathrm{Sales}_t} \right] \right\}$$

For PepsiCo,

$$\begin{aligned}
\mathrm{E}(\text{Cap. E}_{2002}) &\approx 0\% \cdot \text{Cap. E}_{2001} + 100\% \cdot \left\{\text{Cap. E}_{2001} \cdot \left[\frac{\mathrm{E}(\text{Sales}_{2002})}{\text{Sales}_{2001}}\right]\right\} \\
&\approx 0\% \cdot \$1{,}324 + 100\% \cdot \{\$1{,}324 \cdot [1.036]\} \\
&\approx \$1{,}372
\end{aligned}$$

(Note: If a change in capital expenditures policy is contemplated, this item needs to reflect it.)

Other investing: Very sticky, but negatively related to sales growth.

Total cash flows from investing activity:

$$\mathrm{E}(\text{CF-Inv}_{t+1}) \approx (-320\%) \cdot \text{CF-Inv}_t + 340\% \cdot \left\{\text{CF-Inv}_t \cdot \left[\frac{\mathrm{E}(\text{Sales}_{t+1})}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}
\mathrm{E}(\text{CF-Inv}_{2002}) &\approx (-320\%) \cdot \text{CF-Inv}_{2001} + 340\% \cdot \left\{\text{CF-Inv}_{2001} \cdot \left[\frac{\mathrm{E}(\text{Sales}_{2002})}{\text{Sales}_{2001}}\right]\right\} \\
&\approx (-320\%) \cdot (-\$2{,}637) + 340\% \cdot \{-\$2{,}637 \cdot [1.036]\} \\
&\approx -\$850
\end{aligned}$$

Very strongly related to sales growth.

Financing cash flow items: No useful relationship.

Dividends: Very sticky, but negatively related to sales growth.

$$\mathrm{E}(\text{Dividends}_{t+1}) \approx 159\% \cdot \text{Dividends}_t + (-82\%) \cdot \left\{\text{Dividends}_t \cdot \left[\frac{\mathrm{E}(\text{Sales}_{t+1})}{\text{Sales}_t}\right]\right\}$$

This estimated formula often does not make much economic sense: Why would dividends go down if sales go up? It is not altogether impossible, of course. For example, if the firm experiences great sales surprises, it may decide that it needs the money to cover working capital or that it wants to reinvest the money rather than pay it out as dividends. However, you should consider this on a case-by-case basis. You might be better off just assuming last year's dividends.

Net stock issuing: No useful relationship. Strongly related to sales growth.

Net debt issuing: Strongly related to sales growth.

$$\mathrm{E}\left(\text{Debt-Issue}_{t+1}\right) \approx (-192\%) \cdot \text{Debt-Issue}_t + 195\% \cdot \left\{\text{Debt-Issue}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

Total cash flows from financing activity: Mildly related to sales growth.

$$\mathrm{E}\left(\text{CF-Fin}_{t+1}\right) \approx (-7\%) \cdot \text{CF-Fin}_t + 25\% \cdot \left\{\text{CF-Fin}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}
\mathrm{E}\left(\text{CF-Fin}_{2002}\right) &\approx (-7\%) \cdot \text{CF-Fin}_{2001} + 25\% \cdot \left\{\text{CF-Fin}_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\
&\approx (-7\%) \cdot (-\$1{,}919) + 25\% \cdot \{-\$1{,}919 \cdot [1.036]\} \\
&\approx -\$363
\end{aligned}$$

Foreign exchange effects: Sticky.

$$\mathrm{E}\left(FX_{t+1}\right) \approx 75\% \cdot FX_t + (-52\%) \cdot \left\{FX_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

For PepsiCo,

$$\begin{aligned}
\mathrm{E}\left(FX_{2002}\right) &\approx 75\% \cdot FX_{2001} + (-52\%) \cdot \left\{FX_{2001} \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{2002}\right)}{\text{Sales}_{2001}}\right]\right\} \\
&\approx 75\% \cdot \$0 + (-52\%) \cdot \{\$0 \cdot [1.036]\} \\
&\approx \$0
\end{aligned}$$

This is not the most important item for PepsiCo.

Total net cash flows:

$$\mathrm{E}\left(\text{Net CF}_{t+1}\right) \approx 272\% \cdot \text{Net CF}_t + (-267\%) \cdot \left\{\text{Net CF}_t \cdot \left[\frac{\mathrm{E}\left(\text{Sales}_{t+1}\right)}{\text{Sales}_t}\right]\right\}$$

Here is an example of an estimated formula that serves as a warning: A negative coefficient on the sales growth–adjusted number probably makes little sense for most large companies. Yes, it could be that the company does consume more working capital as it grows, but it just does not seem to be applicable in many cases—such as PepsiCo. You might just want to avoid this formula.

In conclusion, do not trust these formulas. They are merely tools that you can use for constructing a first draft of your pro forma—they are not good blueprints. Forecasting the performance of any business, but especially a new business, remains an art that relies on the underlying sciences of economics, statistics, accounting, and finance. Don't just rely on statistics alone. Use common sense. Use good knowledge of the economics of the business and the industry. Document your reasoning in informed and detailed footnotes. And then—pray!

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question

What financial statement components seem to be most sales (scale) sensitive? What seem to be least sales (scale) sensitive?

answer

The sensitivity is the γ_{Variable} coefficient. It is high for COGS, all income measures (such as operating income or income before tax), income tax, and investment activity (such as cash flows from investing activities). It is lower for such items as COGS, interest income, depreciation, and outright negative for changes in working capital, foreign exchange effects, and total net cash flows.

EOC MATTER

eocproblems

question

Complete the 2002 forecast in the cash flow statement model in Table **??** on Page **??**. Create a forecast for 2003. (Iterate on depreciation and investing to determine sensible inputs into both.)

answer

There is no clear and unique answer to this question. Here is a reasonable attempt.

Deeper: The formulas were estimated using "regression analysis." For you super nerds: All variables were normalized by sales, regressions were run firm by firm, and the coefficients were then averaged over firms. Even more sophisticated modeling assumptions and techniques did no better than the simple regression approach adopted here.

	Income Statement	December			
		2001	2002	2003	Model Used
=	Sales	$26,935	$27,906	$28,911	grows by 3.6%
	COGS	$10,754	$10,761	$11,023	$3,506+26% of revenue
	+ SG&A	$11,608	$12,279	$12,721	44% of revenue
	+ Deprec/Amort	$165	$168	$168	3-year average
	+ Unusual Expenses	$387	$279	$289	1% of revenue
–	= **Operating Expenses**	$22,914	$23,486	$24,201	Sum The Above
=	**Operating Income**	$4,021	$4,420	$4,710	Subtract The Above
+	Net Interest Income	$8	$0	$0	Too Ignorant and Lazy
=	**Income before Tax**	$4,029	$4,420	$4,710	Subtract The Above
–	Corporate Income Tax	$1,367	$1,591	$1,696	36% of IBT
=	**Income After Tax**	$2,662	$2,828	$3,014	Subtract The Above
–	Extraordinary Items	$0	$0	$0	Too Ignorant and Lazy
=	**Net Income**	$2,662	$2,828	$3,014	

	Cash Flow Statement	December		
		2002	2003	Model Used
=	Net Income	$2,828	$3,014	transferred
+	Depreciation and Depletion	$1,149	$1,221	formula
+	Deferred Taxes	$286	$305	18% of Income Tax
+	Non-Cash Items	–$46	–$46	Average Historical
+	Decreases in Working Capital	$262	$271	27% of Revenue Increase
=	**Total Operating Activity**	$3,955	$4,223	Sum Above
=	Capital Expenditures	–$1,313	–$1,321	$-\$1{,}200 - 4\% \cdot \text{Earnings}$
+	Other Investing	–$1,000	–$1,000	Arbitrary. Sticky.
=	**Total Investing Activity**	–$2,313	–$2,321	Sum The Above

Depreciation: 42% times prior year depreciation plus 62% times sales-grossed-up prior depreciation. Therefore, for 2002, depreciation would be $0.42 \cdot \$1{,}082 + 0.62 \cdot \$1{,}082 \cdot 1.036 \approx \$1{,}149$.

question
Does it make sense for the net income coefficient to have a negative coefficient on the first term?

question
In the in-a-pinch models, is the expected growth rate of each financial data item plus one a linear function of the expected growth rate of sales plus one?

Part II

Additional Chapters (Other Topics)

parttext

What You Want to Learn in this Part

This part covers many topics that most introductory classes unfortunately just won't have time to cover. They are important, though. These chapters are stand-alone, meaning that there is no particular order in which you should read them.

- Chapter 23 shifts the emphasis from capital structure levels to capital structure changes. It explains how managers should be thinking about effecting change in their capital structures (and firm sizes).

  extract
  Typical questions: What mechanisms can managers use to change capital structure and firm size? How do the pecking order view of capital structure (which you learned earlier) and the financing pyramid view of capital structure relate to one another? What happens if managers act suboptimally? How are actual offerings typically structured? Are initial public offerings different from ordinary offerings by established publicly traded companies?

- Chapter 24 describes the empirical capital structure evidence in the United States. That is, it does not explain what capital structure should look like, but what it typically does look like. The first part of the chapter describes how easily the IBM financials from Chapter **??** generalize to other types of firms, big and small. The second part explains both the corporate motives for capital structure change and the mechanisms by which it happens. This means it looks at capital structure changes through the lens of the theories discussed in earlier chapters.

  extract
  Typical questions: How have firms' current capital structures come about? Are large firms' capital structures different from those of small firms? What are the companies with the most debt and the least debt? How important are equity issues in determining the debt/equity ratio of the typical company? Do managers use capital structure to minimize corporate income taxes or to avoid financial distress?

- Chapter 25 describes the role of investment banks and makes a detour into mergers and acquisitions (M&A)—an area in which investment bankers are playing a major role, too.

  extract
  Typical questions: What do investment bankers really do? Who are the top investment bankers? How much do they charge? How common are mergers and acquisitions, and why do they occur?

- Chapter 26 focuses on corporate governance in more detail. It explains how managers really behave (not just how they should behave) and how firms should be set up to reduce conflicts of interest between professional managers and shareholders. In some firms, this has become a "fox in the henhouse"

problem, because managers themselves can sometimes be in charge of setting up these arrangements. Corporate governance is the set of control mechanisms that induce managers to satisfy their obligations to the ultimate owners: the creditors and shareholders. Corporate governance is often mistakenly confused with good management.

> **extract**
> Typical questions: How can managers steal or waste the firm's money in their own interests? What can creditors, shareholders, the legal environment, and the public do to rein in such behavior? How effective is corporate governance in publicly traded U.S. corporations today?

- Chapter 27 explains the role of currency translations and international market segmentation for both investments and corporate budgeting purposes. It is a throwback to earlier chapters, in that it carefully works

Chapter 22

Firm Scale, Capital Structure Dynamics, Capital Acquisition, Issuing, Working Capital

Dilution—explain how it may reflect info that would have come out anyway; or how it may be due to the issue itself.

intro

In the real world, as CFO, you rarely have the luxury of thinking about the optimal capital structure and the optimal firm size from scratch. Instead, you are saddled with a situation caused by the firm's history. You have a set of tools at your disposal, and a set of goals you want to accomplish. You must learn how to decide on your goals and how to get from here to there. This is the role of this chapter. It connects the theories of capital structure levels to changes in capital structure and firm size, both on a conceptual level and on an institutional-detail level.

Along the way, this chapter covers subjects that occasionally receive their own treatments: working capital management and initial public equity offerings. They are integrated in this chapter, because they really are just one component of an overall capital structure and capital size policy.

22.A Capital Structure and Firm Scale

x

Say you are the CFO of a large firm who wants to maximize shareholder wealth. Your current capital structure was determined in your firm's past—you are not starting from scratch. Some of the future changes are under your control, some

are not. Faced with your current situation, what questions and issues should you ponder? What tools do you have at your disposal? What can trip you up?

The Key Decision Questions

x

There are a lot of actions you can take, such as paying out cash, raising more cash, expanding your operations, and so on. If you are a manager who wants to act on behalf of the firm's owners, then you should always keep two key questions in mind when you make decisions:

1. Can you invest your investors' money better through your firm than what your investors could find as investment opportunities elsewhere?

   If not, you should return their money to them. After all, it is not your money, but your corporation's investors' money, that you are working with. They should own the earnings the firm generates.

2. Do your investors share your beliefs that your actions will increase value—that the additional money will be well spent?

   If your investors agree with your managerial judgment, as they would in a perfect market, then you have no problem. However, if your investors disagree with you—as they may in an imperfect market—then you may have a problem. For example, if you know that investing in a new technology is highly worthwhile but requires cutting your dividends, then your investors (the market) may interpret this negatively. This means that all your current investors would be taking a hit on their market value right now, just as they would if you had thrown away their money. If you are correct, however, then your investors will eventually realize the value gain, and thus your share price will appreciate again. But this is little consolation to those investors who have to sell their shares this year. Should you represent your current investors or your future investors? There is no easy answer to this difficult question. (Incidentally, many agency researchers are skeptical about managers' claims that they weigh the choices and decide to represent the long-run investors—researchers tend to believe that such claims are only excuses for managers to represent themselves. But everyone agrees that good communication from managers to investors can only help.)

x

The latter dilemma shows that capital structure has intricate links to your firm's project opportunities, corporate governance, and disclosure policy. If your firm has great opportunities, if your managers are well motivated, and if your firm can convince investors of these great opportunities, then the answer to both of the

above questions is often yes. You can then create value even by reducing dividends and share repurchases and by raising more equity. If the answer to both questions is no, then the firm should not issue equity and instead seek to increase dividends and share repurchases. And if the answers to both questions are contradictory or fuzzy—as they often are—then you have tough judgment calls to make.

---

question
What should be your two main questions when deciding on capital structure actions?

answer
From a value perspective, your two main questions when deciding on capital structure actions should be: (1) Can you invest your investors' money better than they can? (2) Do your investors understand this?

Mechanisms Influencing Capital Structure and Firm Size

x

Let's presume that you have worked out what is in the interest of your investors. You know what capital structure and firm size you want to get to. Most capital structure tools at your disposal have consequences for firm size (and vice versa). If you issue equity or debt, your firm becomes larger. If your firm grows in a good year, not only does the equity of your firm increase, but your leverage goes down as well. As CFO, you must use your tools carefully, keeping an eye on both outcomes—capital structure and firm size. x

Let's look more systematically at the tools at your disposal. Table 22.1 organizes some available mechanisms by their effects on both outcomes. Many of these mechanisms are what you already suspected. For example, when a firm issues debt, both the firm size and the debt ratio increase. Most, but not all, of the changes listed in the table contain transactions that are due to active financial market intervention orchestrated by you, the manager. x

If you now think that you can easily deduce which firms today have higher leverage just by a quick naïve glance at their historical financial debt and equity issuing activities, then you are mistaken. There are a number of disconnects, some of which you have already seen in the case of IBM's capital structure (in Chapter **??**). Here are some issues to ponder:

x

Nonfinancial claims: Nonfinancial claims on the firm are often as large as financial debt and equity. Corporate operations can increase both your assets and your liabilities (e.g., pension claims or accounts payable), just like your financial claims. You therefore cannot ignore your firm's real operations when thinking about indebtedness.

Table 22.1: Nonoperating Capitalization and Capital Structure Influences

—[a] Firm value changes can be exogenous to the firm (e.g., investors change their preferences, or government or nature intervenes) or endogenous (e.g., the firm returns earnings or wastes funds).
Boldfaced changes are common, though not necessarily of equal quantitative importance. Non-boldfaced changes are much rarer. Note that this table ignores the complex interactions with existing capital structure. In particular, if the firm is 100%-equity-financed, an increase or decrease in firm value, an equity issue or equity repurchase, and a dividend payment have no influence on the firm's debt/equity ratio—it will remain at 0%.

	Firm Value (Firm Size)		
Debt/Equity Ratio	**Decreases**	**Constant**	**Increases**
Decreases	• **Debt repurchase (e.g., sinking fund and interest payment)** • **Repayment of principal or interest** • Debt call	• Debt-into-equity conversion • Equity-for-debt exchange (more equity, less debt)	• **Firm value increases**[a] • **Primary seasoned equity issue in M&A context** • **Share creation for employee compensation purposes** • Primary seasoned equity issue outside M&A context • Warrant exercise
Could Be Either	• Simultaneous debt/equity payout • **Sale of assets (e.g., carve-out)**		• Simultaneous debt/equity issue • **Hybrid security issue** **Purchase of assets (e.g., M&A)**
Increases	• **Firm value drops**[a] • **Share repurchase** • **Cash dividend**	• Debt-for-equity exchange (more debt, less equity)	• **Debt issue**

x

Existing leverage: Your existing capital structure plays an important role in the effect that issuing has on the capital structure.

When a \$200 million firm with a 100% equity structure issues \$100 million in new equity shares, it does not change its debt ratio. But when another equally large firm with a \$180/\$200 = 90% debt ratio issues the same \$100 million in new equity, the effect of this issue is a dramatic reduction in leverage to \$180/\$300 = 60%.

Could a firm that issues \$400 million in debt and \$100 million in equity actually lower its leverage ratio? (Yes—if the firm had \$900 million in debt and \$100 million in equity prior to the issues, its financial debt ratio would drop from 90% to 87%.)

x

Simultaneous issues: Equity issuing often occurs jointly with debt issuing. Most importantly, new equity (and debt) tends to come in dramatically when a firm acquires another firm. Thus, it may even be that when firms issue large amounts of equity, it is precisely the time when their debt ratio goes up—not because of the equity issuing, but because of their simultaneous other activity.

X

x

Value changes: There are firm value changes (aka stock returns) that affect both the scale and the debt/equity ratio of the firm. For example, a \$100 firm that is financed 50-50 by risk-free debt and equity and that doubles in value to \$200 would see its debt/equity ratio change to 50-150, unless managers do something to counteract this decline. You have already seen the effects of stock returns in IBM's case—when its stock price tumbled from \$121 to \$78 per share, its equity lost over one-third of its value. This, in turn, dramatically reduced IBM's size and increased IBM's debt ratio.

X

What factors might cause firm value changes? Some factors are beyond the manager's control. For example, investors could become more risk averse and therefore may no longer be willing to pay \$121 per share for IBM with its level of risk. Other factors that can change IBM's value would be unexpectedly good news (e.g., large orders for video game machine CPUs) or bad news (e.g., an earthquake). Of course, some parts of such value changes are under the manager's control. Your firm may pay out a lot of equity in dividends to shareholders, or you may run the firm poorly.

(Chapter 24 will show you that IBM was not unusual. A considerable proportion of most firms' current debt/equity ratios are determined by such firm value changes, which are reflected most obviously in the firm's stock price.)

There are also the effects of bond price changes, which we ignored. When economy-wide interest rates rise or the firm's credit rating deteriorates, then the debt usually declines in value—although in many cases, so does the equity. Conversely, when economy-wide interest rates drop or the firm's credit rating appreciates, then the debt usually increases in value—though again, so might the equity. Thus, the effect of changing interest rates on the debt/equity ratio is usually ambiguous. (Moreover, there are situations in financial distress in which the debt wrests power from the equity—there would be no change in overall capitalization, but a good change in the firm's debt/equity ratio.)

In sum, my point is simple: Don't make the common mistake of equating debt issuing or equity issuing causally with the typical directional changes in your leverage ratio. Yes, they are linked, but they are not linked one to one. Issuing activity does not add to or subtract from capital structure the same simple way that one number adds to or subtracts from another.

The Multi-Consequence and Multi-Mechanism View

x

As a manager, there are some mechanisms that you cannot influence and there are some mechanisms that you have at your disposal, and you need to target both a capital structure ratio and a firm size. For example, recall that Table 22.1 showed the following:

Scale: Dividend payments, bond coupon payments, debt and equity repurchasing, and debt and equity issuing are all mechanisms for transferring cash from inside the corporation to the outside owners, or vice versa.

Debt ratio: Equity issues, debt repurchases, and interest payments are all mechanisms for lowering the firm's debt/equity ratio.

x You need to think about all of these mechanisms simultaneously. How?

Here is an illustration. For simplicity's sake, start by assuming you are still in the perfect-market world of Modigliani-Miller (M&M). Consequently, the mix of financing does not influence total firm value. Your firm is currently worth $1 billion, of which $400 million is outstanding debt (including nonfinancial liabilities). Let's say you choose to raise $100 million in new equity, raise $200 million in new debt, pay out $30 million to retire old debt (principal and interest), pay out $20 million in dividends, and repurchase $50 million of the firm's own equity shares. De facto, your firm has done the following:

1. Transferred $\$100 + \$200 - \$30 - \$20 - \$50 = \$200$ million of cash from the outside to the inside, and thereby increased its value from \$1 billion to \$1.2 billion

2. Increased its debt/equity ratio from $\$400/\$600 \approx 67\%$ to $\$570/\$630 \approx 90\%$

x

Of course, the real world is not M&M perfect. This means that you need to reconsider your choices, because investors will react to them. For example, if investors believe that your corporation suffers badly from agency conflicts (i.e., that you will waste their money), then they may react negatively to the \$200 million increase in extra cash available to managers. On the other hand, if investors believe that the higher debt/equity ratio will save the corporation relatively more in corporate income taxes, then they may react positively to the increase in the debt/equity ratio. In fact, as CFO, you should consider each and every value effect that we discussed in Chapters **??**–**??**. Without knowing more about our particular firm, it would be hard to guess whether the financial markets would look fondly or not so fondly on these capital structure changes. Why does this matter? If your capital structure rearrangement created \$100 million extra in value, for example, it might well be that the outcome is not \$1.2 billion in value and a debt/equity ratio of \$570/\$630, but, say, \$1.3 billion in value and a debt/equity ratio of \$570/\$730. (The web chapter describes in detail how U.S. financial markets have responded to corporate issuing and dividend activity.) x

important

Managers cannot view capital structure as a simple one-dimensional process. It is closely linked to firm size and thus the projects that the firm undertakes. Capital structure is the outcome of many forces, and only some are under the control of managers.

x

Before we move on, there is one last interesting capital structure effect worth noting. The differences between repurchases and dividends were discussed in Section **??**. Of interest in an imperfect world is the fact that your investors would X draw some inferences from the fact that your firm paid out only \$20 million in dividends but repurchased \$50 million in shares. The reason is that dividends tend to be stickier than share repurchases, and thus the fact that your firm pays out more in repurchases than in dividends may send a mixed signal—are the managers worried about the firm's ability to pay out cash again next year?

---

question

Describe the financial mechanisms that can change capital structures and firm sizes.

answer

Table 22.1 describes the financial mechanisms that can change capital structures and firm sizes:

1. Debt ratio increases, firm size decreases: Exogenous value drop, share repurchase, cash dividend.
2. Debt ratio decreases, firm size decreases: Debt repurchase, principal repayment, debt call.
3. Debt ratio increases, firm size increases: Debt issue.
4. Debt ratio decreases, firm size increases: Firm value increase, seasoned equity offering, ESOP share issuance, warrant exercise.

question

When do firms usually experience their most dramatic changes in capital structure?

answer

Firms usually experience their most drastic capital structure changes when they take over other firms.

question

Is the level of corporate debt under the complete control and at the discretion of management?

answer

The answer to whether the level of corporate debt is under the complete control and at the discretion of management is ambiguous. Firms that operate may incur liabilities, so in this sense the answer is no. Moreover, economy-wide interest rate increases could reduce the value of the firms' financial debt. However, firms could change their operations or refinance their liabilities by raising equity.

question

A $500 million firm is financed by $250 million in debt and $250 million in equity. If the market value does not change, describe some actions that managers can undertake to increase firm size to $600 million and change its debt/equity ratio to 5:1.

answer

To have a 5:1 debt/equity ratio with $600 million in overall value, the firm needs to have $500 million in debt and $100 million in equity. One way to accomplish this is to issue $250 million in debt and repurchase $150 million in equity. (New firm size = $250 debt + $250 debt + $250 equity – $150 equity = $600 total.)

question

What is the effect of a share repurchase on the firm's size and the firm's debt ratio in a perfect market?

answer

A share repurchase decreases the firm size and increases the firm's debt ratio.

22.B Theories of Capital Structure Levels, Changes, and Issuing Activity

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Given that firms in the real world rarely start from scratch, it is no surprise that our theories of capital structure levels spawned versions tailored to capital structure changes. The most prominent theory has its own name—the **pecking order** theory. You have already seen it in Section **??**, but it is well worth elaborating here. X

The Pecking Order

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The pecking order theory is the name for two connected empirical implications:

1. Firms decline more in value when they announce issuance of more-junior securities.

2. Firms are reluctant to issue more-junior securities (e.g., equity instead of debt).

The second implication should not be surprising, given the first. Managers who want to increase firm value should not issue securities that reduce their firms' values. x

The name "pecking order" comes from the insight that this implies that firms fund new projects in a specific order. They first fully exhaust funding projects with the most senior claims that they have available to them. Only after these are exhausted will they proceed to the next class of more-junior claims. In the extreme, if they can, firms may never issue equity to fund new projects.

Deeper Causes for Pecking Orders

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The pecking order applies in situations in which issuing more-junior securities is more expensive than issuing more-senior securities. Clearly, if your firm already has more equity than is optimal, then issuing even more equity would be detrimental to firm value. x

In Chapters **??** and **??** you learned the forces that pull firms toward a capital structure in which having more debt is better than having more equity. You can go through these chapters and realize that every force that favors debt over equity can pull a firm toward following a pecking order (assuming absence of other forces). Here are some examples: X

1. **Inside information:** When your company wants to raise more financing, it is in your interest to convince investors that managers and owners are confident in the firm's future. Put differently, as existing owners and managers, you

want to signal your confidence in the firm by remaining as heavily invested yourself as you possibly can. If your firm were to issue equity, investors would infer the worst and your firm value would drop. It follows that managers should not like to issue equity. (Historically, it was in the context of inside information theory that the pecking order theory first emerged.)

2. **Agency considerations:** This is quite similar, except that the future is now under the manager's control. The idea is that when you want to raise more financing, it is in your interest to convince investors that you will not waste money. The more junior the security that you are issuing, the more free cash flow you could waste without likely penalty in the future. Thus, if you want to invest money profitably instead of wasting it, you will not mind the more stringent requirements that come with newly issued senior securities. The end effect is the same as it was in story number 1: If you were to issue equity, firm value would drop. Thus, managers do not like to issue equity.

3. **Issuing costs:** It may simply be much more expensive to issue more-junior claims. Issuing equity is more expensive than issuing debt, which in turn is more expensive than funding projects internally. (This is empirically true, and it could be due to legal liability, regulations, difficulties in finding/costs of convincing investors to buy more-junior securities, etc.)

There are also other theories that explain why senior securities can add value. Of course, for the pecking order to apply to a particular firm, the net of all factors favoring issuing debt must outweigh the net of all factors favoring issuing equity. Otherwise, firms would experience a positive response if they issued more equity—they should then be eager to do so, and the pecking order would not apply.

Gradations of Seniority

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Here is a novel fact to the pecking order theory. As you already know, the definition of a more junior security is that it is paid off in bankruptcy only after the more senior securities are paid off. Equity is (usually) the most junior security. Debt is more senior. But there are also seniority differences within the firm's debt financing. Some examples:

- Bonds with stronger covenants are safer than bonds with weaker covenants.
- Short-term bonds are safer than long-term bonds. (Creditors in the former are likely to get their money back long before the firm can run into trouble in the more distant future.)

- Collateralized bonds are safer than ordinary bonds. Again, creditors can lay claim to the collateral even before ordinary bonds are paid.
- Factored receivables (that is, accounts receivable that are sold off) are often short term and can be safer than the debt of the firm itself. By taking the firm out of the repayment process, receivables can become safer.

So far so good. But you may be surprised to learn what the most senior claim is: If the firm already has funds (as retained earnings), it does not even need to issue any new claims. In comparison, even the most senior debt is more junior than retained earnings, because it may not be fully repaid if the firm suffers a catastrophic loss. (This makes such debt junior to funds that the firm in effect raises from itself.) x

With so many different seniority gradations, the pecking order theory therefore states that a firm should prefer to fund new projects from its own cash first until this funding source is exhausted. Then it should issue the most senior, short-term debt next, until that is exhausted, too. And so on. In sum, the more junior the funding source, the more reluctant managers should be. If managers instead carry out with a more junior offering anyway, the firm's value should drop more on its announcement. x

Chapter **??** showed that one important force pulling firms toward debt is the presence of corporate income taxes. If the firm is highly taxed, issuing debt rather than equity can reduce the firm's tax burden. Thus, high-tax firms would experience a worse stock-price response to a new equity issue than they would to a new debt issue. Consequently, such firms should be reluctant to issue more equity. Corporate taxes can therefore explain a pecking order between debt and equity. However, the corporate income tax does not offer a reason why internal funds are better than debt (using retained cash is not tax-preferred to paying out cash and issuing senior debt to finance projects).

Empirical Evidence

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What is the empirical evidence? The academic consensus is by and large that many large publicly traded corporations are underlevered. This suggests that such firms should follow a pecking order, in which they should be reluctant to issue more-junior securities. Indeed, the empirical evidence suggests that this is the case, too. Equity issues are rare among such firms, and when they do happen, they are usually associated with a decline in firm value. Moreover, internal funding tends to be used before debt is. In the United States, such large publicly traded firms cover about 50-90% of their funding needs with retained earnings. (The remainder is

usually predominantly debt-financed, and preferentially with short-term notes and collateralized debt rather than with general-obligation junior debt.)

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question
What is the financing pecking order?

answer
The pecking order states that managers prefer issuing higher-priority (safer) securities first, before proceeding to lower-priority, less safe alternatives. Therefore, they prefer to finance first from cash, then from collateralized debt, then from senior debt, then from junior debt, then from convertible debt, and finally from equity.

question
Evaluate: If a theory predicts that issuing equity is more expensive than issuing debt, a pecking order should naturally arise.

answer
True: If a theory predicts that issuing equity is more expensive than issuing debt, then a pecking order would arise naturally.

Alternative Non-Pecking-Order Financing Arrangements

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Not all firms are best off following the pecking order prescription of funding projects with the most senior securities possible. For example, there are many small high-tech firms that start out with a lot of debt. Depending on the particulars of the situation, many such firms can gain value if they issue equity instead of debt. Similarly, many utilities firms are often better off if they issue equity instead of debt

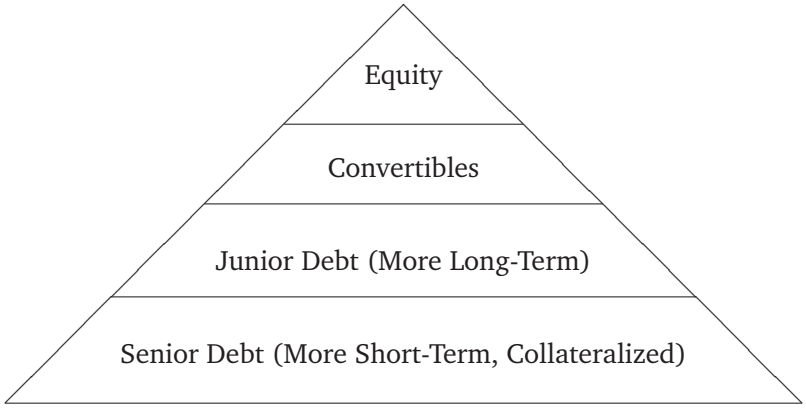
x due to the way their cost of capital is computed by their government regulators.

A less obvious example of behavior that is not pecking-order-like applies to many private-equity firms. For example, the typical leveraged-buyout firm owns a number of acquired firms, each called a portfolio company. The inside information version of the pecking order theory states that an LBO firm should issue more-senior securities because it should want to keep as much of the upside as possible, which signals its confidence in its own company. It should issue claims that are less safe only if it is absolutely unavoidable. However, it turns out that LBO firms purchase a number of companies, but keep each of them in its own insulated shell. Thus, if one portfolio company goes bankrupt, it does not bring down the other portfolio companies. (This arrangement provides good incentives to the management in each individual company. A mistake by a portfolio company's

x management could be deadly!)

Figure 22.1: A Hypothetical Financing Pyramid

—This figure illustrates the capital structure of a firm that follows a financing pyramid. It has more senior debt outstanding than junior debt, more junior debt than convertibles, and more convertibles than equity.



The lenders know that they will not be able to lay claim to any other portfolio companies if the management of one were to perform poorly. And they know that the LBO firm was not confident enough in the quality of each particular acquisition to pledge its remaining portfolio companies to the lenders. If the LBO firm had followed the intuition of the adverse selection/pecking order, it should have been willing to stake all its projects as collateral when it borrowed money for each portfolio company. Because it failed to do so, lenders demand significantly higher interest rates from individual portfolio companies than they would otherwise have demanded. Therefore, the LBO firm has to pay the price in a higher total cost of capital than it otherwise would have. LBO firms believe that the net benefits of this insulation strategy outweigh the net costs, and they therefore do not follow the pecking order prescription.

The Financing Pyramid

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Historically, the pecking order theory was taught together with the so-called **financing pyramid**. A financing pyramid is a name for a capital structure in which most of the funding sits in the most senior claims (at the bottom), presumably short-term, collateralized notes. Less funding would sit in more-junior, ordinary, long-term debt. Even less funding would be convertibles, and very little funding would be equity. This is illustrated in Figure 22.1.

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x

There is a natural connection between the pecking order and the financing pyramid. If the firm does nothing but issue financial claims, and nothing else happens (in particular, no value changes occur), then pecking order issuing behavior would build up a financing pyramid, because firms prefer issuing securities at the bottom or at least further down in the pyramid. However, a financing pyramid is not a necessary consequence of a pecking order, and vice versa.

The most important wedge between the pecking order and a financing period is changes in the value of the firm. Over time, many firms operate, pay down debt, and gain in value. Thus, once publicly trading, a firm can follow a perfect pecking order in its issuing activities—raising funds only internally or through debt—and yet be financed with much more equity than debt. (It could also be that many firms follow this pyramid financing arrangement, not because they actively issued debt, but because they incurred many operating liabilities along the way.) Empirically, some firms' capital structures indeed look like financing pyramids, but most capital structures do not. (In particular, convertibles are fairly rare relative to equity. And many historically profitable firms tend to have more equity than debt, even though they do not issue equity.) Chapter 24 will show that the actual capital structure of a firm is determined more by its industry, past performance, and M&A activity than by its past issuing policies.

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question

What is the financing pyramid? Is it a good description of empirical reality?

answer

The "financing pyramid" states that companies are financed predominantly by safer securities. Equity would be the small part of the pyramid at the top. The traditional view of the financing pyramid does not apply to many successful companies, because the equity would have grown over time.

question

Does the pecking order necessarily imply that firms are financed like a financing pyramid?

answer

No, the pecking order does not fully imply that firms have to follow a financing pyramid. Equity can change in value (and debt can accumulate during operations). Many firms follow a financing pecking order, but their capital structures do not look like a financing pyramid.

The Influence of Stock Returns on Opportunistic Issuing

From the above and from IBM's example in Chapter **??**, you know that stock returns have a direct influence on capital structure, just like active equity or debt-issuing activities have influence. We could call this influence the "direct" effect of stock returns: A firm that is financed by $1 billion in debt and $1 billion in equity and that loses one-quarter of its value ($500 million) will experience a debt/equity ratio increase from 1:1 to 2:1. (If so desired, managers can counteract this effect by issuing more equity and retiring some debt.) x

But stock returns and value changes could have a second entirely different conduit by which stock returns can influence capital structure. Although it is tied directly to past stock returns, it is not automatic. Instead, it is about how managers respond through issuing to market returns. There is some evidence that CFOs believe and act as if they can predict ("time") the financial markets. This is not too surprising. Most managers' sense of their firm's value is based on the corporate X internals, not on how the financial markets have moved recently. If the financial markets have moved up, managers' internal beliefs do not catch up immediately, so they now believe that they can raise equity relatively cheaply at high market valuations. They feel that their stock is relatively more overpriced. Note that this mechanism suggests exactly the opposite behavior to what would be required for the firm to return to its original debt/equity ratio. If the firm wanted to keep a particular debt/equity ratio, it would have to repurchase equity after it has gone up and issue more equity after it has gone down. If the firm instead wanted to time the market, it would do just the opposite: Repurchase equity after the stock has gone down, and issue more equity after it has gone up. Moreover, there is even better evidence that managers seem to try to time general interest rates and the (Treasury) yield curve. If interest rates are higher (lower) than they were in the past, companies tend to avoid bonds, and vice versa. If the yield curve is steep by historical standards, corporations tend to borrow more at short-term interest rates and issue fewer long-term bonds. In an efficient financial market, there should be little benefit to attempts at market timing, but also no cost to doing so. You can look at this attempt at market timing as just another investment, which is a fairly harmless attempt by managers to make profitable investments. x

However, what is surprising is not the fact that managers have tried to time financial markets but the empirical evidence that this has actually turned out to be profitable! Even stranger, managers have been good not only in predicting their own stock price level but also in predicting the overall stock market level—an incredibly difficult feat. (In fact, why bother being a corporate manager if you have this ability? You could get rich much more easily.) There is academic controversy as to whether this success has been the result of coincidence or real timing ability.

For example, one counterargument is that this seeming timing ability is merely
X survivorship bias: Firms that failed in their timing disproportionally disappeared. It could also just be that when the financial markets go up, more and more firms raise external funds, and this stops when financial markets go down. Thus, even though managers cannot predict the financial markets, when economists look at when firms raised funds, they will find that they did so before the market went down. Either of these two theories could explain seeming market-timing ability where there is in fact none. Hopefully, by the time the next edition of this book appears, we will understand corporate market timing better than we do today.

22.C Capital Market Pressures toward Optimality

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Finding the best capital structure is not easy. Why should you make your life so difficult by trying to determine the best capital structure? Why can you not simply copy the existing capital structures of similar comparable (and often competitor)
x firms?

Unfortunately, simple imitation is often a bad idea. The empirical evidence suggests that firms are very slow to counteract what stock market changes do to them, even when stock market changes have caused very large changes in their debt/equity ratios. Your comparable (and you!) may have a 30% debt ratio one year and a 70% debt ratio the following year. This finding has led to an academic debate (still unresolved) about what this implies:

1. Are the transaction costs too high to make it worthwhile for managers to readjust their capital structures? (If this is true, all our earlier arguments about what should drive capital structure are relatively unimportant. The best advice would be to do nothing to avoid paying issuing or repurchasing costs.)

2. Does the optimal capital structure itself change one to one with the firm's market value? (If this is true, we should not see firms change their capital structures. Whatever it happens to turn out to be is also likely the optimal capital structure.)

3. Are firms making mistakes by failing to optimize their capital structures? (If this is true, then copying comparable capital structures would be a bad idea.)

x

Let's evaluate the third perspective. Such a conclusion should hinge on your belief in a reasonably efficient market for corporate control. If you believe that an outside investor can make money by fixing a bad capital structure, as in a

perfect market, then you would also believe that current capital structures in the market are more than likely fairly close to optimal. Unfortunately, the perfect-markets scenario may be too far away from reality in this context. To "arbitrage" an incorrect financing choice, you would have to mount a corporate takeover. A typical takeover requires a premium of 15% to 30% above the current market price, plus another percentage point to pay in fees to the investment banker. To X recapture such a large control premium, rectifying an incorrect capital structure would have to create large tangible benefits. But capital structure corrections are not likely to do so. A more reasonable estimate for the value increase when moving from a bad capital structure to the optimal capital structure is typically on the order of 1% to 3% per annum. Even capitalized over many years, this rarely reaches the 15-30% control premium. x

Does the fact that outside investors cannot easily rectify capital structure mistakes mean that capital structure is irrelevant? No. The situation for inside managers is different, because they do not have to pay a control premium. They are already in charge. For them, 1-3% is not an inconsequentially low amount—especially because it is annual and because it requires almost no effort or investment to fix. For a company like IBM, which is worth several hundred billion dollars, the value created may be "only" a couple of billion dollars per year—certainly enough to cover your consulting fee! In sum, the fact that external shareholders cannot easily bring much pressure to bear on managers does not mean that internal managers should not try to get it right. x

Returning to our original question, can you find your own optimal capital structure by copying your comparables? There are several arguments against imitation:

- Whatever capital structure the comparables chose is not necessarily the outcome of competitive market pressures, in which only the best capital structure could have prevailed. Instead, there can be a whole range of capital financing arrangements that could persist in the economy—including poor ones—and no one but the managers in charge can fix them.

- You also know that managers' incentives differ from those of the shareholders. Managers like free cash flow, financial flexibility, and control over large firms. Do you want to learn how to maximize firm value, or how to maximize managerial comfort?

- Comparables are never perfectly comparable. You already know from Chapter **??** that "comparable" may be an oxymoron, because most seemingly similar firms ultimately tend to be very different upon closer inspection.

- Maybe there is value to being different from your competitors. For example, if all of them are very indebted, you might want to remain unlevered to speculate that a recession might wipe out all your competition. (The low-debt capital structure would be a strategic option—most likely not a good idea, but nevertheless there would be states of the world where it could be
X fabulously successful.)

In sum, unlike stock market values where you can believe in reasonably efficient markets, capital structure and corporate control are not as efficiently determined. Thus, as manager, you cannot have blind faith in the "magic of markets" to get the capital structure right. Some modest faith may be appropriate, though. Knowing what other managers are doing can still be helpful. Just take this knowledge with a big grain of salt.

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question
Are existing capital structures necessarily optimal?

answer
No, existing capital structures may not be optimal. The market pressures that force poorly financed companies to their optimal capital structures are too weak. In addition, other firms' managers may not even want to optimize the firm's capital structure—they may be more interested in making their own situations as pleasant as possible.

22.D Working Capital Management, Repo, and Financial Flexibility

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Much day-to-day capital structure management has to do with working capital management. Corporate growth usually consumes working capital. Customers buy goods, but they do not pay immediately. (Terms are often 30 days until payment.) This delay can create short-term cash problems, especially for small and fast-growing firms. There are many intrinsically profitable companies that have had to fold because of poor liquidity management. As the CFO of such a firm, long-run capital structure is not as important as **cash management**—and fortunately, unlike capital structure where your target was murky, this one is easy and straightforward.

important
As a manager, you would not want to let your company run out of cash. From a firm value maximization perspective, this is usually, but not always, the case, too. (This will soon become clearer.)

Of course, I do not mean cash in the register but rather cash necessary to pay creditors. Your company does not have to have lots of cash on hand. It is enough

if you can borrow with ease and rapidity to satisfy creditors when payments are due. It is not unusual for firms to refinance principal payments on loans with new loans. x

An important market for raising corporate funds is the so-called **repo** market. Although no one knows the exact size (including the Federal Reserve), estimates are that this market is many trillion dollars large. Repos are loans that are collateralized with securities owned by a firm. The lender provides cash and takes the borrower's collateral; and the borrower agrees to buy back the collateral at a higher price on a future date. Most repos are very short-term. In fact, many are loans that are extended every morning for only 24 hours. x

The repo borrowers are often companies that want to take advantage of the lower borrowing costs that short-term borrowing provides when the yield curve is steep. (Even if the Treasury yield curve is flat, the fact that default risk is often higher in the long run means that corporate issuers typically face steeper term structures.) Repo is particularly popular among firms that have high leverage or run large financial services divisions (like banks or financing companies, which includes such giants as General Electric). The lenders are often money-market funds, which want to earn a few extra basis points over the Treasury. x

But problems can arise when your firm operates too close to the brink of its financial flexibility. In this instance, it is quite possible that either of two self-fulfilling prophecies ("equilibria") can occur:

1. Lenders are not worried about the company. The company borrows and operates profitably. Lenders see their beliefs confirmed and are repaid.

2. Lenders are worried about the company and are unwilling to extend credit. Without money, the company goes bankrupt. Lenders see their beliefs confirmed that it was wise not to have extended more credit.

The financial crisis of 2008 showed how quickly the repo market could backfire. The prominent collapse of the investment banks Bear-Stearns in March 2008, and Lehman Bros and AIG in September 2008 were partly such self-fulfilling prophecies. Once lenders started worrying about repayment, they pulled their overnight credit lines from one day to the next. Without short-term financing, on which these investment banks had relied heavily, they collapsed almost immediately. Merrill-Lynch and Morgan-Stanley barely escaped the same fates only at the 11th hour. Naturally, the dark side of repo borrowing only became clearer to many borrowers during the 2008 crisis. It made the firms (more) profitable in the good times, but at a huge risk in bad times. In essence, they made money (and the traders and executives their bonuses) by "picking up pennies in front of steamrollers." x

What can you do to avoid the second, disaster equilibrium? You have a number of options, though all of them are costly:

Match assets and liabilities: You can try to match expected future cash coming in with cash going out. For example, say you want to take out a loan to pay for a new factory. The factory will produce income in 3 years. You could then take out a loan that requires interest and sinking fund payments beginning in 3 years. Matching future inflows to expected outflows is easier if your cash flows are relatively more predictable and if they occur sooner. Moreover, if you borrow with longer-term debt, you may have to pay higher liquidity premiums, risk premiums, and credit premiums. Note also that matching inflows and outflows makes more sense on a firm-wide basis, and less sense on a project-by-project basis.

Pay for flexibility: You can pay a commercial bank for an irrevocable credit line. However, although it is often cheap to get a credit line in sunny times, it is often expensive to get one that will hold up (not be revoked) in rainy times. Even IBM's $15 billion credit line is subject to various bond covenants—and if IBM were to get into trouble and needed this credit, it might no longer be available.

X

Hold liquid investments: You can invest cash in assets that have fairly safe values and allow for relatively quick and cheap liquidation. Unfortunately, unless your company is a Treasury bond fund, your business is not likely to need such assets as much as it needs the kinds of assets that are risky and hard to liquidate. For example, your half-constructed laboratory or half-finished R&D would be very difficult to resell quickly, but these are precisely the types of assets that will allow you to create value.

Adjust capital structure: You can keep liabilities low relative to your equity cushion. In this case, it is likely that your future cash flows will easily cover your future debt obligations. Moreover, if you have a low debt ratio and high interest rate coverage, you will have an easier time borrowing more cash if you ever need more. Of course, both liquid investments and a low debt ratio are costly in themselves. For instance, both would likely increase the corporate income tax obligation of your firm.

x

When CFOs are surveyed, they state that they pay close attention to their "financial flexibility"—they care very much about their interest coverage ratios and bond ratings. Such concerns may be good for firm value from a liquidity perspective. With high bond ratings and a lot of cash to pay for interest, firms

are unlikely to go bankrupt, which can save on expected bankruptcy costs. Is this managerial concern a good sign of benign intent? x

Not necessarily. There is also a very dark side to this flexibility. From the manager's perspective, having more cash is always better than having less cash. Yet, especially in large and slow-growing firms, access to all that cash "lying around" tempts managers to waste money or undertake ventures that they should not and otherwise probably would not undertake. Your investors may not even be all that thrilled if management is insulated from financial default because of its great working capital management—this ability can lead management to be satisfied with a status quo of inefficient operations. Both management and employees would likely work harder if they knew that the company would go bankrupt if they performed poorly. Consequently, if the company has great working capital management and enough of a financial buffer, it may never go bankrupt, but it may also remain stuck with poor management and unmotivated employees.

anecdote

In 2005, investment bank Lehman Brothers introduced a new debt hybrid called an **ECAPS** (enhanced capital advantaged security). These are securities that have tax-deductible interest payments (which the IRS does not allow for any perpetual bonds), but they are also very long term and allow for interest-payment postponement. Therefore, these bonds are risky and in many ways more like equity than bonds. This is a very efficient tax innovation: Firms effectively get interest-payment tax deductibility on an equity-like security.

Yet an earlier incarnation of such bonds (known as trust-preferred securities) had stalled because Moody's and S&P had not determined how to treat these securities. The ECAPS deal succeeded because Moody's assigned it into its "Basket D," which counted ECAPS as 75% equity and 25% debt. Therefore, with the extra cash inflow and its (according to Moody's) modest debt increase, an ECAPS would not likely impact the issuer's rating negatively.

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question

How can managers reduce the likelihood that they will run out of cash?

answer

Managers can reduce the likelihood of running out of cash by matching cash inflows and outflows, paying for an irrevocable credit line, holding liquid investments, or reducing their liabilities relative to their equity.

22.E Debt and Debt-Hybrid Offerings

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We first turn to firms' debt-issuing activities. Debt offerings are much more frequent than equity offerings. In fact, except in the context of acquisitions where both equity and debt offerings are common, large publicly traded firms tend to finance almost all of their projects through either retained earnings or debt offerings. Debt offerings are the bread and butter for both firms and investment banks.

Does Fair Pricing Imply Choice Irrelevance?

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Section **??** explained how to think about the many bond flavors available to you. Recall all the features and variables involved: seniority, security, covenants, collateral, conversion, callability, putability, maturity, duration, fixed or floating, and so on. IBM's debt structure, described in Tables **??** and **??**, is a good example of the variety of debt claims a single firm may have outstanding. For most bond features, as for all other financing methods, the basic finance mantra holds: You get what you pay for. For example, if as CFO you give bond buyers more rights (e.g., a conversion feature), you get to pay a lower interest rate. If you want to keep more rights (e.g., write in a call feature), you must pay a higher interest rate. Despite the just mentioned empirical behavioral finance evidence on timing to the contrary, by and large it seems unlikely that managers can guess very precisely what features the market generally overvalues or undervalues, and of course whether interest rates will go up or down.

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But fair pricing does not mean that you cannot add value by choosing debt securities that employ the features that are most appropriate to your own firm. Recall the example (from page 581), that required changing the CEO every week. Or consider a bond feature that says that all factories will be permanently closed if the AFC team wins the Super Bowl. In a competitive market, you will get a fair price for these bonds and any other securities that you might issue, but these are not a great security to issue if you want to maximize market value. The point is that you should offer bonds that have features that are well suited to your company. But if you stay within the limits of ordinary and frequent bond features (say, choosing a convertibility or callability feature), it is often true that it will matter only modestly which exact features your bonds are offering.

Assembling the Building Blocks of a Bond Offering

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So far, you have enjoyed the à la carte approach to bond features—each by itself, one at a time. Let's now have a full-course dinner. How do large, publicly traded corporations really borrow money? The most common way for many mid- to

large-cap companies to borrow is to obtain a bank credit facility and issue multiple bonds ("term debt") at the same time. The typical financing package consists of two parts, the revolver and the term debt:

The revolver (i.e., a revolving credit line) is a line of credit on which the company can borrow and repay, and borrow again, until a termination date/maturity. The bank offering the revolving credit line also receives a fee for the unused/undrawn portion of the revolver.

The term debt is structured in one or more [pl]tranche (French for "slices"). The principal payment schedule and maturity date are different for each of the tranches. Tranche A would begin to amortize right away and would have the shortest term to maturity. The tranche B term loan would amortize and mature after the tranche A term loan but before the tranche C term loan, and so on.

The revolver and tranche A loan usually carry the same interest rate spread over LIBOR (the London Interbank Offer Rate) and are marketed as a package. The tranche B and C lenders receive wider spreads over LIBOR to compensate creditors for the added credit risk of having a longer-term loan to maturity. x

Who sells these instruments? If the bond issue is large, a "lead" investment banker ("underwriter") syndicates a large part of the corporate bond to other investment banks to make it easier to place the bond. (Lead underwriters are often the big-money banks, such as JP Morgan Chase or Citibank.) The deal itself is brought to the capital markets (potential investors) with proposed pricing by the syndicate lead, but it is ultimately priced at whatever price (interest rate) clears the market. x

Who are the investors in these multiple loan instruments (all issued simultaneously)? Because institutions and mutual funds are not set up to provide revolving credit, the "pro rata" revolver piece and tranche A loan are often purchased by commercial banks. The market for subsequent tranches of term debt is more liquid, and these bonds are typically purchased by mutual funds, commercial banks, hedge funds, and the like. x

Smaller companies usually borrow in simpler ways. They often have a relationship with either a smaller syndicate of commercial banks or perhaps a regional bank in the case of a very small company. The structure would in all likelihood be less complex—a revolver and only one tranche of term debt, or perhaps even only a revolver. In terms of pricing, their bonds must offer premium pricing to compensate the lenders for the added credit risk of lending to a small company and for holding a less liquid financial claim. (The price is negotiated between the borrower and lender.)

x

Post-Issue Placement and Bond Liquidity

As with all securities, issuers can raise financing at lower costs if they can give potential investors more information and the ability to liquidate their investments quickly. Equity securities are usually bought and sold on stock exchanges after the original offering. The two most important exchanges in the United States are NASDAQ and the NYSE. Bonds, on the other hand, often do not trade on any exchange (such as the **New York Bond Exchange**). And when they do trade, the markets tend to be not very liquid. (The bond trading volume on exchanges is very low.) Instead, most bonds are traded **over the counter**, that is, by large investors

X who call up individual investment banks' desks. The transaction price is usually not disclosed in such cases, and trading is fairly rare. Because the vast majority of bond transactions take place between dealers rather than on an exchange, accurate bond prices are difficult to come by. (As an individual investor, you are better off staying away from purchasing individual corporate bonds. Buy a mutual fund that holds corporate bonds instead.) Over the last few years, however, a financial market has developed that is a close substitute for the corporate bond market—the

X credit default swap (CDS). Instead of purchasing a corporate bond on IBM, an investor can purchase a Treasury bond and sell a CDS. The two strategies are almost exactly alike.

x

Coercive Bond Exchange Offers

Most bonds include contract provisions by which covenants can be changed. However, such provisions are usually difficult to invoke, except in financial distress.

x For the most part, firms must live with whatever covenants they write up front.

But there are two mechanisms that allow creditors to change the terms that

X public bondholders have negotiated. The first is bankruptcy, a process in which the judge can change the terms. The second is the **exchange offer**. These days, exchange offers are rare, because creditors have learned to protect themselves

x against such "offers." Still, the basics of this mechanism are worth knowing.

Consider a firm that had earlier sold only one class of bond with a face value of $1,000 to 100 creditors. You are one of the creditors and you hold one bond. Each bond is a claim to $10. Unfortunately, the firm value has already dropped to $500, so your bond is now worth only $5. Would you agree to reduce the face value of your bond from $10 to $6 now? If you were to agree, and if the firm later had some luck increasing its value from $500 to, say, $1,000, you would not

xnopar receive anything more than $6. It turns out that the firm can "make you an offer that you cannot refuse." Let's say that the firm offered each creditor the option to exchange the $10 bond into a $6 bond that is more senior. Now consider what is

in your interest:

- If no other creditor accepts the exchange offer, and neither do you, then your unexchanged $10 bond is worth $5. If you accept the exchange, your senior bond is paid before the other bonds, so your bond's value increases from $5 to $6.
- If all other 99 creditors accept the exchange offer, then they would have claims on $99 \cdot \$6 = \$594$ of the firm worth $500. Your own $10 bond is more junior, so you would get nothing.

x

It is in the interest of each bondholder to participate, but that means they will collectively end up worse off. Thus, the bond exchange offer works by playing off creditors against one another—the firm cannot play the same game if one single creditor (a bank) holds the entire bond issue. To eliminate such coercive bond exchange offers, many bond covenants now require firms to obtain approval by majority or supermajority vote before they can exchange any bonds (or waive covenants). In our example, every bondholder would vote against the exchange offer, and thereby all bondholders would come out better off.

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question
How does a coercive bond exchange offer work?

answer
A coercive bond exchange offer gives existing bondholders the right to exchange their bonds for more senior bonds with lower face values. Bondholders who do not participate are effectively expropriated.

22.F Equity Offerings

x

Most publicly traded shares appear on an exchange in the context of a public equity offering. A **seasoned equity offering** (also known as a **follow-up offering**) is the X sale of shares in an already publicly traded company. Seasoned equity offerings are rare events for large, publicly traded corporations, except in connection with M&A activity. Remarkably, in contrast to bonds, liquidity is often not a big problem for after-market stock investors. Over 10,000 large U.S. firms now have their common stock traded on a major public stock exchange, such as the NASDAQ or the NYSE. There, any investor can easily purchase and sell shares, and closing prices for the previous day can readily be found in most newspapers. Not all shares are first

issued and sold on an exchange. Some shares may simply be granted to employees or managers. These shares sometimes come from the **treasury stock**, which are the shares that the company itself has repurchased.

The institutional process required to sell new shares in a public offering is lengthy and unwieldy. (For initial public offerings, it is an outright ordeal.) Fortunately, firms with fewer than 100 investors that do not try to sell their claims to the public are not (or are at least less) regulated by the SEC and thus can avoid the long process. (In a famous incident, Google ran into the constraint that it had more than 100 entities owning shares, so it had no choice but to go public, even though it did not need external funds.) Many smaller companies and hedge funds would simply be overwhelmed by the costs of navigating the SEC processes and requirements.

Public firms can issue seasoned equity through various mechanisms. Three are most important:

1. **A standard issue:** For example, a firm with 50 million shares representing $400 million in outstanding equity (i.e., $8/share) may announce that its board of directors has approved the issuance and sale of another 10 million shares in 3 months. The shares are to be sold into the market at the then-prevailing stock price 3 months later. If the stock price will be $10/share at the time of the offering, the firm value will be $500 million just before the offering and $600 million just after the offering. Both immediately before and after the offering, each old shareholder will still own a claim of $10/share.

2. **A shelf offering (Rule 415 offering):** For new equity shares registered with the SEC under Rule 415, the firm does not set one specific date at which the shares are to be sold into the market. Instead, the firm can put the shares "on a shelf" and sell them over a period of up to 2 years, at its own discretion and without further announcements.

3. **A rights offering:** Yet another way to sell new equity shares is a **rights offering**. These are rare in the United States, but they are popular in some other countries (e.g., the United Kingdom). Instead of issuing new shares to anyone willing to purchase them, the company grants existing shareholders the right to purchase 1 additional share of equity at $2/share. If all 50 million shareholders participate, the company will raise $100 million. Each shareholder will own 2 shares, so there will now be 100 million shares to represent $600 million in assets. Each share will be worth $6, and each old investor will have invested $12 for 2 shares.

So far, there is no difference between the rights offering and the plain cash offering: Both facilitate the raising of $100 million without loss for existing shareholders. However, what happens to a shareholder who does not participate? This shareholder will then own 1 share, for which she will have paid $10 and which will now only be worth $6. This nonparticipating shareholder will have been expropriated. Therefore, rights offerings allow the firm to leave existing shareholders with no reasonable choice but to participate in the offering. (Of course, if a shareholder does not have cash, selling the shares to someone else for a fair price—or, if possible, the unbundled rights—solves such liquidity constraints.)

Like bond offerings, equity offerings are usually orchestrated by an underwriter. X
In both types, both the issuer and the underwriter are liable not just for false statements but even for "material omissions." Nuisance lawsuits, especially after an IPO has declined, are not uncommon. x

You also need to know what **primary shares** and **secondary shares** are. These are confusing names, because they do not describe the distinction between shares from an initial public offering and a seasoned offering. Instead, primary shares are shares that are newly minted and sold by the firm itself. The proceeds go to the firm itself. (These are really the kinds of offerings that we just discussed.) Secondary shares are shares that are sold by an investor in the firm (e.g., by the founder). The company does not receive the issue proceeds. Secondary offerings are more like insider sales, so they are also often smaller than primary offerings. But they are usually greeted especially negatively by the market: An owner who wants to abandon ship and sell out is not good news. Because our book focuses X
on the firm's capital structure, we are concentrating on primary offerings.

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question

Assume that there is a rights offering for a firm that is worth $500 million and that offers its shareholders the right to buy 1 extra share for each share they already own. The "discount" price for the new shares is $1/5$ the price of the current shares. Assume that half the investors do not participate. What is the loss to nonparticipating investors (shares) and the gain to participating investors (shares)?

answer

Assume that the shares are $10 each. You can then purchase shares for the $1/5$ price mentioned in the question, that is, $2 each. Of 50 million shares, 25 million will participate. You will raise an extra $50 million. Thus, total corporate assets will be $550 million. There are now 75 million shares in total. Therefore, each share will be worth $7.33. Participating investors will own 2 shares worth $14.66, for which they will have paid $12. This represents a 22% gain. Nonparticipating

investors will own 1 share worth \$7.33, for which they will have paid \$10. This represents a 26.7% loss.

question
How could a coercive seasoned equity rights offering work?

answer
A coercive seasoned equity rights offering could give existing shareholders the right to purchase more shares at a price below the market value of shares. Investors who do not participate are effectively expropriated.

22.G Initial Public Offerings (IPOs)

x

In contrast to a seasoned equity offering, an **initial public offering** is the first public sale of shares. There is no established price, so it is considerably more difficult and risky to place IPO shares than SEO shares. Moreover, without an existing public price, we cannot measure how the financial market responds to
x the announcement of an IPO.

In a typical IPO, the issuer must provide audited financials for the most recent 3 years. Thus, unless the firm is so new that it has no recent history, or unless the firm has carefully planned its IPO years ahead, many firms must go back and create audited financials for activities that happened long ago. Similarly, firms often have a lot of other housecleaning to do—folding in or laying out subsidiaries, untangling relationships between the private owners and the firm, and so on. The real IPO process starts when the firm selects an underwriter (usually after competitive presentations by several investment bankers). It is the underwriter who orchestrates the offering, who shepherds the institutional process, and who markets the offering to generate interest among potential investors. Together with the auditor and legal counsel, the underwriter and the firm create a preliminary offering prospectus and file it with the SEC. They then give a set of "road show" presentations to solicit interest among potential investors. But neither the firm nor the underwriter is legally allowed to make statements beyond those in the preliminary prospectus. The preliminary prospectus also does not usually name one fixed price, only an estimate (a price range). The range itself is estimated via the methods you have already learned, specifically, through NPV and comparables. However, the exact assumptions used to come up with the range are not explained in the prospectus in order to avoid legal liability if the projections turn out to have been overly optimistic. Finally, the underwriter can informally collect a list of interested parties but is not allowed to take firm buy orders. This process is called

"book-building," and the information in the book is ultimately used both to set the final offering price and to decide on who receives what shares.

Usually within 48 hours after the SEC approves the prospectus, the offering goes live. The final offer price is set on the morning of the offering, based on investor demand reflected in the book. Remarkably, IPOs are usually priced to create excess demand among investors, so shares become rationed. The average IPO experiences a jump of about 10-15% in 1 day (not annualized!), called **IPO underpricing**. During the 1999-2000 bubble, however, average underpricing reached as high as 65%, a remarkable rate of return for just 1 day! There are a number of theories that help explain why IPO underpricing occurs, and in real life, they probably all carry some degree of truth:

Winner's curse: If you are an uninformed investor and ask for allocations, you will likely be stuck disproportionately with shares in the hard-to-sell offerings. For example, if half the offerings earn +10% and are oversubscribed by a factor of 2, and half the offerings earn –10% and are undersubscribed, it would be 0% on average, but you would most likely receive an allocation of only half as many shares in the +10% offering as in the –10% offering, so your average rate of return would be

$$\underbrace{50\%}_{\substack{\%\text{ Underpriced}\\ \text{Offerings}}} \cdot \overbrace{0.5}^{\substack{\text{Expected Share}\\ \text{Allocation}}} \cdot \underbrace{(+10\%)}_{\text{Underpricing}} + \underbrace{50\%}_{\substack{\%\text{ Overpriced}\\ \text{Offerings}}} \cdot \overbrace{1.0}^{\substack{\text{Expected Share}\\ \text{Allocation}}} \cdot \underbrace{(-10\%)}_{\text{Overpricing}} = -2.5\%$$

Consequently, if shares on average earn a 0% rate of return, you and others like you should not participate. Your return will be negative. To keep you in the market, underwriters must underprice their IPOs.

Information extraction: How can underwriters get you to tell them what you think, so that they can build an accurate book (of preliminary orders)? Without a financial incentive to tell the truth, you and others like you would tell the underwriter that you believe that the offering is not worthwhile, hoping to get them to price the offering lower. With underpricing as the currency of compensation, the underwriters can pay you to tell truthfully your otherwise private reservation price. The underwriter must then reward the more enthusiastic investors with more (and just mildly) underpriced shares. It has been shown that such a strategy can actually maximize the offering proceeds.

Good taste in investors' mouths: How can firms signal that they are in the game for the long run, rather than just a fly-by-night fraud? The best way is to show patience and to give you a relatively good deal in the IPO. It would create "goodwill" among investors and thus make it easier to place subsequent offerings. A bad or fraudulent issuer would not want to play this game, because the fraud would likely collapse before the goodwill ever pays off.

Cascading, highly elastic demand: As an investor, you can probably learn a lot from how excited other investors are about the IPO. If investors all eye one another, and if shares are just fairly priced, any IPO could end up either a tremendous success or an utter failure, depending on where the investor herd is stampeding. From the perspective of the underwriter, the demand for shares would be both very elastic and very noisy. In this case, underwriters may prefer to ensure success by underpricing. This creates enough enthusiasm and avoids the risk of failure.

Agency conflicts (underwriter selling effort): Underwriters do not like to work very hard to sell difficult-to-place, fairly priced shares. However, the issuer cannot easily learn how hard the banker is trying to work the crowd. Thus, it is often more efficient for the issuer simply to underprice shares to make selling easier than it is for the issuer to price the shares correctly and then try to ascertain whether the underwriters are doing their best to place the offering.

Agency conflicts (additional underwriter compensation): Although it may not be in the interest of the issuer, underwriters use IPO underpricing as "currency" to reward their best brokerage customers. This requires that the underwriter be in the driver's seat, not the issuer (and for the issuer to acquiesce to give away money). (In my opinion, this was probably the best explanation for the extremely high underpricing during the tech boom of the late 1990s.)

X

Firms typically only sell about one-third of the firm to the financial markets. Therefore, to the entrepreneur, 10% underpricing of one-third of the firm translates only into about 3% in terms of value. Clearly, the entrepreneur would be better off to keep this 3% than to donate it to external investors, but the loss is modest. It is outright small compared to the potential diversification benefits experienced by many entrepreneurs, who are often very undiversified. Thus, many of them are less worried about 3% underpricing and instead more eager to successfully "cash out" to enjoy some of their wealth and to become less dependent on the fortunes of their single company.

x

After the firm is publicly trading, the underwriter often tries to promote the firm and maintain reasonably stable pricing and trading volume in the after-market. X Indeed, for most smaller offerings, the underwriter usually also becomes the NASDAQ market maker, providing investors that want to buy and sell shares with the appropriate liquidity. x

Underpricing is just one among a number of interesting phenomena for IPO firms. We do not yet fully understand all of them, but here is an interesting selection of findings about IPOs:

- On average, IPO firms drastically underperform similar benchmark firms, beginning about 6 months after the IPO and lasting for about 3 to 5 years. (A conservative estimate is a risk-adjusted underperformance of about 5% per annum relative to the overall stock market.) However, it is not only the IPO firms themselves that seem to perform poorly after the IPO, but also firms that are similarly sized and in the same industry. No one really knows why. We do know that this downward drift is considerably stronger for firms that are relatively more aggressive in the reporting of their financials at the IPO. (A similar downward drift occurs after firms issue seasoned equity.)

  Who would be foolish enough to hold onto shares of a firm that has issued equity for more than the first 6 months? Because academic researchers cannot find out where equity shares are located (most stock holdings are confidential), we cannot fully study this phenomenon. The "word on the street" is that many of these shares end up in the accounts of very unsophisticated investors, such as "trust accounts" for widows and orphans.

- Underwriters' analysts routinely issue "buy" recommendations on their IPOs. This is not surprising. What is surprising is why this still seems to matter. Why would any investor pay attention to these obviously conflicted analysts' opinions?

  anecdote

  The number of analysts' [pl]buy recommendation outnumbers the number of [pl]sell recommendation by a ratio of about 5:1; when limited to **strong buy** and **strong sell** recommendations, this ratio changes to over 10:1.

  The primary reason for this imbalance is a conflict of interest. Most brokerage firms—and by extension their analysts—are owned by investment banks. (They are even called "sell-side" analysts, even though their "advice" goes to investors!) The investment banks are well aware that a sell recommendation is likely to induce the targeted firms not only to exclude the particular analyst from obtaining further information about the firm but also to induce the targeted firm to select a different underwriter. Therefore, the investment banks discourage their analysts subtly and not so subtly from issuing sell recommendations. Although this analyst bias was always widely recognized by professional

investors, it had received scant attention in the press and little recognition by small investors—until 2001, when it suddenly became a public scandal. (It is still somewhat of a mystery why then, but not before.) In April 23, 2003, ten of the largest investment banks settled a lawsuit by setting aside funds for making independent research available to brokerage clients and promising a separation of their brokerage analysis from their investment banking functions. It is not yet clear how effective these reforms have been. Recent financial market issues have overshadowed and diverted attention from these issues.

- Insiders routinely sell their shares as soon as a pre-agreed lock-up period (typically, 6 months) expires. When the lock-up expiration week comes around, the IPO stock price predictably goes down by about 2%. This is a financial mystery: Who would want to hold IPO shares the day before the lock-up expiration?

- IPOs either happen in droves or do not happen at all. When the overall stock market and the firm's industry have recently performed well, IPOs tend to pour in. Professionals call this an "open IPO window." When the opposite occurs, the window is closed and there are zero IPOs. IPOs are not just reduced in price or scale, but they are typically withdrawn completely. Why?

- It is not surprising that the average IPO pays 7% in underwriting commission—the maximum allowed by the National Association of Securities Dealers (NASD)—though many issuers find some backdoor mechanisms to raise the underwriter commissions further. But it is surprising that virtually every IPO pays 7% commission. In such a competitive market, why do underwriters not compete more fiercely on the commission front?

These are all interesting questions for future research.

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question

Evaluate: IPOs should be underpriced by about 10-15%, because the average rate of return on the stock market is about 10-15%, too.

answer

False. The 10-15% IPO underpricing is not an annualized figure, unlike the stock market, which has a rate of return of about 10% per annum. IPO underpricing is a 1-day figure. Thus, the IPO 10% magnitude is enormous.

question

Here is another winner's curse example. A painting is up for auction. There are

5 bidders, you among them. Each bidder has a private signal (opinion) about the value of the painting. One of them overestimates the value by 20%, another by 10%, another estimates its value correctly, and two underestimate the value by 15%.

1. Is the average private value equal to the expected painting value?
2. You do not know the value of the painting, but believe it to be worth \$150. The distribution of bidders' relative valuations is still 20%, 10%, 0%, –15%, and –15%. What should be your absolute maximum bid before you expect to lose money?
3. (Advanced) What should you bid in a real-world auction in which each investor has a normally distributed signal with mean of \$100 (the true value) and standard deviation of \$10? (In the real world, you must judge the reasonable uncertainty that you and others have around the true value.) To draw normally distributed random values in a spreadsheet, use **norminv(rand(), 100, 10)**. In each row, have five such entries (columns A–E), one for each of the five bidders in the auction. In column (F), write down how much the maximum bidder believes the painting to be worth. (Hint: Use **max (A:E)** in this column.) Create 1,000 such rows, and compute the average highest bid. How biased is it? What would you expect to earn if you bid your best private guess? (You could repeat this with more or fewer bidders and graph the estimate of the winning unbiased bid against the true value—what should you bid on eBay against a hundred other bidders?)

answer

For the painting:

1. Yes, the average private value is equal to the expected painting value, because $(20\% + 10\% + 0\% - 15\% - 15\%)/5 = 0\%$.
2. You should assume you are the one that had the 20% overestimate. Thus, if you know that there is exactly one bidder with the highest overestimate, it being exactly 20% of the value, then you should shave 20% off your bid. In this example, if you have drawn \$150, then you should offer no more than $\$150/1.2 = \$125$.
3. When you follow the instructions, you will find that with five bidders, your expected winning painting bid is about \$111.7. So you should bid no more than $\$100/\$111.7 \approx 89.5\%$ of your private value estimate. Here are more expected values of the top bid as a function of the number of bidders:

Number of Bidders	1,000-Rows Average of Top Bid
1	\$100.0
2	\$105.7
3	\$108.7
4	\$110.2
5	\$111.7
10	\$115.4
20	\$118.6
100	\$124.8
1,000	\$132.3
∞	\$138.4

question

If shares in successful IPOs are oversubscribed by a factor of 3, and if offerings are equally likely to either appreciate or depreciate by about 15% on the first day of trading, what would you expect your rate of return to be without IPO underpricing, assuming fair rationing?

answer

This is an example of the winner's curse in the IPO context. An uninformed investor would expect to be rationed if the offering is underpriced. For every share requested, fair rationing means that she would only receive $1/3$ of a share (due to the oversubscription by a factor of 3). Thus, this investor would earn $\frac{1}{2} \cdot \frac{1}{3} \cdot (+15\%) + \frac{1}{2} \cdot 1 \cdot (-15\%) = -5\%$.

question

What fraction of the firm is usually sold in an IPO?

answer

The typical IPO sells off about one-third of the firm.

question

What are various reasons why IPOs are underpriced?

answer

There are a number of explanations for IPO underpricing—such as the winner's curse, payment to investors for revealing information, the intent to leave goodwill for future offerings, highly elastic cascade-related after-market demand, and agency conflicts between the firm and the underwriter.

question

What are the main empirical regularities about IPO pricing and stock returns?

answer

On average, IPO shares appreciate by 10-15% from the offer price to the first after-market price and then lose about 5% per annum over the following 3 to 5 years. (Other regularities are described in the text.)

question
What is a good predictor for future IPO waves?

answer
The performance of an industry in the stock market is a good predictor for future IPO waves.

22.H Raising Funds through Other Claims and Means

Debt and equity are not the only claims that corporations can issue to raise funds, but they are the broadest categories and the best studied. Investment banks regularly help firms to issue all sorts of debt/equity hybrids, and for the most part, you can think of many hybrids as combinations somewhere along a continuum. For example, a bond may be straight, or it may have a conversion feature only at a very high firm value (in which case it is almost like a straight bond), or it may have a conversion feature at a very low firm value (in which case it is almost like equity). The aforementioned ECAPS is a good example.

Firms can obtain financing not only from public markets with the help of an investment bank but also from plain old commercial banks—and most large publicly traded corporations do. (Most smaller firms rely on banks almost exclusively as their loan providers.) But insurance companies, pension funds, mutual funds, foundations, venture capital funds, private equity funds, and even a multitude of government support programs have also jumped into the fray and may help provide specific companies with needed capital.

Firms can also obtain funds by the issuing of hedging contracts (which may promise future delivery of a good in exchange for cash today), securitization (in which the firm sells off assets such as its accounts receivable instead of retaining its assets), and so on. (The firm can also reduce its cash needs through transactions in which it leases instead of buys, through divestitures, etc.)

An often-important method of obtaining (or granting) financing is trade credit, in which the seller of a good allows the buyer to delay payment. (The typical publicly traded firm has just a little less in accounts payable than it has in all its financial debt together.) A customer firm may even raise financing unilaterally simply by not paying bills on time. But small and shaky firms are not always alone in stretching payments. Even large firms may earn an important competitive advantage through better working capital management. For example, Wal-Mart has often been accused of squeezing its suppliers (i.e., by not paying them for a very long time). It can afford to do so because its suppliers dare not risk losing Wal-Mart's large market distribution. From 2000 to 2005, the very large British

retailer Tesco increased its accounts payable by £2.2 billion while its inventory stock increased by only £700 million—prompting the British Office of Fair Trading to open an investigation as to whether this was due to unfair pressure on suppliers or merely an efficiency gain in working capital management (though one does not exclude the other). Amazon actually has negative working capital—it first receives customer payments before it obtains the goods, thereby having capital with which it can either run its business and/or earn a financial rate of return.

These are all plausible and common methods to finance operations—whether they are wise or not depends on the situation and the firm.

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question
What is trade credit? Can trade credit be an important source of funding for firms?

answer
Trade credit is extended by a firm's supplier in the form of delayed payment due dates. That is, the firm is not required to pay for the goods upon receipt. Therefore, the firm has some time to sell the goods that it purchased via trade credit. This gives it an alternative source of funds—the supplier rather than, say, a bank. The empirical evidence suggests that trade credit and accounts payable are very important sources of financing for firms—for many firms they are as important as their financial debt financing.

22.I The Capital Market Response to Issue (and Dividend) Announcements

x

As CFO, an important question on your mind will be how your stock price would respond if you decided to issue equity or debt (or the opposite, if you decided to retire equity, pay a dividend, or retire debt). By and large, if your actions raise firm value, then your stock price should increase. If your actions decrease firm value, then your stock price should fall. Beware, however, that it is only "by and large," because it may not be your actions themselves that would necessarily be responsible. Recall the second question at the outset of the chapter, which asked whether your investors understand why your actions are good for the firm. For example, it could be that an equity issue is truly in the interest of your investors, but they incorrectly believe that your issuing equity signals that you plan to waste the money. Or, it could be that your equity issue saves your firm from catastrophic bankruptcy and thereby adds value, but your investors had not realized how bad the situation was. Even though your equity issue adds value, the announcement

of the equity offering would then be associated with a value drop in outstanding shares. x

As a manager, you should therefore be quite interested to find out what you can learn from the announcement price reaction of other firms having done similar things. Moreover, are your actual issuing costs the sum of the announcement price reaction and the issuing fees? If it costs you \$10 million in fees to issue equity, and your stock price increases by \$10 million upon the announcement, does this mean that the equity issue neither adds nor subtracts value? We also have an academic interest in this question: A more negative reaction to the issuance of more-junior securities is the prime assumption underlying the pecking order. Are these reactions really negative for many firms?

What Announcement Value Changes Mean

x

First, let's work out how issuing costs (such as investment banking fees and your time) relate to the stock price reaction when the firm announces an offering. Start with a perfect market in which a \$100 million firm raises \$50 million and pays the underwriter \$30 million in commissions. Who ultimately pays for these commissions? It is the old shareholders. The new shareholders participate only if they can buy at the appropriate price. Because the post-offer firm will be worth \$120 million, new shareholders demand \$50/\$120 $\approx$ 41.7% of the firm in exchange for their \$50 million contribution, or they will balk. Old shareholders therefore experience an announcement price drop:

Existing Outstanding Equity Value	
Pre-Announcement Value:	$100\% \cdot \$100 \text{ million} = \$100 \text{ million}$
Post-Announcement Value:	$58.3\% \cdot \$120 \text{ million} \approx \$70 \text{ million}$
$\Longrightarrow$ Issuing Announcement Drop:	30%

A common measure of the cost of an offering is the ratio of the announcement drop over the amount of equity raised, called **dilution**—and here 60% (30% of \$50 million). Put differently, the firm value increased by only 40% of the \$50 million issue. The rest was dissipated. X x

Some CFOs add the dilution cost (\$30 million) to the underwriting fee (\$30 million) to come up with a total cost of issuing. You should now understand why this is a mistake. The dilution (the announcement drop) is not a measure of additional cost but a measure of total inclusive cost. Adding the two would be double-counting. x

If you were now to observe that the value of outstanding equity had dropped from \$100 million to \$60 million instead of to \$70 million, then the firm must have

lost another $10 million in value through the issuing of the equity not explained by fees. In contrast to the direct fees, you usually do not immediately know the causes for the extra $10 million in remaining dilution. You have to make an educated guess. It could be that existing owners believe that the firm gave away too much in features, or that it chose the wrong securities features, or that the firm or shareholders will now pay more in taxes, or that shareholders learned the bad news that management was doing poorly and needed to raise more money. Actually, the announcement effect is more likely not just one or the other but the sum of all of these value effects. In the end, the point is that the extra loss of $10 million is a cost, just like the direct cost of $30 million paid to the underwriter. Note that this $10 million cost is merely associated with the offering, not necessarily caused by it. For example, as already mentioned twice, it could be that the market merely reacted negatively because it learned that the firm had run out of money—something that would have happened sooner or later even if the firm had never issued any equity. Not issuing equity would not have helped—in fact, it could have made things far worse.

x

The converse also works. If the value of outstanding equity had dropped from $100 million to $80 million, the issue must have cost the $30 million in commissions but created $10 million in value elsewhere. In the extreme, if the firm value increased upon the announcement from $100 million to $110 million (and we know that some firms do, in fact, increase in value upon the announcement of a new issue), you would know that the issue cost $30 million in underwriting fees but created $40 million in value.

important

- A firm that seeks to maximize shareholder value should minimize all costs of issuing—whether underwriter/related costs or deadweight costs (such as taxes)—and maximize all value created by issuing.
- In an efficient and perfect market, the instant dilution at the announcement includes the costs and benefits of an issue. Never add dilution and issuing costs together to come up with a total cost of issuing.
- Some dilution is correlated with issuing activity but not caused by it. For example, investors may learn to expect a worse future if the firm issues equity, and the stock price may drop. This does not mean that the act of issuing equity itself reduced the value of the firm. In the extreme, it could even be that the alternative of not issuing could leave the firm bankrupt and worthless.

x

In real life, why can you not just look at the announcement reaction and then decide whether you want to issue equity? Unfortunately, when you consider whether to issue, you have not announced it yet, and so you do not know the

exact stock price reaction. How about the following strategy, instead: Could you announce your intent and wait to see what the value consequence is—and if it is negative, then couldn't you just announce that you have changed your mind and not go forward? Unfortunately, if the market can anticipate that you are just floating a trial balloon, then the stock price may not react at all. If the market response is a function of what it believes you will do, and if what you will do is a function of what you believe the market will do, then the blind may be leading the blind. The outcome could be anything. If the market believes you will carry through an equity offering, it could respond negatively, and you would cancel the issue. Interestingly, sometimes managers do cancel offerings if the stock market reaction is especially violent. In this case, the stock price usually shoots up again. The net value effect is not as bad as it would have been had they carried through with the bad issue—but the empirical evidence also suggests that it is still worse than if they had never announced an issue to begin with.

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question
In an efficient market, when would you expect the issue announcement price drop to occur—at the instant of the issue announcement or at the instant of the issue?

answer
Recall from Section **??** on Page **??** that any value drop must occur at the instant of the issue announcement. Otherwise, you could profitably trade on your advance knowledge of the already-announced event that will occur in the future.

question
If you know that offering more equity will reduce the value of your firm, does this mean that issuing such equity would be harmful to the firm?

answer
Issuing such equity would not necessarily harm the firm—it could even rescue it. The negative reaction may come from your investors learning (possibly correctly) that something bad has recently happened—for example, your R&D has failed. To rescue the firm's valuable projects, your best choice would still be to obtain more funding despite the negative reaction.

The Exact Empirical Estimates

x

Before you mistake this for a cliff-hanger in which you will never learn how the U.S. stock market reacts to announcements, let me tell you the historical event study evidence. (The web chapter describes it in much greater detail.) X

Equity offerings: On average, when firms raise more external equity capital, it is bad news and the stock price drops. For publicly traded firms in the United States from 1980 to 2000, the 2-day announcement price change for an equity issue (increasing firm size and decreasing debt/equity ratio) was a drop of about 1.5-2.0%, with a standard deviation of about 6%.

Because offerings are much smaller than the outstanding capitalization, the average dilution was about 15%. This 15% is the total cost of issuing. It includes the direct fees. Figure 25.4 shows that these direct equity issuing costs are around 5%, so they can explain only about one-third of the 15% dilution. Thus, the evidence suggests that investors either infer that management will not use the extra money productively, destroying another 10% in value, or that the firm can no longer produce as much money as they thought it could (which investors would have found out sooner or later anyway).

X

Debt offerings: On average, the announcement of a new debt issue seems to be neither particularly good nor bad news. The equivalent announcement price change for the typical debt issue was about +0.2%, with a standard deviation of about 3%. Though statistically significant, this is a very modest drop. You can almost consider it to be about zero.

Debt-for-equity exchanges: On occasion, some firms have replaced debt with equity, or vice versa, keeping the firm size unchanged. On average, when firms moved toward debt, their stock prices generally increased. Conversely, when they moved toward equity, their stock prices generally decreased.

Dividends: On average, the market likes dividend increases. The equivalent announcement price change for a dividend announcement in our sample was a price gain of about 0.25%, with a standard deviation of about 4%.

Remarkably, the size of the issue or the size of the firm seems to have mattered little. However, bigger dividends and dividends issued by smaller firms were greeted with a relatively more favorable response. In all of these announcements, there was also considerable heterogeneity. For example, some firms issuing equity were greeted with very positive market reactions.

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question

What do you expect the price reaction to be on the day that the new seasoned equity offering shares are sold into the market? (This is not the announcement day.)

answer
The price reaction on the actual issue day should be about zero, because the share sale is an event that was announced earlier and thus should have been almost perfectly anticipated. If the market did not use this information efficiently, and the share price were to go down on the day of the offering, you could short the equity shares the day before the offering, and repurchase them the day after the offering for a profit.

Extrapolating the Average Empirical Evidence to Your Company

x

As a CFO, what can you learn from what other corporations have experienced in the same situation? How can you interpret these market reactions? Should you apply them as a prediction for your own firm? x

Recall that both debt issues and equity issues increase the size of the firm, but they have opposite effects on firms' debt ratios. Taken together with the empirical announcement price evidence, this suggests the following:

- Increases in firm size are bad news. Payout of capital is good news.
- Increases in debt ratios are good news. Increases in equity ratios are bad news.

For debt issues, the two effects roughly cancel each other out; for equity issues, they act in the same (negative) direction. x

Thinking further, this suggests that the market believes that, for the average publicly traded company, tight finances (with high debt burdens and little free cash flow) enhance corporate efficiency. This supports the agency perspective of capital structure. (The evidence is also consistent with a corporate tax perspective and an inside information perspective, but not with a financial distress costs perspective.) x

There are also a number of caveats why you should not overread the evidence. The event studies have definite limits: They try to isolate an effect from very noisy stock prices; they suffer from the fact that investors may have anticipated the offering; and they rarely apply directly to any one given company. (The average company in the market is unlikely to be a good comparable for your company.) For example, even the very pronounced equity announcement drop of 2% still allows about 40% of all firms to experience a positive announcement reaction—this could be your company! In sum, yes, the evidence is useful and informative, but you must also think about your own firm. Other firms' experiences can only take you so far.

If you want to understand these issues better, please read the web chapter on capital market responses.

question

Are activities that increase firm size through issuing usually good news from a firm value perspective? Are increases in debt ratios usually good news from a firm value perspective? What about from a CFO's perspective?

answer

From a firm value perspective: The answers are no and yes. The empirical evidence suggests that increases in funds and thus firm size are usually bad news for the firm. Increases in debt ratios are usually good news. (The deeper explanation is consistent with a view that investors see equity issues as more opportunities for managers to waste money.) From the perspective of a CFO, it would probably be the opposite—recall the agency conflict discussion in Section **??** on Page **??**. (It will also be taken up again in Chapter 26.) Managers usually like to reside over big empires (managers of larger firms also usually earn more) and like to enjoy financial flexibility that makes life easy for them.

wideonecolumn

Summary

widetwocolumns

This chapter covered the following major points:

- Both capital scale and capital structure dynamics are influenced by factors under management's immediate control (such as debt issuing or share repurchasing) and factors beyond management's immediate control (such as value changes, a.k.a. stock returns).
- A CFO should consider a comprehensive view of capital policy. Many activities and external factors influence both the firm scale and the debt/equity ratio.
- Appropriate cash management should be a primary concern in many firms, especially in small high-growth firms.
- Many firms follow a "pecking order" financing scheme, in which they finance projects first with retained earnings, then with progressively less senior debt, and finally with new equity (as a last resort).
- There is empirical evidence that many managers try to "time" the financial markets. Remarkably, this has often turned out to be profitable, although we do not yet fully understand why.

- Debt offerings come in many varieties, and although we have surgically dissected their features, the actual debt offerings are often complex packages.
- Seasoned equity offerings are rare, especially among large, publicly traded corporations. They can be standard, shelf-registered, or rights offerings. Secondary shares are more insider sales than corporate capital structure events.
- Initial public offerings tend to appear in waves within certain industries and at certain times. The average 1-day IPO underpricing is about 10-15%, but IPOs begin to underperform the market beginning about 6 months after the offering for about 3 to 5 years.
- Ordinary financial debt and equity are not the only venues for raising financing. There are other methods, for example, stretching out the payment of bills.
- The financial markets respond negatively to the announcement of an equity issue, neutrally to the announcement of a debt issue, and positively to the announcement of dividends. However, there is considerable heterogeneity across firms in this response.
- The typical firm drops about 2% when it announces a new equity issue. This corresponds to a 10-20% dilution cost for existing shareholders. Dilution costs and underwriting fees must not be added to determine the total cost of an offering.

EOC MATTER

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eocproblems

question
What are the two important questions that a CFO acting on behalf of shareholders should ask?

answer
From a value perspective, your two main questions when deciding on capital structure action should be: Can you invest money better than your shareholders can on their own? Do your shareholders understand and agree that you are acting in their interest?

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question
Is it possible that issuing new equity to take a positive-NPV project reduces the value of the firm?

answer
Yes, issuing new equity can reduce the firm's value if investors do not believe that the new equity issue will be used for a positive-NPV project.

question
Give an example of one financial mechanism each in a perfect market that (a) increases the debt ratio of the firm and decreases the firm size; (b) decreases the debt ratio of the firm and decreases the firm size; (c) increases the debt ratio of the firm and increases the firm size; (d) decreases the debt ratio of the firm and increases the firm size.

answer
See Table 22.1. check: reference: table 21.1

question
Name some examples of financial and nonfinancial liabilities.

answer
Financial liabilities: Secured, senior, junior, or convertible debt and notes. Non-financial liabilities: Pensions, accounts payable, and others.

question
A firm issues $50 in new debt and $200 in new equity. Does this mean that its debt/equity ratio decreases?

answer
No, it depends on the existing capital structure before issuance. If the firm had no debt and all equity, for example, it would have a higher debt-equity ratio.

question
Does the debt/equity ratio of a firm change only with the firm's issuance and retirement of debt and equity?

answer
No. The debt-equity ratio also changes with the (stock) value of the firm.

question
A $500 million firm is financed by $250 million in debt and $250 million in equity. It issues $150 million in debt and repurchases $50 million in equity. The market believes the $100 million increase in value will result in wasteful spending by managers, which costs $5 million in NPV. However, the higher $150 million in new debt will also create $20 million in additional tax shelter NPV. What is the firm's new value and new debt/equity ratio?

answer
Before the market reacts, the firm will have $\$250 + \$150 = \$400$ million in debt and $\$250 - \$50 = \$200$ million in equity. The market believes these transactions will create $\$20 + (-\$5) = \$15$ million in equity. If all accrued to shareholders, there would be $215 million in equity for $615 million in value, which would be a $\$400/\$615 = 65\%$ debt-asset ratio. If none of this $15 million accrued to shareholders,

the debt-asset ratio would be \$415/\$615 = 67.5%. The debt equity ratio would be \$415/\$200 ≈ 2.08.

question
What is the effect of a repayment of debt on the firm's value and on the firm's debt ratio in a perfect market?

answer
A debt repayment decreases the firm value and decreases the firm's debt ratio.

question
If the world is not perfect, what is the likely effect of an equity issue on the firm's value and on the firm's debt ratio? How does it compare to the perfect-market scenario?

answer
An equity issue increases the size of the firm—but less in an imperfect market than in a perfect market because an equity issue is bad news. It decreases the firm's debt ratio, but again less than it would in a perfect market.

question
If the pecking order holds perfectly, would managers ever issue equity?

answer
No. In the extreme, if the pecking order holds perfectly, managers would never issue equity.

question
What are the theories that can explain why firms may follow a pecking order when issuing securities?

answer
Inside information, agency concerns, and transaction costs are all possible reasons.

question
Do all firms follow capital structures that were created through a pecking order?

answer
No. Many buyout firms have insulated capital structures, for example. Similarly, firms that are over-levered do not always follow it.

question
Would a firm that has followed only a pecking order after its IPO in its capital-issuing decision end up with more debt than equity in its capital structure?

answer

Not necessarily. Such firms could experience positive stock returns that are much larger than the debt that they are issuing.

question

Explain the difference between the financing pyramid and the pecking order. Which leads to which?

answer

The pecking order is about the issuing preferences of companies. The financing pyramid is a statement about how firms are actually financed—more with debt than with equity. A pecking order can lead to a financing pyramid, but other forces can negate this.

question

Empirically, do managers seem to act as if they believe that they can time the overall stock market (not just their own stock)? Are they doing so successfully?

answer

The evidence suggests that managers indeed seem to act as if they believe that they can time the financial markets overall. Even stranger, there is some empirical evidence that their timing attempts have been successful.

question

Is it a good idea to follow the same capital structure as other firms in your industry?

answer

Not necessarily. Arguments against so are: competitive market pressures are weak; other firms have incentive problems that cannot be easily corrected; the other firms may not be comparable; and there may be value to being different in itself (i.e., that is positioned to do well if other firms do poorly).

question

How can a firm manage its cash to avoid running into financial distress? What are the drawbacks?

answer

The firm can match assets and liabilities, obtain a credit line, invest in more liquid assets, and avoid debt. Unfortunately, doing so is costly—in a public company, too much cash also tempts managers to waste assets and not work as hard.

question

From a firm value perspective, should managers always strive to make financial flexibility a main goal, as they claim in surveys?

answer

No. Financial flexibility is often a code word for "insulation from financial markets pressure". It may not maximize firm value. Instead, the opposite might occur. Financial flexibility might tempt managers to take projects that they shouldn't, and it may cause firms to be stuck with poor management and unmotivated employees.

question

Evaluate the following statement: If a firm faces an efficient bond market, then this firm can issue any bond it likes—it does not matter as far as firm value is concerned.

answer

False. An efficient bond market means that the price will be correct, but if the bond covenant requires blowing up the firm, it is not value-maximizing even if the bond is priced right. If the market is perfect enough to allow new management to take over the firm, fire the manager, and undo this bond, it is not a problem, of course. In the real world, this is not likely, so issuing good bonds even in an efficient market is important.

question

What are the components in a typical corporate bond issue?

answer

A revolver and some tranches of term debt.

question

Do corporate bonds trade very actively? If so, where do they trade? If not, why not?

answer

No, since they are not usually very liquid. They trade mostly over-the-counter.

question

Give an illustration of a coercive bond offer.

answer

See the example in the text. check reference: Section 21.5D

question

How does a rights offering differ from a shelf offering?

answer

Apples and oranges. In a rights offering, existing shareholders receive the right to purchase more shares. If this right is for shares below the stock price, then it is in effect a coercive offering because non-participants lose value. In a shelf offering, firms can put equity on the shelf for 2 years and issue it at their discretion.

question
Your firm has $200 million of debt outstanding (held by 600 creditors) and $300 million of equity outstanding (held by 300,000 shareholders). Construct a coercive rights offering to raise $100 million in new equity. How does your example change if you have no debt outstanding? How does your example change if you want to raise $200 million?

answer
See the text reference: Section 21.6 for an example. It does not matter how much you have in bonds outstanding or how much you want to raise. All that matters is that the shares that you are offering rights for are valued below the current share price.

question
Explain the winner's curse. Does it apply only to IPO shares, or could it also apply to an auction for a one-of-a-kind painting?

answer
The winner's curse is simply the idea that the winner of an auction will likely overpay, probably due to lack of information. See the example in the text reference: Section 21.7. Yes, it could apply to a painting—the person most overvaluing the painting would be most likely to win it.

question
What are the possible reasons for IPO underpricing?

answer
The possible IPO underpricing explanations are: winner's curse, information extraction, good taste in investors' mouth, cascading demand, and agency conflict.

question
What is the empirical evidence on the long-run performance of IPOs?

answer
On average, they seem to decline by about 5% per annum for about 3 years. It is worse for firms with aggressive accounting numbers.

question
Evaluate: Everyone knows that analysts are conflicted and not trustworthy when evaluating IPOs that their own firm issues. Therefore, because no investor would pay serious attention, analysts do not publish recommendations to buy or sell shares in their own bank's IPO firms.

answer
True: they are conflicted. Yet, false: They do still issue recommendations. And oddly, some retail investors do seem to pay attention.

question
What typically happens to the IPO share price when the lock-up period expires?

answer
When the IPO lock-up period expires, share prices usually dive by about 2%.

question
What is an "open IPO window"?

answer
An open IPO windows is period during which many IPOs are coming to market. It usually happens after a bull market.

question
What is the typical underwriting commission for IPOs?

answer
The direct payment is around 7%.

question
Can a firm raise financing through its management of accounts payable?

answer
Yes—the firm can simply refuse to pay quickly. This raises net working capital. (Net Working Capital = current assets – current liabilities): See Section **??**. reference: Section 13.4)

question
How would you measure the whole cost of issuing, including deadweight costs that capital structure changes create, direct fees, and everything else? Should you add the dilution costs and the underwriter fees?

answer
You should measure the whole cost of issuing through the degree of dilution at the announcement price reaction. You should not add dilution and underwriter fees, because the former already includes the latter.

Chapter 23

Empirical Evidence of Capital Structure Dynam

intro

In this chapter, we will look at the empirical evidence that describes capital structure changes in the United States. This includes an analysis of the role that stock returns and active managerial activity have played; an analysis of how different active managerial changes have been influenced; and a discussion of survey evidence about what managers claim they are doing.

23.A Mechanisms versus Causes

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Our next question is how the debt/equity ratios of publicly-traded companies evolve over time. First, a short lesson in metaphysics. You can examine phenomena at different layers of causality—you can always drill deeper and deeper. Eventually, if you dig deep enough, you will find yourself in the world of philosophy and theology. For example, say you want to know what makes a car fast. The first layer of causality may be that its speed is due to lots of power, low weight, and low wind resistance. But why is there a lot of power? This question brings you to a deeper layer of causality, with questions such as how many cylinder and intake valves your engine has. You can then drill down into yet another layer of causality. Why is this particular number of cylinders/valves more powerful? Yet another deeper layer of causality emerges with questions such as why and how gasoline combusts. If you continue this long enough, you end up with questions about why nature's physical constants are the way they are—it can even become a question of theology. Moreover, it is often the case that when you drill deeper, you become less and less able to explain the specific phenomenon, here the speed of the car (because you must necessarily work with simplifying models). All of this diversion applies just as much to corporate capital structure choice as it does to cars.

x

We are going to explore the dynamics of debt/equity ratio changes on two levels:

1. We can call our first, somewhat shallow layer the "mechanistic layer": How important are the various mechanisms through which debt/equity ratios can evolve? These mechanisms are basically the cells you have already seen in Table 22.1, such as debt and equity issuing and repurchasing.

2. The second, deeper layer is more causal and explores how some variables determine issue debt and equity. As in our car example, you cannot expect these forces to work as well in explaining capital structure choice as the mechanisms.

3. At the deepest layer we will look at more general aspects of firm characteristics, which can influence everything above them. Thus, we explore the variables, characteristics, and economic forces that induce firms and financial markets to engage these mechanisms in the first place. And, these forces are really not going to work well in explaining capital structure choice as the shallower mechanisms and causes.

Some factors can be classified into different layers here. However, one is especially worth mentioning: the role of stock value changes. You can think of value changes either as a mechanism that shifts capital structure around or as an economic force that lies partly inside and partly outside the domain of the mechanisms that managers can use to change capital structure.

23.B Mechanisms of Capital Structure Change

Let's begin with the big-picture mechanisms. In the real world, what is the relative importance of the various mechanisms that you learned about in the previous chapter? That is, has the typical company's debt/equity ratio been driven more by the firm's value or by the CFO's net issuing activities (which include issuing, repurchasing, and dividends)? This question can be phrased as, "If you knew in advance how much every firm would issue over the next x years, net of all repurchases, what fraction of the change in capital structure could you explain?" Table 23.1 answers this question for 5-year horizons.

Net Debt and Equity Issuing Activity

The first row of Table 23.1 shows that CFOs were by no means inactive in the capital markets. If you had known perfectly how firms had issued and retired

Table 23.1: Relative Importance of Mechanisms Determining Capital Structure Changes over 5 Years

—These fractions measure how much of the change in capital structure from today to 5 years from now that you could explain if you had perfect foreknowledge of each component. Net issuing means issues net of retirements. The samples were all publicly traded U.S. stocks from 1964 to 2003. (The numbers need not add up to 100%, because one component can have information about the other components.) The equity is measured by its market value. Source: Welch, JPE 2004.

All Net Issuing (with Dividend Activity)			69%
All Net Issuing (without Dividend Activity)			66%
All Net Debt Issuing Activity		40%	
Convertible Debt Only	4%		
Short-Term Debt Only	14%		
Long-Term Debt Only	32%		
All Net Equity Issuing Activity		16%	
Direct Effect of Stock Returns on Existing Capital Structure		40%	

debt and equity and paid in and paid out funds, you could have explained 69% of firms' total capital structure changes over a 5-year horizon. The remaining 31% were necessarily corporate value changes that were not directly influenced by managerial issuing and repurchasing. Omitting dividends dropped the explanatory power from 69% to 66%, so dividends could explain only a meager 3% of capital structure changes—as far as comparative debt/equity ratio dynamics in publicly traded corporations are concerned, dividends were a sideshow.

x

Net debt issuing: The third row in Table 23.1 tells you that 40% of all capital structure changes over 5 years were due to firms' net debt issuing activity. The next three rows tell you that long-term debt alone could account for 32% of changes in debt/equity ratios, that short-term debt was somewhat less important, and that convertible debt was fairly unimportant. It would be interesting to break these debt issuing activities into their components—issuing and repurchasing—and to break the repurchasing in turn into sinking fund payments, interest payments, and principal repayments, so that we could understand better what part of the mechanism really drives capital structure. Remarkably, despite the obvious importance of debt issuing activity, no one has yet worked out this decomposition.

x

Table 23.2: Typical Equity Share Activity Among S&P 100 Stocks, 1999-2001

—Categories describe equity issued in conjunction with an activity. Equity share activity is measured per annum and as a fraction of total assets. For scale, changes in total liabilities were about 10.07% of assets, and changes in retained earnings were about 1.37% of assets. Source: Fama and French, JFE 2005.

Total Seasoned Equity Offering Activity	+ 3.77%
M&A Related	3.68%
Not M&A Related	0.09%
Executive Compensation	+ 1.05%
Convertible Debt	+ 0.14%
Warrant Exercise	+ 0.05%
Share Repurchases	– 1.44%
= Changes in Equity Outstanding	+3.57%

Net equity issuing: The seventh row in Table 23.1 shows that net equity issuing could explain about 16% of changes in firms' debt/equity ratios, and therefore was less important than net debt issuing as a determinant of capital structure. Nevertheless, equity issues are more glamorous, so economists
x have studied them a lot more.

Table 23.2 decomposes equity issuing (this time, not net of equity repurchasing) into its components, though only for the very large S&P 100 firms. (Unfortunately, there is no equivalent information for smaller firms.) The table dispels the popular myth that most shares occur through plain seasoned equity offerings (SEOs). Instead, from 1999 to 2001, equity shares appeared most commonly through equity offerings in connection with corporate acquisitions. (We cannot conclude that firms' debt/equity ratios declined during acquisitions. We also know that firms commonly issue not only equity but also debt to finance acquisitions and that leverage ratios are nonlinear, too. Outside an acquisition, seasoned equity offerings were exceedingly rare. We also saw these patterns in IBM's case in Section **??**—IBM did not issue equity, repurchased some shares into its treasury, and then used equity shares from its treasury in its acquisition of PwCC Partners and in its funding of employee
x stock option plans.

Moreover, evidence from other papers similarly suggests that, even including M&A activity, public equity offerings are rare. The 10,000 or so firms trading on the NYSE and NASDAQ conducted only about 12,000 equity offerings

from 1990 to 2000, of which about half were initial public offerings and about half were seasoned equity offerings. With only 300 SEOs in an average year, you can work out that a typical publicly traded firm would have issued equity only about once every 20 years.

Firm Value Changes and Stock Returns

The final row in Table 23.1 shows the direct effect of stock returns on capital structure. Recall that this is the change in the debt/equity ratio that a company experiences when it increases or decreases in value—a $200 million firm with $100 million in debt and $100 million in equity, which doubles in value from $200 million to $400 million, experiences a drop in its debt/equity ratio from 1:1 to 1:3. As mentioned earlier, corporate stock returns can be viewed both as a mechanism (itself influenced by deeper forces) and as an external force that tugs on firms' debt/equity ratios.

Table 23.1 shows that if you had known perfectly how stock returns would turn out over the next 5 years, you could have explained 40% of firms' total capital structure changes. (Note how all issuing was able to explain 69%, so a good part of variation must have been explainable by either issuing activity or stock returns—suggesting that the two are linked.) The fact that stock returns are a major factor should not come as a big surprise to you. If you recall our IBM example from Section **??**, it was changes in the stock price that first reduced IBM's equity value by one-third from 2001 to 2002 and was the primary cause of its debt/equity ratio's increase from 0.31 to 0.55.

Importantly, you can think of these stock returns as the "relevant" changes that were not undone by managers. If firms had undone the value changes and rebalanced through issuing equity after negative stock returns and repurchasing after positive stock returns, then knowing the stock returns would not have helped in explaining changes in capital structure. Our empirical evidence therefore suggests that even over a 5-year horizon, firms do not fully rebalance their capital structures.

You may wonder whether some part of this 40% could also have been due to managers trying to "time" the market (issuing more equity as the stock price went up). However, other empirical evidence suggests that, even if present, market timing is likely to be only a small factor. The reason is that, in response to stock price increases, firms issue not only equity but also debt, and they tend to pay out more in dividends. Therefore, the timing effect on net debt/equity ratios is fairly modest. The 40% that we see is almost entirely the direct value effect of stock returns on debt/equity ratios.

Explaining 40% of something that is as variable and firm-specific (as corporate debt/equity ratio changes are) is quite robust—even though our explanatory variable is conceptually on a fairly shallow level of causality. Consequently, if you want to know why some firms have high debt/equity ratios today and why other firms have low ones, a part of your first explanation has to be not just that the former issued a lot of debt and the latter issued a lot of equity, but that the former had experienced negative stock returns and the latter had experienced positive
x stock returns.

Managers also typically do not pay out large value gains or raise more funds in response to large value losses. Therefore, like debt/equity ratios, firm scale has a large external component too—firms that are large today may not be large primarily because they raised a lot of funds, but rather because they appreciated in value. In sum, few firms seem to deliberately choose their target scale and target
x debt/equity ratios, and then act to retain these targets.

This relationship between stock returns and capital structure would suggest a natural debt/equity life cycle for firms. Firms could start out being highly levered—the owner must borrow to finance the firm. Eventually, as the firm survives and accumulates equity, its scale should increase and its liabilities and debt ratio should
X decline. Can we see this in the data? Do large firms have smaller debt ratios? In the next chapter, you will learn that:

1. Many of the nonfinancial giant companies indeed seem to have very low debt ratios, often in the single digits. This is supportive.

2. Depending on the precise measure of debt ratio, large firms have debt/equity ratios around 40%. This is nothing even close to zero. This is not supportive.

Most importantly, larger publicly traded firms today tend to have higher debt ratios. Thus, the answer as to whether large firms have smaller debt ratios is no.
X But this is not the last word. An important data factor is “survivorship bias”—that is, the average publicly traded firm in the United States lasted for only about 5 years before it went bankrupt, was bought by another company, or merged into an entirely new entity. This makes it difficult to track the long-run evolution of firms’ capital structures. The firms you see today are not the firms you would have wanted to follow over the years. In sum, the relative importance of the mechanisms that have created the diversity of firms’ capital structures today is still

not fully understood.

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question
What are the most important financial mechanisms influencing capital structure changes over 5-year horizons?

answer
Over 5-year horizons, the most important financial mechanisms were (a) debt net issuing and (b) the direct influence of stock returns. Both accounted for about 40% of the variation in debt/equity ratios. Beyond this, (c) long-term debt net issuing accounted for about 30%, and short-term debt and equity net issuing accounted for about 15%.

question
Is dividend activity a major factor in determining capital structure changes in U.S. firms—explaining why some firms have high debt ratios and other firms have low debt ratios?

answer
No, dividend activity is typically fairly unimportant from a larger capital structure perspective. Table 23.1 suggests that dividends explain only about $69\% - 66\% = 3\%$ of capital structure changes.

question
Is long-term net debt issuing a major factor in determining the capital structure changes of U.S. firms—explaining why some firms are increasing their debt ratios and other firms are lowering their debt ratios?

answer
Yes, long-term debt net issuing activity is important. It can explain over 30% of the variation in 5-year changes.

question
How important is seasoned equity issuing activity that does not occur in the context of M&A activity, at least for S&P 100 firms?

Deeper: Stock returns are good proxies for the value changes we discussed in Section 22.B. Theoretically, however, stock returns could miss some of the change in the underlying asset values, if these changes benefited or hurt debt holders by making debt repayment more or less likely. However, unless the firm is in—or close to—financial distress, almost all of a firm's own value change goes to equity owners. In the extreme, risk-free debt would not be affected at all by firm value changes, and stock returns would be exactly equivalent to the value change. In any case, we do not mean that debt value changes cannot occur, just that they tend to be so much smaller that our proxy of stock returns will capture most of how firms differ from one another in terms of value changes at any given point in time. Besides, we do not have good market value data for corporate debt, so we could not really measure the whole change in value even if we wanted to.

answer
On average, seasoned equity issuing activity outside M&A is trivial.

question
If many equity shares appear in the context of M&A activity, does this imply that the firm's debt/equity ratio is likely to go down?

answer
No. For example, in the context of M&A activity, although it is correct that many equity shares appear, generally even more debt offerings appear. This can increase or decrease the debt ratio.

23.C What are the Underlying Rationales for Managerial Capital Structure Changes?

x

You know how important the mechanisms that change debt/equity ratios are, but you do not yet know why firms use them. You also know that if you had a choice, you would want to learn first what drives net debt issuing (especially long-term debt), because it seems most important for capital structure changes, then what drives net equity issuing and net short-term debt issuing, and only finally what drives convertible debt issuing and dividends—in that order. You can usefully think of these mechanisms as "channels" through which other forces can operate—forces that are one layer deeper in terms of causality. You can now ask the main question for each of the six channels:

1. What makes firms change their nonfinancial liabilities?
2. What makes firms issue debt?
3. What makes firms retire debt?
4. What makes firms issue equity?
5. What makes firms retire equity (or pay dividends)?
6. What makes firms experience good/bad corporate value performance? (As noted earlier, you might classify value changes as deeper than a managerial mechanism, though.)

Again, these questions are getting at the deeper issue of why capital structure is what it is. Thus, you cannot expect them to work as well as the above mechanisms

in terms of explaining capital structure. But the deeper reasons are also more interesting than the mechanics discussed earlier. (No pain, no gain.)

If a variable strongly influences one channel, this influence will likely—but not necessarily—percolate into an influence on the overall capital structure. For example, if solar flares were to make firms issue debt, then we would also expect solar flares to increase firms' debt/equity ratios. However, this is not a necessary outcome. If solar flares had a strong positive influence on debt/equity ratios through one channel and a strong negative influence through another, then solar flares could end up having no influence on overall capital structure. Moreover, you learned earlier that it is possible for a variable to explain a lot of equity issuing, yet have no influence on typical debt/equity ratios. If the firms that are subject to this variable are already 100% financed by equity, the firm will still remain all-equity. The opposite can also be the case. Some variable could have only a weak influence through every single channel and we would be tempted to discard it as too weak, but if it worked for all six channels, it could end up having a strong influence on the firms' overall debt/equity ratios.

A Comprehensive Empirical Study

x

A recent large-scale empirical study by Hovakimian, Opler, and Titman (2001)—let's call them HOT—explores how different variables exert influences on four of the above channels over 1-year horizons. The authors document that there are a multitude of variables that seem to have played statistically significant roles—but all of these variables together could explain only a few percentage points of the total variation in capital structures across firms. For the most part, there are no smoking guns. We can explain only a small fraction of firm behavior, that is, of what is driving their corporate financing choices. x

The study did not look at the first channel (nonfinancial liabilities) or the last channel (stock returns), but it did look at the others:

x

The debt issuing channel: For the second channel, HOT found that firms issued more long-term debt if they had high market/book ratios, if they had good recent stock market performance, and if they had much of their existing debt coming due soon. Firms issued more short-term debt if they had poor recent asset performance and if they had less short-term debt than their industry peers. In both cases, though, the relationship was very weak: These causes could explain only 2% to 3% of its cross-sectional variation (called R^2)—a miniscule proportion. In sum, it is still largely a mystery why firms issued debt.

x

The debt retirement channel: For the third channel (debt retirement), HOT found that firms reduced their debt if they were above their industry peers in terms of their debt ratios and if they had good recent stock market, but bad accounting, performance. Interestingly, these actions were thus the opposite of what it would have taken to rebalance to the previous debt/equity ratio. How important were these causes? Here we get a much better 12% in explanatory power (R^2)—not good, but better.

x

The equity issuing and retiring channels: The fourth and fifth channels are where most of the academic research has focused. There are three good reasons for this: First, we have robust theories here, specifically the pecking order theory, which seems to be reasonably consistent with some of the evidence. Second, the announcement of market-related equity issuing and dividend activity plays a prominent role in the financial press. And third, we have a lot of publicly available data here. Nevertheless, dozens of earlier studies have informed us that equity issuing and retiring activity also remain a mystery.

HOT's evidence seems to suggest that firms first and foremost did not like to issue equity—consistent with a pecking order. When firms did announce that they would issue equity, it was on average greeted with a negative return on its outstanding stock. (This is the subject of the web chapter.) On balance, firms tended to issue equity (rather than debt) if they had worse accounting performances and better stock market performances. (Although firms also tended to issue debt in response to positive stock returns, their tendencies to issue equity were stronger—possibly evidence that managers tried to "time" the stock market.) Especially firms with higher tax obligations preferred issuing debt over equity.

Altogether, the authors could explain 3% of the variation in firms' equity repurchasing activity and 15% of firms' equity issuing activity.

The Deepest Rationales

x

Putting this (and other) evidence together, here is my overall impression of what factors play important roles in influencing capital structure outcomes, roughly in order of their importance:

Direct stock performance influence: If you classify stock returns as a cause rather than a mechanism, then it is by far the most important variable in nonfinancial firms. Because firms do not counteract stock returns, firms with good stock price performances tend to end up with lower debt ratios, while firms with poor stock price performances tend to end up with

higher debt ratios. (You may want to dig deeper and ask what causes stock performance, but this would again be a difficult predictive exercise.)

Equity issuance avoidance: Firms seem to want to avoid issuing equity. A seasoned equity offering is a rarity, and even more so outside of an M&A transaction. Given that the costs of an equity issue are high (including the often negative market reaction), this is not surprising behavior. X

Peer similarity: Firms not only seem to end up with capital structures similar to those of their industry peers due to their commonality in industry stock returns, but they also seem to like being similar, often issuing or retiring debt or equity to come closer to their peers. Some industries (R&D heavy with few tangible assets) have avoided debt financing altogether. (You may want to ask what determines peers' ratios, and why firms want to be similar to their peers, but this is an even deeper level of causality—one that is still mostly beyond our current knowledge.)

Corporate income taxes: Firms with high corporate income tax rates tend to actively issue debt and retire equity, that is, increase their debt ratios.

Nevertheless, many high-tax firms have low debt ratios. How can this be? The reason is that good performance translates not only into high profits and therefore high corporate taxes, but also into positive stock price performance. The latter directly reduces the firm's debt ratio. Although the end effect can be complex, on average, net issuing activity is usually not enough to undo the direct stock return effect.

Accounting performance: Firms prefer net debt issuing over net equity issuing if they have better accounting profitability and more tangible assets (which can be easily collateralized). But as with taxes, good accounting profitability correlates strongly with higher stock prices, which in turn correlates strongly with lower debt ratios.

M&A activity: Much debt and much equity are issued in connection with M&A activity, although proportionally more debt is issued than equity. M&A activity may be the most important reason why most well-performing nonfinancial firms do not end up with practically zero debt. However, because firms usually start acquiring firms after good stock price performances, the overall capital structure effect can be complex. Good operating performance can lower the debt ratio through the value increase but then increase the debt ratio through acquisitions.

Financial distress: Firms that are in dire straits have no choice but to retire some debt and issue equity. This seems to be an unusually solid net issuing influence, but only for firms close to the verge of bankruptcy.

Credit ratings: To access the commercial paper market, firms need to have a reasonable credit rating. To maintain it, many firms tend to borrow less, especially if they are close to the margin where more or less debt could make a big difference (i.e., if they have an AA– or A+ rating, or a BBB rating).

X

Tangibility: Firms with relatively more tangible or collateralizable assets are able to borrow more—and often do so.

X

Active market timing: Firms that experience stock price increases tend to issue more securities—through both debt and equity, so the capital structure consequence is not too strong. Moreover, such firms also tend to pay out more in dividends, so even the net equity issuing effect is not yet clear. Nevertheless, when surveyed, CFOs claim that they do watch their stock market value, and respond to it—perhaps even try to time it. In any case, active market timing is the newest and thus the most interesting factor to explore—as more research comes forth, we may learn that we underestimated or overestimated its importance.

Uncertainty: Firms with more volatile underlying assets tend to have less debt in their capital structures.

I also believe that managers in many old, large, publicly traded companies, in which corporate governance has broken down, have equity in their capital structures even if this is not optimal for the firm—simply because managers like equity more than debt. However, it is difficult to measure whether these firms have a lot of equity because corporate governance has broken down, or whether corporate governance has broken down because there is a lot of equity.

---

question

How good is our knowledge about what deeper determinants create the empirically observed capital structure patterns?

answer

Our knowledge about the deeper determinants is not very good. We can only explain a small part of the variation of capital structure with proxies for deeper causes such as financial distress or agency costs.

question
Firms with large tax obligations are known to be more inclined to issue debt and retire equity. Does this mean that firms with high tax obligations usually have high debt ratios?

answer
Firms with large tax obligations may not have high debt ratios, because these are often the same kinds of firms that were highly profitable—which would have increased the value of their equity.

question
What deeper characteristics help explain corporate debt/equity ratios?

answer
The important deep factors seem to be direct stock performance, equity issuance avoidance, peer similarity, corporate income taxes, accounting performance, M&A activity, financial distress, credit ratings, active market timing, and uncertainty.

Does the Empirical Evidence Test Our Theories?

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The above variables are interesting, but they are not exactly what the theories were asking for. For example, an interest coverage ratio is often used as a proxy to measure the proximity to financial distress—but it is not exactly the same financial distress. Some firms have low interest payments relative to earnings and are in distress; other firms have high interest payments relative to earnings and are financially sound. Yet ultimately, we study such specific variables only because they are relatively easy to measure empirically. We would have preferred direct measures of our theories of capital structure, but such measures are usually not as easily available. Most of the time, our variables are a compromise between empirical availability and theoretical construct, and we then try to interpret our empirical findings through the lenses of our theories. From our proxies, we can draw two basic conclusions about the theories: First, it appears that agency concerns, pecking order concerns, financial distress (in very few companies), and corporate taxes all matter in some ways, at least a little. Second, there are some other variables that matter, for which the reason is still mysterious. For example, why do firms not counteract market influences very strongly, and why do they seem to "like" capital structures similar to those of their industry peers? Future research will tell us the answers.

x

You now know that we do not yet fully understand the factors that are driving firms to actively change their capital structures. It seems to be a complex process,

possibly with a lot of idiosyncratic behavior. Our variables are statistically significant, but they leave much to be explained. You can read this situation in a number of ways:

1. Our variables may not matter much, because they are poor proxies for our theoretical constructs (e.g., for tax savings or bankruptcy costs). With more research, we may eventually find better proxies that will improve our understanding of capital structure.

2. There are other theories and factors not yet understood that may be more important than those that we have now.

3. Our variables may not matter much, because capital structure choice is practically irrelevant. Whatever managers may be acting on—whether based on, say, book-market ratios or their horoscopes—may have only minimal value consequences. You could think of this as an empirical validation of Modigliani-Miller.

4. Managers may just act poorly and erratically (or in their own self-interests), and there is nothing outsiders can do to correct it.

X

The lack of explanatory power may also reflect a little of each of the above reasons. Right now, capital structure is an especially fertile area for behavioral finance, because idiosyncratic managerial behavior seems important and because there is no easy way for financial markets to arbitrage misbehavior. Empirical capital structure remains an exciting field of research. We are definitely making progress in learning how managers behave, but we also have a long way to go.

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question

Why do our theories of capital structure explain relatively little of firms' capital structures?

answer

Theories of capital structure may explain relatively little of firms' capital structures for the following reasons: Our variables may be poor proxies, our theories may have guided us to the wrong forces, capital structure policy may be irrelevant, and managers may act poorly and/or erratically.

Managerial Lessons

What can CFOs learn from the empirical evidence? A lot! First, the evidence that (partly) external stock returns have a long-lasting effect on capital structure is solid. What can you conclude from this?

- **Is** the fact that managers do not rebalance their sizes and their debt/equity ratios evidence that they make bad decisions? Absolutely not. It might well be that the optimal firm size increases and the optimal debt/equity ratio decreases as the firm's underlying business becomes more valuable. In this case, managers should be happy with their capital structures. Or it might be that such rearrangements are fairly expensive, relative to the costs. In this case, managers may be unhappy with their capital structures, but it would not be profitable for the firm to fix it.
- **Could** the fact that managers do not rebalance their sizes and their debt/equity ratios be evidence that managers make bad decisions? Yes, it could be—but it does not need to be. In some firms, the evidence that managers are mis-capitalized is fairly suggestive. In other firms, we are not so sure. There is lively academic controversy surrounding this question.
- Does this mean that you should not worry about capital structure or appropriate corporate scale? Absolutely not. Even if many other managers are passive and/or do not do the right thing, you still can! Your managerial choices should remain intelligent and dynamic.
- Does this mean that you cannot rely on the capital structures of other companies to judge what the capital structure of your own firm should be? Probably yes. Their capital structures are less indicative of deliberate designs than they are of their historical performances.

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question

If firms fail to readjust their capital structure, does this mean that learning about capital structure theories is a waste of your time?

answer

It could be a waste of time if we got the theories wrong and missed the most important ones. However, it is more likely that our capital structure theories would still be useful. If firms do not readjust their capital structure, the capital structure theories (forces) may mean that there is a lot of money left on the table by managers. If you can join such a firm, you may be able to optimize its capital structure and thereby save the firm a lot of money.

23.D Survey Evidence from CFOs

x

There is another way to approach the question of how managers choose capital structures—just ask them. Of course, we should not blindly believe that just because CFOs publicly proclaim a motive that it really is their motive. Graham and Harvey (2001) surveyed 392 CFOs to find out what they proclaim makes them issue equity or debt. Graham and Harvey found not only interesting, but also some rather puzzling, results.

x

First, the good news: CFOs do care about the tax benefits of corporate debt, at least moderately. But they seem more concerned about their credit ratings. We know that credit ratings are closely related to interest coverage ratios (interest payments divided by earnings) and are good proxies for possible financial distress costs. Managers seem cognizant of the basic trade-off between taxes and financial distress.

X
x

Now for the bad news, at least from the perspective of some of our theories:

1. Many of our other capital structure arguments seem unimportant to managers, from personal income taxes borne by their shareholders, to expropriation concerns by their creditors, to strategic product market factor considerations, to deliberate control of free cash flow incentives, to intentional signaling of good or bad news (inside information), to transaction cost considerations.

   On the one hand, this may not be as bad as it appears. Managers may still care about these considerations, because their cost of capital itself reflects these considerations. (For example, if a firm's investors face higher tax consequences, it increases the firm's cost of capital, and we know that managers do care about their costs of capital.) On the other hand, if a firm does not need to raise money, managers may not compute the correct hurdle rates for their projects. If they do not take these factors into consideration when estimating the cost of capital that the market would be charging, they could set too high or too low of a project hurdle rate.

2. Managers like "financial flexibility," which means that they like having cash around and having untapped debt capacity for possible future activities. Liking this kind of flexibility makes perfect sense from the manager's perspective—but it also hints that free cash flow is a real problem. Managers

seem to like this "flexibility" primarily in order to take over other companies—a move that is often not value enhancing for their shareholders. With almost no chance of bankruptcy in many large companies, it is unlikely that fear of a cash crunch is the driving concern behind the desire for flexibility.

3. Managers worry about lower earnings per share (called **earnings dilution**) if they issue more equity. This makes little sense in itself, because the newly raised funds would presumably also produce earnings.

4. Even managers who claim to target a debt ratio tend not to retire equity if their equity has recently increased in value, and tend not to issue more equity if their equity has recently fallen. This makes little sense because this is exactly what is required in order to target a debt ratio.

5. Managers believe that they can time the financial markets.

   - About two-thirds of managers feel that the stock market undervalues their firm—a fact that restrains many from issuing equity. When their stock market values have recently increased, then managers feel that they have a "window of opportunity" for equity issues. In other words, they believe that they can forecast their stock prices, and the stock market's usual pessimism will be appropriately corrected in due course.
   - Even more remarkable, CFOs believe that they can time overall market interest rates: They issue more debt when interest rates fall or have fallen.

   Amazingly, although it seems almost absurd to believe that they have this ability, there is some new and actively debated empirical evidence that managers have indeed collectively shown some ability to time the market. To explain such corporate issuing activity and its success, it appears that we have to look more toward the field of behavioral finance.

x

You already read about another survey in Section **??**. CFOs generally see the X
question of dividends versus repurchases as one of desirable flexibility—dividends being steady, share repurchases being paid "as available." Their other answers mirror those in the Graham and Harvey survey. Here, too, managers pretty much considered personal income taxes on dividends to be fairly irrelevant both to themselves and to the preferences of their shareholders. They also believed that dividends tended to attract more individual retail shareholders than large institutional tax-exempt investors. If the CFOs are correct, it is investors who are acting irrationally. Once again, this seems like a fruitful area of future research for behavioral finance.

question

Managers frequently state that they like sound finances with plenty of financial flexibility. Is financial flexibility also always good for shareholders?

answer

No, financial flexibility could be bad for shareholders. If managers have a lot of money lying around, they can often do as they please. They can build empires, avoid being fired if they make bad decisions (because the firm will not run into financial distress), and so on. Thus, financial flexibility is great for managers but not necessarily for shareholders, given the firm's profitability. Of course, it is better for firms to have more cash rather than less, and there could also be some beneficial effects (e.g., distress avoidance).

wideonecolumn

Summary

widetwocolumns

This chapter covered the following major points:

- We can explore both the mechanisms of capital structure change and the underlying forces (causes). These forces can work through multiple mechanisms.
  - Over a 5-year horizon, the two most important mechanisms affecting capital structure are stock returns and net debt issuing activity. Both can explain about 40% of the changes in debt/equity ratios.
  - Long-term debt can explain about 30% of the changes in debt/equity ratios, short-term debt and equity issuing can both explain about 15%, and both convertible debt and payout policy can explain less than 5%.
- Among the S&P 100 firms, seasoned equity offerings are rare, and they appear almost always in the context of acquisitions. (Executive compensation is remarkably high, and about as important as share repurchasing activity.)
- We know a number of statistically significant forces (potential causes), but they can explain only a very small percentage of capital structure dynamics. Among the more important influences are these:
  - Stock returns
  - A reluctance to issue equity
  - A desire to imitate industry peers

  - Corporate income taxes
  - Accounting performance, such as profitability
  - M&A activity
  - Financial distress
  - Credit ratings
  - Market timing
  - Uncertainty

  In addition, executives of large, old, publicly traded corporations probably like equity even if it is not value enhancing.
- In surveys, CFOs claim to be very concerned about their credit ratings and financial flexibility. Together with often largely untapped debt capacity, these findings can be evidence of significant free cash flow problems. CFOs also claim not to care about taxes borne by their investors or many other factors suggested by the theories, but they do believe that they can "time" the market.

Most importantly, even if firms do not seem to act according to the theories, the capital structure theories still offer good guidance about how you can add value by doing things differently.

(Apologies: This chapter has fallen short in describing the empirical linkage between firm expansion/contraction and capital structure changes.)

EOC MATTER

eocproblems

question
Are value changes (stock returns) a major factor in determining the capital structure changes of U.S. firms—explaining why some firms have higher debt ratios and other firms have lower debt ratios?

answer
Yes, stock returns can explain over 40% of the variation in 5-year changes.

question
Is seasoned equity issuing net of repurchasing activity (excluding M&A activity) a major factor in determining the capital structure changes of U.S. firms? That is, does it explain well why some firms increase their debt ratios and other firms lower their debt ratios?

answer
Seasoned equity net issuing behavior is only modestly important. All together, it can explain only about 16% of the variation in 5-year changes. And ordinary seasoned equity offerings are pretty trivial among equity changes, suggesting they don't matter much.

question
How did most new equity shares for large S&P 100 firms enter the financial markets?

answer
Table 23.2 reference: table 22.7 shows that the most important item, by far, was M&A related equity offering activity, followed by executive compensation. Other share issuing activity was trivial.

question
What are the important deeper causes for firms' capital structures?

answer
This is a repeat of solve-now question 23.C reference: Solve Now question 22.16.
The important deep factors seem to be direct stock performance, equity issuance avoidance, peer similarity, corporate income taxes, accounting performance, M&A activity, financial distress, credit ratings, active market timing, and uncertainty.

question
If our empirical knowledge about the deeper determinants of capital structure is modest, does this mean that capital structure theories are irrelevant?

answer
No—the theories tell us what should matter. There are a number of explanations as to why they may not translate into observed corporate behavior.

question
What do CFOs claim they care about when thinking about the best capital structure?

answer
Corporate income taxes, credit ratings, financial flexibility, and earnings dilution.

question
Are answers from managers "prescriptive" (i.e., giving good guidance as to what corporations should do)?

answer
No. Managers are conflicted. They do not maximize shareholder wealth, but try to maximize their own welfare.

Chapter 24

Capital Structure Patterns in the United States

intro

We are now returning to the question of how, in broad strokes, publicly traded corporations in the United States have financed themselves over the last few decades. (Private firms are more mysterious. There is not much solid data for them.) You have already learned about the basic patterns from our discussion of IBM in Chapter **??**. This chapter tries to do this more systematically and to reconcile some of our theoretical insights with the empirical evidence.

You should also realize that this chapter is at the current edge of research. There are different interpretations of the data, so it is unavoidable that what you are reading is my interpretation of the evidence. My goal is to give you a taste of what we know—and what we do not know.

24.A Changes vs. Levels

Now let's look at empirical evidence of capital structure levels. Perhaps the most important factoid to understand now is that issuing activity and capital structure changes do not translate into leverage ratios one-to-one. Consider two firms in the same calendar year. Firm A issues 80% debt and 20% equity. Firm B issues 20% debt and 80% equity. Does this mean that firms of type A are more levered or that we need to explain why they like more leverage? For example, if firm A is undertaking new projects, can we conclude that firms taking new projects are levering up, and leverage exists to support new projects?

The answer is an emphatic no. If firm A started with 90% leverage, it just reduced its leverage. If firm B started with 0% leverage, it just increased its leverage. Thus, your conclusion would have been completely wrong—firms taking new projects in my example are actually reducing leverage. Empirically, it turns out that explaining which firms are issuing equity (debt) is almost uncorrelated

Figure 24.1: Publicly Traded Firms in the U.S. in 2009, with at least $1 billion in assets. Source: Welch, IRFI 2010.

—

Figure equities with width 0.75*fullwidth

Figure liabilities with width 1*fullwidth

with which firms are reducing (increasing) their leverage ratios. This is partly because many firms that already have a lot of equity tend to issue more equity, which does not reduce their leverage ratio a bit. Thus, the evidence about capital structure levels that you will see in this chapter is quite distinct from the evidence about issuing activity (and stock returns) that you saw in the previous chapter.

24.B Decomposing the Balance Sheet

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Let's start with the broad picture of capital structure in the U.S. for publicly-traded corporations. Figure 24.1 shows averages as of 2009. When quoted in book values (more about this below), equities are about 38% of assets, total liabilities are about 61%. Equities is almost all common equity these days. Preferred equity has become an anachronism, although it is still common in private equity deals. As you know by now, I don't trust book values of equities, so I think you should not look into its further decompositions here or believe the 38% overall figure. Equity is really a much larger proportion of total firm assets. In 24.1, liability decompositions are more believable and interesting. Financial debt consists of total long-term debt and debt in current liabilities. Financial debt accounts for about 31% of total assets, i.e., half of firms' total liabilities. The other half of total liabilities are nonfinancial. It is primarily curent liabilities and unspecified other liabilities. Convertible debt is a fairly small part of todays' capital structures, too.

The focus of our chapter is the indebtedness of firms, as measured by the relation between financial debt, non-financial liabilities, and equity.

24.C How to Measure Leverage

x

Figure 24.1 did not sweat the details. But we really still need to decide on a good summary measure of how indebted a company is. You may need it not only to assess how likely it is that a firm will fall into financial distress, but also if you want to compute the weighted average cost of capital. So let's look at leverage

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ratios in some more detail.

Book or Market Value?

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By definition, a firm is

$$\underbrace{\text{Total Liabilities}}_{\text{Senior}} + \underbrace{\text{Equity}}_{\text{Junior}} = \text{Assets}$$

Alas, one complication arises immediately. How should you measure the value of equity (which is also a component of the value of total assets)? Should it be the market value of equity or the book value of equity? The market value has the X advantage that it is based on economic value, not on accounting value, and it is my favorite. However, reasonable people can disagree and prefer the book value instead. The main advantage of book value is that it varies less year to year, and thus many contracts and bond covenants are written with respect to the book value and not the market value. Most, but not all, of the discussion in this chapter works with the equity value. In the typical publicly traded U.S. firm, the market value of equity is about twice as large as the book value of its equity—and the older the firm is, the higher is the discrepancy on average. However, there are many firms in which this ratio reverses—and there are even firms that have negative book values of equity. x

You rarely have to worry about book value versus market value with respect to liabilities. You cannot use the market value of liabilities, simply because their values are usually not publicly available. Thus, you have no choice but to use book values. Fortunately, this is not too bad—for liabilities, book values and market values are often fairly similar (unless the firm is in such dire straits that its liabilities have become very risky, too).

Total Leverage: The Total-Liabilities-to-Total-Assets Ratio

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The formula above suggests that our first leverage ratio should be total liabilities (i.e., the senior claims) divided by total assets (i.e., all claims). Let's use IBM to illustrate this leverage measure. You can find the data you need to compute the liabilities-to-asset ratio in Table **??** (all quoted in millions): X

		2001	**2002**	**2003**
Total Liabilities	TL	$66,855	$73,702	$76,593
Market Value of Equity	MVE	$208,437	$133,484	$157,047
Book Value of Equity	BVE	$23,448	$22,782	$27,864
Market Value of Assets	TL+MVE	$275,292	$207,186	$233,640
Book Value of Assets	TL+BVE	$90,303	$96,484	$104,457

A convenient way to compute the market value of assets is to start with the book value of assets on the balance sheet, and then to subtract the book value of equity and add the market value of equity (e.g., for 2001: \$90,303−\$23,448+\$208,437 = \$275,292).

x

Therefore, IBM's total-liabilities-to-assets ratios were

		2001	2002	2003
Total-Liabilities-to-Assets, Market Value	TL/(TL+MVE)	24%	36%	33%
Total-Liabilities-to-Assets, Book Value	TL/(TL+BVE)	74%	76%	73%

You should not be surprised that the market-based debt ratios are much lower—after all, and as is common for older firms, the market value of IBM's equity is much larger than its book value. If you are a newspaper reporter and you want to hype how high IBM's corporate leverage ratio is, you will report the latter. If you are the CEO and you want to brag about how modest your leverage is, you will report the former. For us, a more sensible approach would be to put IBM's leverage ratio into context, by comparing it to those of other similar firms (such as Hewlett-Packard) and to its historical ratios, rather than looking at IBM's leverage ratios in absolute terms.

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A closely related ratio is the liabilities-to-equity ratio. It uses the same two inputs (liabilities and equity), but the denominator is not their sum. You can always translate a liabilities-to-equity ratio into a liabilities-to-assets ratio, and vice versa. (For example, if you have a 3-to-1 liabilities-to-equity ratio, you know you have a 3-to-4 liabilities-to-assets ratio). However, a big problem with equity-denominated ratios is that the book value of equity can be very small or even negative, which can easily make the liabilities-to-equity ratio seem unreasonably large. A second problem is that in the WACC computations, you need a ratio that is denominated by the sum (i.e., here, assets). More below.

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question

In 2004, IBM's financials reported total assets of \$111,003 and total liabilities of \$79,315. Its market value of equity was \$155,459. What was its liabilities-to-assets ratio, in book and market value?

answer

IBM's market value of assets in 2004 was \$79,315+\$155,459 = \$234,774. This means that its book liabilities-to-assets ratio was \$79,315/\$111,003 ≈ 71%; its market liabilities-to-assets ratio was \$79,315/\$234,774 ≈ 34%. The former is higher than the latter, because IBM's market value was more than twice its book value.

Financial Leverage: The Financial-Debt-to-Financial- Capital Ratio

x

The liabilities-to-asset ratio includes nonfinancial claims such as accounts payable (as well as some liabilities that are not even real but invented by accountants). Therefore, a second common measure of leverage ignores nonfinancial liabilities. The financial-debt-to-capital ratio breaks out the financial claims (long-term debt and debt in short-term liabilities) from the firm's total liabilities.

$$\underbrace{\text{Nonfinancial Liabilities}}_{\text{Senior}} + \overbrace{\underbrace{\text{Financial Liabilities}}_{\text{Senior}} + \underbrace{\text{Equity}}_{\text{Junior}}}^{\text{Financial Capital}} = \text{Assets}$$

In the typical publicly traded firm, financial capital is typically about one-half to one-third of the firm's total liabilities. Our second financial leverage measure, then, divides the financial debt by **financial capital**, defined as the sum of financial debt plus equity. Again, Table **??** has all the information you need:

		2001	**2002**	**2003**
Financial Debt	FD	$27,151	$26,017	$23,632
Market Value of Equity	MVE	$208,437	$133,484	$157,047
Book Value of Equity	BVE	$23,448	$22,782	$27,864
Market Value of Financial Capital	FD+MVE	$235,588	$159,501	$180,679
Book Value of Financial Capital	FD+BVE	$50,599	$48,799	$51,496

Therefore, the financial-debt-to-capital ratios are

		2001	**2002**	**2003**
Financial Debt-to-Capital, Market Value	FD/(FD+MVE)	12%	16%	13%
Financial Debt-to-Capital, Book Value	FD/(FD+BVE)	54%	53%	46%

This requires a small correction to my earlier remark—if IBM's CEO wanted to brag about modest debt, he would probably cite the financial-debt-to-capital ratio, not the liabilities-to-assets ratio. x

When you want to explore the financial stability or precariousness of firms, you may find it sometimes helpful to use measures that use firms' short-term liabilities, and especially short-term financial debt. For IBM, this was $6,646 in 2003. You might then compute the ratio of short-term liabilities to cash holdings, or to equity, or to assets. We shall ignore these ratios. X x

Many analysts subtract cash and short-term holdings from financial debt. After all, this cash could presumably be used to immediately reduce this debt. The sum of the market value of equity and financial debt, that is, financial capital at market value, minus cash and short-term holdings is called the **enterprise value**. x

And, as was the case for the liabilities-to-equity ratio, the financial-debt-to-equity ratio has the same two inputs and can act as a stand-in for the financial-debt-to-capital ratio. However, it too can suffer from nonsensibly small equity values and is not what we shall need below to compute the weighted average cost of capital.

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question

(Continued from Q 24.C) In 2004, IBM's financials reported financial debt of $22,927. What was its financial-debt-to-capital ratio, in book value and market value?

answer

You must use the information from Q 24.C. First note that the book value of equity is the difference between total assets and total liablities, that is, $BVE = \$111{,}003 - \$79{,}315 = \$31{,}688$. Financial capital and financial debt add together to arrive at $\$31{,}688 + \$22{,}927 = \$54{,}615$ in book value. The market value of equity was given in Q 24.C as $155,459, so the financial capital is $\$155{,}459 + \$22{,}927 = \$178{,}386$ in market value. This means that its book financial-debt-to-capital was $\$22{,}927/\$54{,}615 \approx 42\%$; its market financial-debt-to-capital was $\$22{,}927/\$178{,}386 \approx 13\%$.

Comparing Total and Financial Leverage Ratios—and WACC

What is the difference between the liabilities-to-assets ratio and the debt-to-capital ratio? Conceptually, the two ratios are cousins, and it is often the case that firms within the same industry have a similar rank ordering regardless of which measure is used. Mechanically, the big difference is that the liabilities-to-assets ratio includes nonfinancial liabilities (such as pension liabilities and accounts payable), which the debt-to-capital ratio ignores.

This raises the question: How are nonfinancial claims different from claims that financial creditors and shareholders receive? Think about what a claim is and how it comes about. Someone provides assets to the firm and receives a claim in exchange. For financial claimants, such as bondholders and shareholders, it is a direct money contribution. For nonfinancial claimants, there is an equivalent contribution, but it is usually not in money. For example, how did IBM's pension fund become a claimant? Employees made a contribution to the firm, which has not been fully paid by the firm yet. The firm still owes the pension claim, which is money to be paid that is still part of IBM's assets.

Many nonfinancial liabilities also require regular payments and often even on timetables that are as rigid as those on financial debt. And, as is the case for financial liabilities, failure to pay nonfinancial liabilities has sanctions and can

force bankruptcy. Moreover, for both financial and nonfinancial liabilities, all payments are made from funds before corporate income tax is computed. x

This perspective suggests that nonfinancial liabilities should be included in a leverage ratio—that is, that you should use the broader liabilities-to-assets ratio and not the debt-to-capital ratio. The liabilities-to-assets ratio would be better for measuring the firm's precariousness in many circumstances. Ignoring the nonfinancial liabilities would seem to be a mistake. x

However, there is also a very good reason to use the financial-debt-to-capital ratio. It was first explained in Section **??**. Financial debt is often the marginal X source of funding, which the firm would have to pay on the next dollar that the corporation could raise. Consequently, it is the financial claims' cost of capital that you should compare to the productivity of your next project. After all, many nonfinancial claims cannot be expanded or contracted at will. Moreover, even if this were not the case, how would you even measure the marginal cost of nonfinancial capital accurately? For example, if you do not pay off your accounts payable for a while, you can indeed earn interest on the cash you retain. However, your delaying payment may deprive your firm of better suppliers and raise your future prices on your inputs. Although this additional cost due to delay is conceptually the same as an interest payment, it is impossible to measure accurately in practice. Not knowing the cost of capital on nonfinancial liabilities means that it would not be easy to compute a weighted average cost of capital that includes your nonfinancial liabilities. x

In contrast, it is relatively easy to compute the WACC if you use the financial-debt-to-financial-capital ratio. For example, for IBM in 2003, all you need is the cost of capital on debt and equity. You would not use the cost of capital on nonfinancial liabilities. IBM was unlikely to go bankrupt, so its stated interest rate was probably close to its expected interest rate. On Page **??**, we guessed that its debt cost of capital was around 2.8%. (Admittedly, it was only the average cost of debt capital; the marginal cost could be higher.) The cost of its equity may have X been around 7%—a number I obtained from a CAPM -type estimation. You can then compute the WACC:

widenecolumn

$$WACC = 13\% \times 2.8\% + 87\% \times 7\% \approx 6.5\%$$

$$WACC = 13\% \times \begin{pmatrix}\text{Expected}\\ \text{Intrst.Cost}\end{pmatrix} + 87\% \times \begin{pmatrix}\text{Expected Equity}\\ \text{Cost of Capital}\end{pmatrix}$$

$$WACC = \begin{pmatrix}\text{Debt-to-}\\ \text{Capital Ratio}\end{pmatrix} \times \begin{pmatrix}\text{Expected Financial}\\ \text{Debt Intrst. Rate}\end{pmatrix} + \left[1 - \begin{pmatrix}\text{Debt-to-}\\ \text{Capital Ratio}\end{pmatrix}\right] \times \begin{pmatrix}\text{Expected Equity}\\ \text{Cost of Capital}\end{pmatrix}$$

This 6.5% is an estimate of the cost of capital on funds that IBM could have raised or retired relatively quickly—that is, on the financial funds that most likely best represent IBM's marginal cost of raising funds. It is this 6.5% that IBM's executives X may have wanted to use as a hurdle rate for projects. Of course, this applies only to projects like IBM's typical projects in 2003.

Now, can you please compute what the WACC is when you include nonfinancial liabilities? (As for me, I simply have no idea how I could do this, because I do not know what the cost of capital on nonfinancial liabilities is.)

howbad

x You may on occasion encounter the ratio of financial debt divided by the value of assets as a measure of leverage. For example, the using book values of assets,

		2001	2002	2003
Financial Debt	FD	$27,151	$26,017	$23,632
Book Value of Assets	TL+BVE	$90,303	$96,484	$104,457
Financial Debt-to-Assets	FD/(TL+BVE)	30%	27%	23%

The debt-to-asset ratio makes no sense. The problem is not that non-financial liabilities are not considered (as is the case with the debt-to-capital ratio), but that non-financial liabilities are considered the same as equity. Thus, a firm can reduce its leverage ratio by increasing its nonfinancial liabilities. If IBM had taken on another $100 billion in accounts payable or was hit with an additional income tax obligation of $100 billion, everything else being equal, its 2003 financial-debt-to-assets ratio would have fallen from $23.6/$104.5 ≈ 23% to $23.6/$204.5 ≈ 12%, even though its indebtedness would have become worse, not better. In real life, some debt covenants are written on the financial-debt-to-asset ratio, and thus some CFOs may care about it—but it is not a sensible measure of leverage.

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question

Are firms partly financed by their nonfinancial liabilities? If so, how do you incorporate this into the firm's WACC ?

answer

Yes, virtually all firms are partly financed by at least some nonfinancial liabilities, too. However, the nonfinancial liabilities may not allow arbitrary use on the margin. Thus, the financial debt may be the marginal method to finance projects. Therefore, we usually do not consider nonfinancial liabilities when we compute the WACC.

A Flow-Based Approach: The Interest Coverage Ratio

Another altogether different approach to measuring indebtedness is through the running obligations incurred by the debt relative to the money coming in, that is, not through the levels of liabilities, debt, or equity. The natural flow-based summary ratio is the interest coverage ratio. It measures how much of the firm's X operating income is consumed by debt service, principally interest payments. The idea is that it measures whether the firm will encounter financial distress because it cannot meet its running debt obligations. The problem with interest coverage ratios is that flow measures can be very volatile from year to year. Specifically, corporate earnings can be highly variable or even negative for 1 or 2 years. In this case, the interest coverage ratio can look unnecessarily dire. In addition, principal repayment obligations are often more stringent than interest payment obligations, and firms must also meet their nonfinancial obligations. Still, the interest coverage ratio gives a good different perspective on the leverage of a firm.

I think you realize by now that characterizing capital structure cannot be accurately accomplished with just one indebtedness ratio. Instead, capital structure must be seen from multiple angles.

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question
What are the drawbacks to using the interest coverage ratio as a measure of indebtedness?

answer
A drawback to using an interest coverage ratio is that the operating profit of a firm can vary greatly from one year to the next. The interest coverage ratio therefore moves around a lot. In some years, it may even be negative. This can render the coverage ratio meaningless. The interest coverage ratio also does not take required principal repayments into account. Finally, it does not reflect the firm's nonfinancial liabilities. This is why the interest coverage ratio—like other ratios—should not be used as an exclusive measure.

24.D Empirical Capital Structure Patterns in 2010

You already saw the capital structure of IBM from 2001-2003 in Section **??** in some X detail. But is the IBM from 2001-2003 representative of how firms are financed today or not? What were the debt ratios of companies of different sizes in 2010? Are there recognizable patterns? Obviously, we cannot look at all publicly traded companies at the same level of detail as we did for IBM. So, you will have to be

satisfied with some glimpses into the capital structures of firms today, relying on
x statistics for summary information.

To recap, indebtedness can be measured in a number of ways:

- You can see indebtedness narrowly or widely: narrowly in terms of the firm's financial indebtedness (long-term debt plus debt in current liabilities), or widely in terms of all liabilities (which includes nonfinancial obligations such as payables, pensions, and other liabilities, for example).

- You can see equity in terms of market value or book value. Although I
X prefer the former, the latter is also often used in practice, especially by creditors who are interested in assets that they can repossess in case of bankruptcy. (Book value is often a more conservative measure of value if a firm is dismembered.) Total assets can be transformed from book value to market value by subtracting off the book value of equity and adding back the market value of equity.

Sometimes, you may see a debt-to-equity ratio instead of a debt-to-capital ratio. The two measures are interchangeable. If you know one, you can translate it into the other. For example, a 3:1 debt-to-equity ratio is a $3 : (1 + 3) = 75\%$ debt-to-capital ratio.

Let's divide firms in 2011 into small firms that had less than $1 billion in the market value of their assets at the end of the fiscal year and large firms that had more. The average sales were about $218 million for small firms and $4.5 billion for large firms. The four leverage ratios that we just mentioned were

		2,379 small firms			2,388 large firms		
		Q1	**Q2**	Q3	Q1	**Q2**	Q3
FD/CP	in market value	0%	**6%**	33%	10%	**25%**	46%
FD/CP	in book value	0%	**10%**	39%	20%	**39%**	59%
TL/TA	in market value	12%	**28%**	53%	25%	**43%**	70%
	FD/TA	0%	**5%**	19%	5%	**14%**	27%
	NFL/TA	9%	**18%**	30%	11%	**20%**	38%
	EQ/TA	45%	**71%**	87%	28%	**55%**	75%
TL/TA	in book value	24%	**43%**	69%	45%	**62%**	81%
	FD/TA	0%	**7%**	26%	8%	**21%**	37%
	NFL/TA	16%	**27%**	45%	21%	**31%**	50%
	EQ/TA	30%	**56%**	75%	17%	**37%**	54%

I abbreviated the variables: FD is financial debt; CP is financial capital, the sum of financial debt and equity; TL is total liabilities; TA is total assets; NFL is non-financial liabilities; and EQ is equity.

Large firms had higher leverage ratios than small firms on all metrics. Book-value based leverage measures were higher than market-value based leverage measures, because market values of equity are typically higher than book values of equity. Total liabilities to total assets ratios were higher than financial debt to financial capital ratios. Large firms used more financial debt than small firms, but both large and small firms had more non-financial liabilities than financial debt. And don't ignore that there is a lot of variability across firms. For example, although 6% was the median financial-debt-to-capital ratio for small firms, more than a quarter of small firms had zero financial debt; and more than a quarter had more than 33% financial debt.

The Dow-Jones 30 Firms

x

How do the capital structures of other firms in the economy look like? Let's look at the thirty Dow-Jones index firms. These are large U.S. firms in a variety of industries. Table 24.1 shows both their book and market values in 2010. If you inspect the table, you will see that the most levered firms are in the finance and insurance business. (General Electric has a very large financing operation. Fannie Mae and Freddie Mac, not in the table, and famous through their collapse in 2007, have even higher leverage ratios.) On the other end, Intel had almost no liabilities and financial debt in terms of market value. Because market values are typically higher than (financial-statement) book values for large old firms, their book-based leverage ratios tend to be higher than their market-based leverage ratios. For example, Boeing's and McDonald's financial leverage ratios are almost four times higher in terms of book value than in terms of market value. Nevertheless, the ordering remains similar. It is often but not always the case that a firm that has a high ratio rank on one leverage measure also has a high ratio rank on another leverage measure. For an example of an exception, Chevron had an average liabilities-to-asset ratio, but a very low financial-debt-to-capital ratio. It financed itself disproportionately through non-financial liabilities (such as accounts payables).

Leverage by Industry and Firm-Size

Table 24.2 looks at both large and small firms in different industries, based on their standard industrial classification (SIC) codes. Again, finance and insurance is the most levered industry in terms of its total liabilities-to-assets ratio, book-value

Table 24.1: Capital Structure of Dow-Jones 30 Firms in 2010

—Sales, Total Liabilities (TL), Total Assets (TA), Financial Debt (FD), and Financial Capital (FD plus equity) are measured in billion dollars at the end of their fiscal years. Firms are sorted by TL/TA, market value.

Conclusions: Financial firms are much more highly levered than other firms. (GE contains a large financing company.) Market-value based leverage measures are typically lower than book-value type leverage measures, because market values tend to be higher than book values. Firms that are high on one measure of leverage also tend to be high on other measures of leverage, although this is not always the case. For example, Chevron relied more on non-financial liabilities, and thus had higher TL/TA ratios than FD/CP ratios. For example, Boeing had much higher debt loads in terms of book value than in terms of market value.

			Market Value		Book Value			Market Value		Bo
Name	Sales	TL	TA	**TL/TA**	TA	**TL/TA**	FD	CP	**FD/CP**	C
Bank Of America	134	2,037	2,188	**93%**	2,265	**90%**	754	888	**85%**	96
JPMorgan-Chase	115	1,941	2,115	**92%**	2,118	**92%**	617	783	**79%**	78
General Electric	149	627	826	**76%**	751	**83%**	479	673	**71%**	59
American Express	30	131	182	**72%**	147	**89%**	70	121	**58%**	8
Boeing	64	66	114	**58%**	69	**96%**	12	60	**21%**	1
Alcoa	21	22	41	**54%**	39	**57%**	9	25	**37%**	2
Kraft Foods	49	59	115	**52%**	95	**62%**	29	84	**34%**	6
Caterpillar	43	53	113	**47%**	64	**82%**	28	88	**32%**	3
Hewlett-Packard	126	84	177	**47%**	125	**67%**	22	115	**19%**	6
Du Pont	32	31	77	**40%**	40	**76%**	10	56	**18%**	1
IBM	100	90	271	**33%**	113	**80%**	29	209	**14%**	5
Disney	38	30	94	**32%**	69	**43%**	13	75	**17%**	5
Chevron	190	79	263	**30%**	185	**43%**	11	195	**6%**	11
Home Depot	68	21	81	**26%**	40	**53%**	10	69	**14%**	2
Cisco Systems	40	37	167	**22%**	81	**45%**	15	146	**10%**	6
Coca-Cola	35	42	193	**22%**	73	**57%**	23	174	**13%**	5
Johnson & Johnson	62	46	216	**21%**	103	**45%**	17	186	**9%**	7
Mcdonald's	24	17	98	**18%**	32	**54%**	12	92	**12%**	2
3M	27	14	76	**19%**	30	**47%**	6	67	**8%**	2
Intel	44	14	130	**11%**	63	**22%**	2	118	**2%**	5

Table 24.2: Leverage Ratio (TL/TA, Book-Value) by Industry and Firm Size

—Large firms had more than $1 billion in market value of assets at the end of their fiscal year. N is the number of firms. The MCap measure is the average market capitalization of assets. The three leverage ratios are the first quartile (Q1), the median (boldfaced Q2), and the third quartile (Q3) of the total liabilities over total asset ratio, in book value. Ranking wise, the basic conclusions are the same for other measures of leverage.
Conclusions: Larger firms tend to carry a median TL/TA leverage ratio of about 50-60% in most industries. The exception is in finance and insurance, where most firms are levered as much as possible. In most industries, small firms carry lower liability ratios. There is considerable variation in leverage ratios within most industries.

	Small Firms			Large Firms		
	N	MCap	Q1 , **Q2** , Q3	N	MCap	Q1 , **Q2** , Q3
All	2,379	$218	24%,**43%**,69%	2,388	$4,561	45%,**62%**,81%
Finance & Insurance	254	$495	68%,**89%**,91%	527	$4,782	80%,**89%**,91%
Real Estate	34	$169	34%,**61%**,88%	19	$2,907	26%,**47%**,71%
Transport & Services	140	$327	33%,**56%**,74%	308	$7,660	56%,**68%**,75%
Construction	19	$352	40%,**51%**,61%	25	$3,348	51%,**59%**,66%
Retail	116	$298	38%,**50%**,67%	131	$3,874	40%,**53%**,69%
Wholesale	61	$148	35%,**47%**,64%	57	$3,051	49%,**60%**,66%
Services	418	$155	25%,**41%**,64%	280	$2,990	34%,**52%**,71%
Manufacturing	1,055	$168	21%,**35%**,56%	703	$5,199	39%,**54%**,66%
Mining	145	$213	16%,**32%**,53%	183	$4,625	34%,**47%**,58%
Agriculture	14	$214	19%,**29%**,44%	6	$2,913	43%,**52%**,63%

based. (Most conclusions are similar if we used other ratios.) Large firms tend to have more leverage, except among real-estate firms. There is good within-industry variation of leverage ratios. For example, the interquartile range of leverage for Service firms is 21% to 56% for small firms and 34% to 71% for large firms.

Financial and Trade Financing

Do firms finance themselves more through financial liabilities, or more through things like trade credit? Although this varies from industry to industry, overall statistics in 2010 were

	Small Firms			Large Firms		
	Q1	Q2	Q3	Q1	Q2	Q3
Financial Debt / Total Liabilities	0%	15%	52%	13%	38%	60%

(IBM's 2003 ratio was \$23.6/\$76.6 ≈ 30%.) At least a quarter of publicly traded small firms had no financial liabilities, at all. Instead, they tended to rely on paying their bills later:

	Small Firms			Large Firms		
	Q1	Q2	Q3	Q1	Q2	Q3
Accounts Payables / Total Liabilities	7%	18%	36%	4%	11%	26%

(IBM's 2003 ratio was \$8.46/\$76.6 ≈ 11%.)

Long-Term and Short-Term Financing

Do firms tend to rely more on short-term or long-term financing?

	Small Firms			Large Firms		
	Q1	Q2	Q3	Q1	Q2	Q3
Short-Term/Total Liabilities	44%	75%	94%	23%	38%	59%

(IBM had \$37.9/\$76.6 ≈ 50%.) Small firms live more precariously than big firms. The median small firm had three times as much in short-term liabilities as the median large firm. If the economic environment turns sour, small firms have less leeway. On the other hand, because small firms tend to have lower total liabilities than large firms, both small and large firms have roughly a similar fraction of their value in short-term liabilities.

question
Roughly and on average, what were the liabilities ratios of firms—large and small—on various measures?

answer
Measured in market values, small firms had median financial debt ratios of about 10-15%; large firms of about 25-35%. Small firms had median total liability ratios of about 30%; large firms of about 50%. Book values tended to be another 15-20% higher.

question
What industries were characterized by very high debt ratios? Which were characterized by very low debt ratios?

answer
High debt ratios: Financial companies. Low debt ratios: Agricultural and mining companies.

International Indebtedness Ratios

x

We can try to extend our analysis from the United States to other countries. Unfortunately, this is not easy. For example, in South Korea, there are four large companies, the so-called chaebol (Samsung, Hyundai, Daewoo, and Lucky Goldstar). There are very few medium-sized companies. In Finland, it is even more extreme: Nokia is the only large global company. Is Nokia then better compared to the single-largest U.S. company or to the top 10% of U.S. companies? (There is no clear answer.) But even in countries with many small- and medium-sized companies, data is tough to come by. And even if data exists, it is not even clear what it means. Debt and liability ratios may not be comparable because international accounting rules are often different from those elsewhere. (For example, German companies record "financial reserves" as liabilities, although these may be more like equity than debt. In many other countries, deferred taxes may never come due and thus may not be booked as liabilities. Of course, M&A activity can also change the book value of equity drastically. And what subsidiaries are consolidated into the main financials in different countries is a science in itself.)

x

Table 24.3 describes the data in one study of the capital structure of large firms in 1991. (I apologize for the dated numbers, but no one has updated them since. This is the best I am aware of.) Despite the comparability problems, the capital structure picture seemed broadly similar in all these highly developed countries. The Anglo-Saxon countries may have had somewhat lower indebtedness ratios, but the differences were mild. The authors additionally observed that companies in all countries displayed substantial heterogeneity—heterogeneity that was usually as large as the reported medians; and that Germany was the only country in which larger firms tended to have lower indebtedness ratios.

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question
In 1991, were U.S. firms more or less indebted than their British counterparts?

answer
In 1991, U.S. firms were slightly more indebted than their British counterparts.

Table 24.3: Indebtedness Ratios in Other Countries, Medians in 1991

—**Conclusions:** The table shows that the three Anglo-Saxon countries tended to have lower debt ratios than the other four countries. Source: Rajan and Zingales, JF 1995.

		US	UK	Canada	Japan	Germany	France
Liabilities to Assets	TL/(TL+MVE)	44%	40%	49%	45%	69%	64%
Liabilities to Assets	TL/(TL+BVE)	58%	54%	56%	69%	73%	71%
Fin. Debt to Fin. Claims	FD/(FD+MVE)	28%	19%	35%	29%	23%	41%
Fin. Debt to Fin. Claims	FD/(FD+BVE)	37%	28%	39%	53%	38%	48%

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Summary

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Before the usual point-by-point summary, let me reemphasize that it is important that you keep the empirical evidence in proper perspective. We do know that our theories can explain at least some of the behavior of corporations. We should not dismiss them as determinants of observed capital structure. There is a good chance that further refining of our theories and proxies will explain quite a bit more about how firms behave. We also do know that we do not know why our theories explain relatively little about the differences in behavior across companies. There is a good chance that there are other systematic factors that we do not yet fully understand (probably in the domain of behavioral finance). There is also a good chance that much corporate behavior is just erratic and will never be explained. We should keep

x an open mind.

Why torture you in this chapter with something that we do not fully understand? The reason is that capital structure is an important area, and you must be aware of what we do not yet know! As a manager, you will meet many investment bankers mustering arguments about what other firms have been doing, and offering advice as to what you should do. As an investment banker, you should know not only what factors influence firms' capital structures but also how important or unimportant individual factors are—and how you can measure them to find new potential clients. As a policy maker, you should know how authoritative the capital structure outcomes

x and choices of firms really are.

But perhaps most importantly, the empirical evidence does not suggest that our theories are worthless. For example, does our empirical evidence mean that just because other firms do not exploit the corporate income tax advantage of debt that you should ignore it, too? Absolutely not! You can still think about how important a corporate income tax advantage is to your firm, and what this means for your

optimal capital structure. Perhaps more importantly, if many firms are ignoring the factors that they should pay attention to, then over time some will end up with very poor capital structures. In this case, you can think about how you can come in and change these existing firms to increase their values. You can effect change from many different directions; You can work in the firm itself and argue for a capital structure change; you can become an investment banker and advise clients on better capital structures; or you can even buy some companies. Maybe you will start the next wave of leveraged buyouts, which usually create much value by increasing the target's leverage.

X

X

Back to the point-by-point summary. In this chapter, we first discussed how to measure leverage.

- Indebtedness ratios can be measured in many different ways. The most common leverage ratios are total leverage (liabilities-to-assets) and financial leverage (debt-to-capital). It often matters greatly whether equity is measured in book value or equity value. An altogether different flow-based way of measuring leverage is the interest coverage ratio.
- The financial leverage ratio is commonly used to estimate the marginal cost of capital via the WACC formula.

We then looked at summary statistics from publicly traded firms in 2010. The following patterns stood out:

- The median small publicly-traded firm, where small means a firm with less than $1 billion in total assets, had only about 5% of its financial capital in financial debt (both in market value). The remaining financing (95%) was equity. About 30% of its total assets were liabilities. Again, the rest was equity.
- The median large publicly-traded firm, where large means a firm with more than $1 billion in total assets, had about 25% of its financial capital in financial debt (both in market value). The remaining financing (75%) was equity. About 60% of its total assets were liabilities. Again, the rest was equity.
- If measured in book values, the market-based leverage ratios should be multiplied by about 1.5.
- There is considerable heterogeneity across firms. For example, more than a quarter of all small firms had no financial debt, while more than a quarter had more than 20% of their assets (and more than one-third of their capital) in financial debt.
- Industry matters. Many financial firms have very high debt ratios.
- Large firms tend to have relatively less of their total debt in short-term obligations (35-40%) than small firms (60-70%). Small firms rely disproportionally more on paying bills later.
- Distressed firms and firms that have recently acquired other firms often have high debt ratios.

EOC MATTER

eocproblems

question
Roughly and on average, what is the typical ratio of the market value over the book value for a large firm? For a small firm?

answer
The market value is typically about twice as large as the book value. This is about the same for small and large firms.

question
Is it inconsistent to use the market value of equity but the book value of liabilities? If they are inconsistent, would it make sense to use them as inputs in the same ratio?

answer
Yes, it is inconsistent to mix the market value of equity with the book value of liabilities, but we have no other choice. Fortunately, for liabilities, the book value should be reasonably close to the market value of debt.

question
In 2005, IBM's financials reported total assets of $105,748 million, total liabilities of $72,650 million, and financial debt of $22,641 million. Its market value of equity was $129,463 million. (a) What was its liabilities-to-assets ratio, in book and market value? (b) What was its financial-debt-to-capital ratio, in book value and market value?

answer

1. IBM's market value of assets was the sum of liabilities and the market value of equity, i.e., $72,650+$129,463 = $202,113 million. This means that its book liabilities-to-asset ratio was $72,650/$105,748 ≈ 69%; its market liabilities-to-asset ratio was $72,650/$202,113 ≈ 36%.
2. With a book equity of $105,748 − $72,650$33,098 million, the book financial-debt-to-capital was $22,461/($22,461+ $33,098) ≈ 40%. The market financial-debt-to-capital ratio was $22,641/($22,641 + $129,465) ≈ 15%.

question
What is "enterprise value"? What does it omit?

answer
Enterprise value is the market value of equity plus financial debt minus cash and short-term holdings. It omits nonfinancial liabilities.

question
Why might you want to use the financial-debt-to-capital ratio rather than the broader total-liabilities-to-assets ratio?

answer
You might want to use the debt-to-capital ratio instead of the liabilities-to-asset ratio for at least two reasons:

1. It is often easier for a firm to raise and retire cash through financial claims that it is through the use of nonfinancial liabilities. Management often has more control over financial claims. Thus they can be thought of as the "marginal" claims.
2. It is difficult to determine a cost of capital for nonfinancial liabilities. This is especially bad if you have to compute a WACC.

question
Is the financial-debt-to-assets ratio a good measure of firm leverage? If yes, please compute it for IBM for 2005, using information from the preceding questions. If no, please explain why.

answer
The financial-debt-to-asset ratio is not a good measure of indebtedness, because the denominator includes nonfinancial liabilities, which the numerator does not. Therefore, a firm with more nonfinancial liabilities would be deemed less levered by this ratio—clearly incorrect.

question
What are your main choices for measuring leverage when you want to describe a firm's capital structure?

answer
The two main leverage ratios are total-liabilities-to-total-assets and financial-debt-to-capital. You can measure assets and capital in terms of market value or book value. You could also use different ratios altogether, such as debt/equity ratios or liability-equity ratios. In addition, you could try to use an interest coverage ratio, which comes from an altogether different concept.

question
What debt ratio characteristics did the largest firms in 2005 have? What firms had very high debt ratios?

answer
The debt ratios of many firms in 2005 seem to have been related to their industries. The financial services industry uses debt as a tool, and thus some financial firms are also often highly levered. A secondary characteristic was that some of these industries were distressed—such as the car companies and airlines.

question
Roughly and on average, what were the liabilities ratios of firms—large and small—on various measures?

answer
This is a repeat of a Solve Now! question. Small firms had median financial debt ratios of about 10–15%, large firms about 25–30%. Measured in market values, small firms had median total liability ratios of about 30%, large firms about 50%. Book values tend to be another 15-20% higher.

question
Did profitable firms have higher or lower indebtedness ratios than unprofitable firms?

answer
This is a repeat of a Solve Now! question. Profitable firms tended to have higher indebtedness ratios.

question
What industries in 2003 were characterized by very high debt ratios? Which were characterized by very low debt ratios? Is it still the same today?

answer
This is similar to a Solve Now! question.
High debt ratios: Utilities and banks had high financial debt ratios, though not necessarily high broader total indebtedness measures. Steel and automobiles are more indebted on broader measures.
Low debt ratios: Mining, drugs, and machines had low financial ratios. Mining and oil had low broader indebtedness ratios.

question
Roughly and on average, how much of very large and very small firms' total liabilities were financial debt?

answer
Financial debt to total liabilities: 20%–25% for small firms, 40% for large firms.

question
Roughly and on average, how much of very large and very small firms' total liabilities were short term in nature?

answer
Short-term liabilities/total liabilities: 35 – 40% for large firms, 60–70% for small firms.

question
How did book and market values of equity compare for firms of various sizes?

answer
The book value of equity was typically less than half of its market value.

question
Were Anglo-Saxon firms more indebted than their foreign counterparts in 1991?

answer
No. Anglo firms tend to be on the low side of indebtedness ratios.

Chapter 25

Banking, and Mergers & Acquisitions

Warning: This chapter is somewhat outdated

intro
Investment banking is the provision of financial services to firms, just as retail banking is the provision of financial services to consumers. The most important financial services relate to financial advice and the handling of deposits and loans. This chapter will go over these functions in more detail. This also gives us an excellent opportunity to take a more detailed look at the capital-issuing and M&A processes themselves.

25.A Investment Banking Functions

The two two main investment banking business functions of banks are:

Capital intermediation: Although firms can and do deposit funds, often in the ordinary course of business, few firms are ultimately primarily depositors. Instead, most firms are consumers of funds. Thus, facilitating funding is comparatively more important in investment banking context. Banks both lend capital themselves and act as agents on behalf of firms that want to borrow money from other capital providers (such as pension funds). Banks orchestrate the process and handle many of the legal aspects of the capital-raising process. Collectively, the loan facilitation functions are called **underwriting**.

Advice and facilitation: Banks offer advice—solicited and unsolicited—and assistance. This matters most when firms want to undertake large investments, such as **mergers and acquisitions** (familiarly known as M&A).

Underwriting

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Almost all public debt and equity offerings by large and/or exchange-traded firms are underwritten by banks. The term **underwriter** originally came from the guarantee of the issuing proceeds by the banker to the issuing client, similar to the underwriting of a policy by an insurance company. This mattered greatly in an era when communications traveled by horse, investors were dispersed over thousands of miles, sales had to be made by foreign agents, and it took weeks to place the shares. Times have changed, though. Communication is now instantaneous around the globe, and every underwriter knows almost every important large investor. A few dozen large institutional funds are so big that they could easily absorb hundreds of offerings. Given today's financial information environment, the underwriter knows quite well on the day of the offering at what price a corporate debt or equity issue can be sold for. If the issuer were to refuse to accept this price point, the underwriter would simply not bring the issue to the market in the first place. Thus, the actual underwriting guarantee itself, which is still legally granted only on the morning of the offering, has become unimportant.

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Instead, the main functions of underwriters today are different:

Issue origination: Underwriters must have the expertise to handle the legal and operational processes.

Issue placement: Underwriters must maintain and tap their investor networks to find the investors desired by issuers. (Many issuers prefer institutional investors; others prefer dispersed ownership.)

Reputation and signaling: Underwriters vouch for the integrity of the process and the quality of the issuer to the investors.

Underwriters also help throughout the issuing process in ways that are not as formal. For example, many banks have large retail brokerage arms. After the offering, the banks' analysts will continue to provide helpful information to institutional and retail investors on an ongoing basis. (For IPOs, they can also help spread "positive hype" through optimistic analyst reports on behalf of the issuer.) This presumably increases the demand for investment in the company and is thus good for selling more shares and debt in the future. Underwriters are allowed by a special SEC exception to "stabilize" (i.e., manipulate) the price.

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Although every major bank nowadays has plenty of contacts to place even the largest issues on its own (and plenty of capital so as not to have to fear the risk of a failed offering), another historical aspect of the underwriting process that has survived is that almost all offerings are brought to market by a **syndicate** of banks put together for each deal. Syndicates typically contain between two

and six lead underwriters. Syndicates are led by [pl]book runner and [pl]lead manager, with the former in charge of assembling the book of investors interested in purchasing shares (actually, a spreadsheet), and the latter in charge of handling the due diligence and the technical and legal aspects of the process. Normally, lead underwriters are also the book runners. Sometimes, different book runners are in charge of different market segments, such as domestic versus foreign placements. Offerings also used to have many co-underwriters who helped to place shares, but this feature has largely disappeared in the last decade. x

Banks care greatly about "bragging rights" (more formally called "reputation"). For example, banks consider it important to be named a lead underwriter, because it helps their rankings. The two main providers of these rankings are Thomson Financial and Dealogic. Historically, before rankings became widely available, the location, placement, and font size of the underwriter's name in the printed financial advertisement of an offering (the so-called **tombstone** advertisement) was another important sign of the relative prestige of a bank. However, tombstones are rapidly becoming extinct, so we will not dwell on them.

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question
What are the most important services and functions of underwriters today?

answer
The three important functions of underwriters today are issue origination, issue placement, and reputation and signaling. There are also a host of less formal tasks (such as analyst coverage).

question
How good and unbiased are brokerage analysts' buy recommendations?

answer
This is actually from Section 22.G: Most brokerage analysts' recommendations are not to be trusted blindly, as evidenced by the fact that most recommendations are "buy." Favorable recommendations help investment bankers attract corporate clients.

Advisory (Merger and Acquisition Facilitation)

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The facilitation of M&A transactions is easiest to visualize if you think of a good common real estate broker—the two jobs are really quite similar. They differ primarily in scale. Here is what a good advisor typically does:

- The advisor identifies his own potential clients, or vice versa. Sometimes, the client initiates the contact when she wants to buy or sell a target business. At other times, the investment banker has an idea that (s)he brings to the client.

- The advisor offers valuation services for potential targets. (This was the subject of most of this textbook. You already know that this is not an easy task.)
- If working for a potential target, the advisor helps to position the business so that it can be sold. This may be a simple or a complex task. It could involve hiring new personnel, restating the financials in a light that makes them look more favorable, helping to advertise the business, and so on.
- The advisor helps to find potential acquirers or targets. This is often not just an intelligence-gathering function. Many good advisors also have personal and/or business connections to potential counterparties that make an approach much easier.

X

- The advisor often has expertise in negotiation, which the client may lack. Advisors have a great incentive not to let negotiations break down. (However, this is not necessarily good. Advisors are often less willing than the principal client to walk away from deals if the terms are not right.)
- The acquirer's advisor can help conduct **due diligence** (i.e., a minimal amount of scrutiny) to locate gaping problems in the target or transaction that would otherwise be overlooked. Most of the time, however, this has become just a legal requirement that must be satisfied.
- The advisor can help with the tax structure of a deal. This can be a hugely important aspect, saving the parties as much as 20% of the deal compared to a worse structure. (For example, a seller is often better off not taking a consulting role in the merged entity. Such a position would have cash flows taxed at high ordinary income tax rates, rather than at lower capital gains tax rates.)
- The advisor can often arrange the financing needed to complete an acquisition. Indeed, most acquirers do not have enough cash on hand, so the bank also often provides **bridge financing** to facilitate the acquisition. As the name suggests, the intent is for the acquirer to liquidate some corporate assets right after the acquisition to repay this loan.
- The advisor knows how to navigate the legal aspects of the process, everything ranging from state laws to SEC regulations.

These are difficult tasks that require expertise that few acquirers or targets have themselves—thus, the role of the investment banker.

Table 25.1: Global Market Sizes and Market Shares in Investment Banking Activities in 2007

—These market shares have changed only slowly, at least until 2010. Original Data Source: Thomson Financial.

			Equity		
Market Shares	**SEO**	**IPO**	**All**	**Debt**	**M&A**
United States	23%	15%	27%	58%	42%
Europe (Middle East, Africa)	33%	41%	33%	37%	40%
Asia	31%	28%	26%		7%
Australia	6%	2%	4%		4%
Japan	4%	2%	3%		3%
Latin America	3%	12%	6%		2%
World Market Share in 2007, in billion US dollars	$362	$304	$844	$6,226	$4,482

Globalization

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The market in which banks act primarily as intermediaries rather than as principal lenders is not just domestic, either. The United States and Europe still have the largest financial markets in the world, although Asia (including China) is clearly coming on strong. Market sizes and market shares in 2007 for seasoned equity offerings (SEOs), initial public offerings (IPOs), debt offerings, and M&A advice are shown in Table 25.1. Market shares have changed only slowly since 2007, so this table is still indicative as of 2010.

Do not take these numbers too literally. Not only do they change year to year, but it is not even clear any longer how to count transactions. For example, a Latin American company may issue securities in the United States underwritten by Deutsche Bank, and these securities may be bought by Japanese banks that are owned by Kuwaiti investors. Which region's capital market would you give credit to? Nevertheless, the exhibit does give some insight into how large capital markets in different regions are. Overall, the United States is still the largest financial market in the world. Yet it is no longer the largest equity market. That honor now belongs to Europe and will soon belong to Asia. This should not be too surprising. The demand for capital in other countries is expanding: Firms in Asia and Eastern Europe are just beginning to go public. Similarly, the supply of capital by other countries has been expanding (principally the capital from Asia). Thus, it is easy to predict that the rest of the world will continue to catch up with the United States. There is just too much capital and economic development happening outside our

x borders.

Many of the world's principal banking operations are headquartered in New York City. Most also have a strong satellite office in London, perhaps another in Hong Kong, Singapore, Tokyo, or Shanghai, and one in their home country. This fact, plus the fact that this text book is itself American in origin, means that the
x United States still deserves special treatment in this chapter.

Inevitably, by the time you read this, any information in this chapter will be outdated. For many exhibits, Thomson Financial publicly posts updated "League Tables" at www.thomsonreuters.com, which not only provide other related information (such as fee revenues), but also slice and dice the data in all sorts of other interesting ways. The Thomson League Tables are free and highly recommended for browsing.

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question
Where are the biggest capital markets for placing securities? Roughly, how do they compare in size?

answer
The United States is still the biggest capital market for securities, but Europe and Asia are no longer far behind. When it comes to equity, they have even surpassed the United States on some measures.

25.B An Example: Goldman Sachs

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It is difficult to explain the operations of complex financial firms. Investment banking is only a small part of their financial operations. Moreover, it is not easy to find much information about financial firms. (Hedge funds are even worse than investment banks in this regard.) Generally, financial firms consider information their competitive advantage, so it is usually impossible to convince them to part voluntarily with any data. (Trust me: I have tried.) Fortunately, SEC disclosure requirements allow us to get a limited glimpse into their operations. The SEC requires financial firms that facilitate issues of other firms (e.g., in the public issuing process of securities), to disclose certain information. Moreover, because all major banks are publicly-traded firms, they have to disclose certain information about themselves in their own annual reports. This allows us to piece together a
x picture of their operations.

The most prominent financial firm today may well be Goldman Sachs. It was founded in 1869 by Marcus Goldman as a commercial paper (i.e., short-term

corporate loans) business. In 1896, Goldman's son-in-law, Samuel Sachs, joined the firm, which was then renamed Goldman Sachs. It became a member of the New York Stock Exchange the same year. In 1999, it converted from a partnership into a publicly traded corporation via an IPO. As of November 2007, Goldman Sachs conducted business in 25 countries: 43% of its employees were outside the United States, 49% of its net revenues and 57% of its earnings were from outside the Americas, and its clients were companies and individuals worldwide. (Despite its obvious Jewish heritage, Goldman Sachs even received a license in January 2008 to operate in Saudi Arabia.)

Goldman is generally regarded as the smartest and most aggressive firm in the business. It behooves any of its clients to watch out for their own interests when dealing with Goldman (or any other financial services firms). This became known to the broader public in 2010, when it was revealed that Goldman had sold some of its clients a bundle of securities that contained unusually many low-quality assets. In fact, it had secretly structured this bundle jointly with a well-known short-seller, who then proceeded to short this bundle that Goldman had sold to its clients. Similarly, Goldman had also sold short many of the products in its account that it had sold its clients long.

The Business

Table 25.2 reports some essential information about Goldman. During the financial crisis, Goldman's marketcap dipped down to about $35 billion, but has hovered around $85 billion in other years. These values were justified by revenues of about $40-$50 billion, with the exception of 2008 (in which they dipped to just about $22 billion); and net income of about $15 billion, with the exception of 2008 (in which they dipped to $2 billion). 2007 and 2008 were actually remarkably good years for Goldman. Unlike most of its competitors, Goldman dodged much of the subprime liquidity crisis of 2007 by placing a well-timed (and subsequently well-publicized) bet against subprime mortgages that ultimately contributed $4 billion in profit to its 2007 earnings—recommended by the three aforementioned traders.

Goldman engages in trading and principal investments, which is basically an investments arbitrage business in fixed income, currencies, commodities, equities, and private equity (with investments in China and Japan). Goldman's asset management arm specializes in institutional clients and high-net-worth individuals, although it also entertains some retail clients. It had about $868 billion of client money under management (of which $151 billion was in alternative investments, such as hedge funds, private equity, real estate, currencies, commodities, and asset allocation strategies), $255 billion in equity, $256 billion in fixed income,

Table 25.2: Goldman Sachs from 2006 to 2010

—This table presents some selected statistics from Goldman's financial reports. Most of the information can be found in "Segment Results" in the annual financial statements. Because the 2010 report is based on restated numbers, this table shows numbers from both reports for 2008. All numbers are in million dollars, except the book leverage ratio and the number of employees.

		from 2008			from 2010	
	2006	2007	2008	2008	2009	2010
Market Cap	84,890	85,520	37,312		86,798	85,971
Book Leverage Ratio	23.4x	26.2x	13.7x		12.0x	11.8x
Revenues						
Investment Banking	5,629	7,555	5,185	5,453	4,984	4,810
Underwriting, Equity	1,365	1,382	1,363	1,415	1,797	1,462
Underwriting, Debt	1,684	1,951	1,176	1,375	1,290	1,286
Financial Advisory	2,580	4,222	2,656	2,663	1,897	2,062
Non-Investment Banking	32,036	38,432	17,037	16,769	40,189	34,351
Net Income						
Investment Banking	1,567	2,570	2,042	2,184	1,502	1,299
Non-Investment Banking	12,993	15,034	294	152	18,327	11,593
Bonus Pool	16,457	20,190	10,934		16,193	15,376
Number of Employees	26,467	30,522	30,067		32,500	35,700

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and $206 billion in money markets. The asset management arm also contains Goldman's prime brokerage business.

The focus of our chapter—Goldman's important role in the contextx of corporate finance—is its investment banking arm. Look carefully at Table 25.2: even though Goldman is often called an investment bank, the term has been a misnomer for a long-time. Goldman is primarily a trading and arbitrage firm (with little regulatory oversight), and not an investment bank. It is trading that consumes most of Goldman's resources: its capital, value at risk, talent, bonus pool, and so on. Of course, investment banking is still an important aspect—and in many ways investment banking is the only aspect that distinguishes Goldman from large hedge funds. (It is also disproportionately to credit for the reluctance of the government to let Goldman go out of business in 2007-8. Helping fund industrial companies was a rationale that enhanced the public relations aspect of the financial sector

rescue. It is hard to imagine that the government would have acted the same if Goldman had had the designation "hedge fund.")

Table 25.2 breaks out the revenues of the two main investment banking functions.

Financial advisory: The advisory branch works mostly on M&A-related consulting, although it also includes restructuring advice, acquisition financing, and cross-border structuring expertise (which is mostly a tax-planning service). M&A advising also links into other services offered by the firm, especially its bridge loan facilitation. As a sidenote, you may find it interesting that Goldman Sachs is unusual in that it has historically specialized in helping management defend itself against unfriendly takeovers. Most likely, this policy was not instituted for moral reasons (i.e., to help poor victim CEOs) but rather to protect its other business.

In a typical year, Goldman earns gross revenues of about $2 billion from advice, roughly half of Goldman's total investment banking business. But in 2007, Goldman earned $4.222 billion (of its $7.555 billion in investment banking) in advising on approximately $1.5 trillion in about 400 transactions. Goldman's advice cost about $7.5 million per deal on average ($10 million per deal in the United States). Two-thirds of Goldman's advisory business is still in the United States.

Underwriting: The underwriting branch helps client firms issue securities, principally debt and equity.

Equity and debt underwriting is an even more steady business for Goldman, earning revenues of about $2-$2.5 billion throughout all years in the table. For example, in 2007, Goldman earned $1.382 billion on underwriting about $71 billion worth of proceeds in over 200 equity transactions. It earned approximately $1.951 billion on underwriting about $312 billion worth of proceeds in about 700 debt transactions. About half of Goldman's underwriting business was in the United States. (Note that much of its debt issuing activity is not on behalf of corporate clients but on behalf of foreign countries, federal credit agencies, mortgage-backed securities, municipal debt, and so on).

x

Generally, it has always been the case that underwriting as an activity is less profitable but even more stable than financial advice. In turn, equity underwriting deals are more profitable than debt underwriting deals. Goldman earned more in equity underwriting, even though it underwrote four times as much debt as equity. x

Unfortunately, Goldman's financials do not break out much more information. Thus, we have to look at some other data sources, which cannot be perfectly reconciled with the information in Goldman's annual report. Nevertheless, they still allow you to get a few more glimpses. Thomson Financial reports how competitive and important Goldman was in its markets. Goldman's market shares in 2007 were as follows:

	Market Share	
Activity	**Deal Size**	**Fees**
U.S. Equity	9.0%	11.2%
Worldwide Equity	5.6%	8.1%
Worldwide Debt	4.9%	4.3%
High-Grade Corporate		9.1%
Worldwide Debt and Equity	5.6%	4.8%
U.S. M&A Advice		10.6%
Worldwide M&A Advice		7.1%

Goldman is a major player in the markets it competes in, with worldwide and domestic market shares between about 5% and 10%. It also charges a premium for its participation in equities: Its market share of equity fees is higher than its market share in equity deal sizes.

Goldman's Employees

x

Table 25.2 also provides some basic information about Goldman's main assets—its employees. Goldman's staff grew steadily, even during the financial crisis of 2008. About half of its employees are in the United States. About one in twenty employees is a managing director, which is the highest job title that Goldman conveys. Investment banking hierarchies are usually fairly flat, with only four or five ranks: analyst, associate, vice president, director, and managing director. (You may also find it interesting that Goldman Sachs was among the pioneers recruiting MBAs and PhDs from many business schools.) Investment banks are unusual businesses in that their main resources walk out of their buildings every night (though it may often be after midnight). Keeping its best employees happy is perhaps Goldman's main business challenge. Many successful Goldman employees have left to join hedge funds (such as Goldman's ex-head of prime brokerage, Emmanuel Roman, now co-CEO of GLG Partners) or government (such as Goldman's ex-CEO, Henry Paulson, U.S. Treasury Secretary under George W. Bush). Incidentally, the government exempted Paulson from paying capital gains taxes on $500 million of Goldman stock, saving him an estimated $200 million in taxes and thus making

Paulson the best-compensated government employee in the history of the United States. x

To fight against the departures of valuable employees, who ultimately generate Goldman's revenues, it is not surprising that Goldman has to pay more to its employee than it leaves for its shareholders. Similarly, Goldman's non-employee costs are much lower than employee costs. After a dip in 2008 after the record $20 billion in 2007, Goldman's bonus pool has returned to about $15 billion in 2009 and 2010. Even more surprising, during the 2008 dip, when Goldman earned only $2 billion, it still paid $11 billion to its employees. In 2007, the $20.2 billion comes to an average of just over $600,000 per employee, most of which was in the form of bonus payments. The distribution of compensation is highly skewed. For example, three traders (aged 35 to 40) who pushed Goldman into a profitable bet against subprime were paid between $5 and $15 million each. Interestingly, on Wall Street, the top earners in any given year need not be the CEO. It could equally well be the traders with the best performance. In 2007, however, it was Goldman's CEO, Lloyd Blankfein, who took home $100 million. Four other top executives also earned between $30 and $60 million. x

Interestingly, despite its reputation as a shark among sharks, Goldman prides itself on a more collaborative internal atmosphere than its competitors. To foster this atmosphere, its annual bonus and retention evaluation scheme takes into account how collaboratively an employee behaves. On the flip side, like many other investment banks, Goldman has a policy of laying off 5% of its worst-performing staff every year. x

As with airlines, where unions have enormous power, it is not clear whether Goldman shareholders will receive much for their investments in the long run. Goldman is worth nothing without its employees. Collectively, these employees may well be capable of clawing back all retained earnings, or gamble them away in the process of trying to earn high bonuses. x

Goldman's size is actually fairly modest compared to many other global financial services firm. But if you have read the preceding carefully, you probably understand why the limiting resource is not financial capital (though having more capital definitely helps), but expertise and human talent. As long as Goldman and other U.S. and U.K. banks still excel in attracting and retaining the best talent from all over the world (and they still do), they will remain the global leaders in investment banking.

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question

What was the approximate average compensation of a Goldman Sachs employee in 2007? What would you guess the average seasoned investment banker earned?

answer
The average compensation of a Goldman Sachs employee was about $600,000. It was highly skewed, though, with many individuals earning double-digit million-dollar salaries. Given that Goldman also has an administrative staff, which did not earn as much, a safe guess is that the average seasoned investment banker earned a seven-figure compensation.

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anecdote
In a 2008 Journal of Finance article called "The Making of an Investment Banker," Paul Oyer tracked Stanford MBA graduates from the classes of 1960 through 1997. Investment bankers enjoyed between $2 million and $6 million in discounted lifetime income (in real 1996 dollars). This is much higher than what they would have earned if they had entered other professions. Fifteen years after graduation, the average I-banker earned 60% more than the average management consultant at graduation, and 300% more than the average Stanford MBA graduate. (Today, it is not uncommon for investment bankers to earn $1 million per year or more.)

More interestingly, Oyer found that stock market conditions at graduation time played a big role not only in obtaining a first job in I-banking but also in the probability that an individual would ever end up on Wall Street. (And, equally remarkable, many of the individuals graduating in bear years ended up as entrepreneurs!)

Oyer concludes that random factors beyond talent are very important in determining individuals' lifetime paths and compensation—and that there is a very deep pool of potential I-bankers in any given Stanford MBA class.

25.C A Short U.S. Banking History

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In the United States, the distinction between investment banking and ordinary banking has not just been a conceptual one. Investment banking has had a rather unusual history here. During the Great Depression, many banks that had invested depositors' money in the stock market collapsed. Thus, Congress passed the **Glass-Steagall Act of 1933**, which prohibited the mixing of retail business—the taking of deposits from retail investors—and investment banking. Glass-Steagall therefore made it impossible for large consumer banks, such as Citibank or Chase Manhattan Bank, to compete effectively in the investment banking sector. Many other countries never made such a distinction—they just had one type of bank that performed both consumer/commercial and investment banking. It was our unusual laws that made the United States unique in fostering a large number of relatively small investment banks.

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Over the decades, Glass-Steagall was augmented with other laws, first strengthening it and later weakening it. It was finally repealed in November 1999. With the

legal separation between ordinary and investment banking gone, the investment banking sector rapidly began to consolidate. For example, Citicorp and Travelers Group merged in 1998 to become Citigroup. In the same year, Smith Barney purchased Salomon Brothers to become Salomon Smith Barney. A year later, with Glass-Steagall fully repealed, Citigroup then purchased Salomon Smith Barney, so the five formerly independent financial services providers are now all just parts of one large financial conglomerate. Similarly, Chase Manhattan purchased JP Morgan in 2000, then merged with Bank One Corporation (a large credit card issuer) in 2004. CSFB is the combination of Credit Suisse, a very large Swiss bank, and First Boston, an old U.S. investment bank. And so on.

The Financial Crisis

The financial crisis of 2008-9 was a watershed year. It became clear that most U.S. financial firms had taken on riskier and riskier bets over the years. As long as this worked, it generated record profits and banker bonuses. When it finally (and inevitably) failed, most financial firms in the U.S. were defacto bankrupt—and, after letting a large investment bank (Lehman Bros) fail, the government realized that it really had no choice other than to bail out the industry. (The sudden disappearance of the financial sector would have likely caused a recession not seen since the Great Depression.) After the worst immediate crisis was over, and the Fed and Treasury had poured many billion dollars into these firms (much of it in a back-handed fashion not to arouse the curiosity of the public), Congress passed the **Frank-Dodd** bill in 2010 to improve regulation, the most significant of which may well have been the so-called **Volcker Rule**, which prohibited financial firms that were regulated banks—and all investment firms converted into such banks in order to receive access to Fed funds. However, the bill left much detail to the regulators. In turn, this left enough space for a horde of lobbyists, spending hundreds of millions of dollars, to work hard on both the regulators and Congress to defang all provisions of the act that could harm its business of risk-taking (gambling). Even if the Volcker rule were to become law (and this is a big if), ultimately, the risk-seeking incentives of Wall Street executives and traders have not changed. Smart people will find ways to gamble—bonuses on Wall Street are multi-million dollars in years in which a firm or trader wins the gamble. Thus, the next financial crisis is already preprogrammed. (You read it here first.)

The financial crisis of 2008 brought dramatic changes in the financial services sector. There used to be five major standalone investment banks, which did not focus on retail clients and thus were not regulated by the Federal Reserve. These pure investment banks no longer exist. Bear Stearns was forced to sell out for practically nothing. Lehman Brothers went bankrupt. Merrill Lynch was bought

at a firesale price. And the two remaining large stand-alone investment banks, Goldman Sachs and Morgan Stanley, converted into ordinary banks. By converting into ordinary banks, Goldman and Morgan qualified for emergency funding from the Federal Reserve. They did this just in time to avoid a run on them, too. (A run occurs when all clients pull their deposits because they fear the bank will go bankrupt, and the bank goes bankrupt because all clients are pulling their deposits.)

Nevertheless, the banking operations of the operations of these five firms (well, now three subsidiaries plus two firms) are still primarily focused on corporate clients and not retail clients. In this sense, they still exist. Finally, all five investment banks do a tremendous amount of proprietary trading, which in many cases dwarves their actual investment banking activities.

As I am writing this chapter, regulators are finalizing the implementation of the very complex Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. Its intent is to regulate these firms better. At the same time, the Wall Street firms are heavily lobbying regulators and Congress to reduce its bite. It is not yet clear what the outcome will be.

Banks are systemically important to our aggregate economies. They are also very dangerous. Banks are not only global but also heavily networked. They owe one another many billion dollars, often across many different jurisdictions. This is especially the case for European and American banks. Thus, if one large bank were to go bankrupt, it would most likely drag almost all other large banks into bankruptcy, too. U.S. bankruptcy laws allow the bankruptcy trustee not to pay any obligations, but keep any assets. Thus, if bank A borrows $100 from bank B in market X, and vice-versa in market Y, then, if A goes bankrupt, the bankruptcy trustee may keep B's $100, and add A's debt to B into the queue of liabilities that have to be sorted out through the courts over the next several years. (This gets even more interesting if some of the assets are in other countries—and, as in Lehman's bankruptcy case, billions of dollars can move across borders literally overnight.) With typical liabilities that are twenty times larger than capital, it is easy to see that one bank bankruptcy could cause the equivalent of a nuclear chain reaction.

In the U.S., size was clearly an asset during the financial crisis of 2008—in effect, the U.S. had no choice but to bail out its very large banks, fearing the total collapse of the financial system if any one of these large banks had gone out of business. In fact, as of 2011, the Fed is continuing to subsidize banks heavily, although this now occurs largely behind a (very thin) curtain. The banks have not only received credit and support at below-market values during the crisis, but are continued to be allowed to arbitrage interest rates. (They receive money from the Fed at low interest rates, which they can immediately redeposit at higher interest rates.)

The recent Dodd-Franks Act has tried to add some more safeguards, but

ultimately the situation remains much as it was. (Banks have excellent lobbyists in Washington, that are very effective in neutering rules that prevent them from taking high leverage and risk.) For example, the Dodd-Franks Act reiterates that a committee in the Fed has the power to break up banks that are too large to fail—but it is hard to fathom why the top-20 U.S. banks are not already too large to fail. Goldman-Sachs, which converted into a bank during the crisis to access capital and ensure itself against a "run on the bank," is currently considering unbecoming a bank again, so that it can escape further regulation. Most regulators work in the financial services sector before and after their Washington stints—how tough do you think they would be on their past and future empoyer? And so on.

The United States is a particularly egregious example of legal corruption. Congressmen are relatively cheap to buy (if they cooperate) or unseat (if they do not, by funding their opponents heavily). But this is not the only problem. In many foreign countries, banks are also seen as national resources, or as threats to public welfare. State regulation then often serves to proffer politicians' pockets in illegal ways, too. There are no easy solutions here. Only the government has the power to prevent banks from acting against the public interest, but the government itself is not trustworthy easy.

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question
What was the Glass-Steagall Act?

answer
The Glass-Steagall Act of 1933 prevented retail banks from doing investment banking. When it was repealed in 1999, a number of financial institutions merged to become larger financial conglomerates.

question
What was the Frank-Dodd Act?

answer
The Frank Dodd Act of 2010 sought to strengthen the regulation of financial firms after the financial crisis of 2008-9. Much of its implementation was left to the regulators, and it is not yet clear how stringent it will be.

25.D The Global Market Today

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It would be a mistake to consider domestic banks in isolation. They exist in the context of a larger and global banking market. Nowadays, banks from all over the world compete to provide capital to institutions not only in the United States but

also in Europe, Asia, and everywhere else. Moreover, many large global banks not only can act as intermediaries for most of their clients' credit needs, but can also satisfy their clients' needs with loans from their own capital base.

Table 25.3 lists many of the biggest global banks in 2011. The United States and United Kingdom together are still very prominently represented, but some other European, Japanese, and even Chinese banks have joined the list of banks with deep pockets. As noted, many of these banks are not so much intermediaries as principal lenders. Other banks on this list are both.

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question

Can you name some of the leading global commercial banks from memory? Roughly how much Tier 1 capital, market value, and client assets do the top 25 banks have?

answer

See Table 25.3 for the top commercial banks worldwide. The so-called eyeball scientific method suggests that the typical bank in this list had around $50 billion in Tier 1 capital, $100 billion in market value, and $1.2 trillion in client assets.

The Underwriting Business

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Now that you understand one investment bank in some detail, let's look at the investment banking industry more broadly. Thomson Financial is more or less the standard data provider in this industry. It reported that in 2007 global debt underwriting fees topped $19 billion (on over $6 trillion in issuing proceeds), and global equity underwriting fees topped $22 billion (on about $1.5 trillion in proceeds). You already know how much of this Goldman earned, but who "owned"

x

the rest of this market? And what kind of securities were underwritten?

Table 25.4 shows how the largest investment banks in the United States divided the pie from 2005 to 2007. The most important debt issuers are the three U.S. government agency bonds: the two home-loan agencies—Freddie Mac and Fannie Mae—and the Federal Farm Credit System. They accounted for a staggering 75% of the bond market. In the remaining 25% segment, most bond issues are of

X

investment-grade quality. Non-investment-grade debt is fairly rare—though even the most reputable investment banks underwrite in this market. This relative rarity is easy to explain: It is often cheaper for smaller firms to borrow from commercial banks instead of going to the public market. (This market for original high-yield junk bonds was invented in the early 1980s by Michael Milken of

X

Drexel-Burnham-Lambert.) Underwriters charge about three times as much for

Table 25.3: Some Large Global Banks in mid-2011

—This table contains the largest 10 US banks, plus the largest banks of some other countries. All values are in billion-U.S. dollars. Tier 1 Capital (also called **core equity**) is common stock, disclosed reserves, and retained earnings. Although tier-1 capital is based on book value and therefore unreliable, it is the most common regulatory definition for bank capitalization. Market value is the market value of equity, as of early 2008. Source: The Banker, 2011.

Bank	**Country**	**Tier 1 Capital**	**Market Value**	**Client Assets**
Bank of America	US	164		
JPMorganChase	US	142		
HSBC	UK	133		
Citigroup	US	126		
Industrial Commercial Bank	CN	113		
WellsFargo	US	109		
China Construction	CN	96		
Royal Bank of Scotland	UK	94		
BNP Paribas	FR	77		
Barclays	UK	84		
Santander	ES	81		
Credit Agricole	FR	77		
Lloyds	UK	74		
Goldman Sachs	US	71		
Unicredit	IT	58		
Deutsche Bank	DE	57		
Morgan Stanley	US	53		
Royal Bank of Canada	CA	33		
PNC Financial	US	26		
Scotia Bank	CA	25		
ING	NL	56		
Credit Suisse	CH	40		

issuing non-investment-grade securities (fees are about 1.3%) as they charge for investment-grade securities (fees are about 0.5%). The government agencies paid the lowest fees—only 0.1% on average. (After their highly publicized troubles in 2008, their fees will surely go up.) These figures naturally varied with the specific
x underwriter, the specific issuer, and the specific market conditions.

Table 25.5 is the equivalent table for equity underwriting activity. Compared to the corporate debt issuing market, the equity issuing market is only about half the size in terms of number of offerings, and even less in terms of proceeds raised. (This is not even counting government bonds.) However, as you have already seen in Goldman's case, equity underwriting fees are much higher than those for debt. Thus, equity underwriting is the more profitable of the two markets. From the perspective of investment banks, bonds are the bread and butter, equity is the
x gravy.

Convertibles and preferred stock are hybrids, having both equity-like and
X debt-like characteristics—and both are fairly rare. The average issuing proceeds are roughly similarly sized, but underwriter spreads are on average higher for preferred equity (at 2.6%) than they are for convertible debt (at 2.1%). The SEO issuing market and even the IPO issuing market are much larger. They also tend to involve the same firms: In the life cycle of firms, more equity issuing ocurrs relatively early in firms' lives when the firms are still small. Not shown in the table, about one in four IPO issuers returns for more funding within a few years, which means that a good fraction of the SEOs shown here are conducted by firms that
X have gone public fairly recently. From the perspective of underwriters, both are important markets, because the spread in SEOs reaches 3.5% and that in IPOs reaches 5.6%. These are proceeds-weighted fees, thus emphasizing the fees in larger offerings more. (Smaller offerings command higher underwriter spreads.) Like the debt underwriting market, the equity underwriting market seems highly competitive, with many active players, none of which control more than 10% of
x the market.

Underwriters have good reason to charge more for placing riskier securities:

1. Investors can be found a lot more easily for safer securities. In the extreme, safe short-term investment-grade corporate bond issues could almost be substitutes for Treasury bonds, so investors are not very concerned about risk analysis, which means that investors are easy to find.

2. Due diligence is much more difficult to do for a small high-yield issuer than for, say, a high-grade debt offering for General Electric.

3. Underwriters put their own reputation capital on the line. For example, when an underwriter takes a firm public in an IPO that later goes bankrupt, it will

Table 25.4: U.S. Nonconvertible Corporate Debt Underwriting, 2005 to 2007

—The proceeds statistics are averages for offerings for which the underwriter identity, proceeds, and gross spread were known. (The gross spread is the amount of money the underwriter receives from the issuing proceeds, and represents the lion's share of the issuer's payment to the bank.) When U underwriters led an offering, each underwriter was credited with $1/U$ of the proceeds. (This means that these statistics are less than those touted by the underwriters themselves.) Proceeds are measured in millions of U.S. dollars (e.g., JP Morgan issued $108 billion in agency debt). Quoted fees are the proceeds-weighted average of gross spread, quoted as a fraction of proceeds. N is the number of lead underwriters in offerings. (Because an offering can have more than one lead underwriter, this number is larger than the number of offerings.) This table was put together based on an original data source with just under 35,000 offerings from 2005 to 2007 in the Thomson securities issuing database. The government agencies were Freddie Mac, Fannie Mae, and the Federal Farm Credit System. (Not all debt issues had full data available, especially underwriter spreads. We are also omitting offerings without a debt rating.) Data Source: Thomson Financial.

	Government Agency			**Investment Grade**			**Speculative Grade**		
Underwriter	**Proceeds**	**Fees**	**N**	**Proceeds**	**Fees**	**N**	**Proceeds**	**Fees**	**N**
JP Morgan	$108,348	0.1%	655	$147,385	0.4%	585	$11,354	1.3%	47
Citigroup	$46,779	0.1%	255	$160,556	0.6%	549	$8,705	1.5%	37
Merrill Lynch	$92,972	0.2%	1,336	$106,762	0.6%	354	$5,889	1.6%	16
Goldman Sachs	$73,635	0.2%	287	$143,902	0.4%	354	$2,468	1.4%	12
Lehman Brothers	$93,557	0.2%	568	$100,968	0.4%	301	$3,998	1.4%	23
Morgan Stanley	$59,407	0.1%	398	$116,239	0.4%	346	$4,336	1.4%	15
UBS	$127,920	0.1%	1,086	$28,144	0.6%	177	$1,833	0.8%	9
Bank of America	$55,949	0.1%	418	$103,482	0.4%	428	$4,370	1.2%	28
Deutsche Bank	$84,482	0.1%	416	$33,870	0.4%	181	$3,578	1.1%	21
CFSB	$35,173	0.1%	397	$58,388	0.4%	190	$3,080	1.3%	23
HSBC	$49,347	0.1%	315	$57,501	0.3%	125			
Wachovia	$57,048	0.2%	568	$63,164	0.5%	285	$1,779	1.0%	14
Barclays	$57,048	0.1%	362	$32,586	0.5%	190	$954	0.7%	6
Bear Stearns	$41,662	0.2%	505	$17,914	0.4%	44	$610	1.7%	5
All Others	$265,837	0.2%	9,244	$86,393	0.4%	477	$2,584	1.3%	15
Grand Sum	$1,209,505	0.1%	16,810	$1,257,254	0.5%	4,586	$55,540	1.4%	271

Table 25.5: U.S. Corporate Equity Underwriting, 2005 to 2007

—The proceeds statistics are averages for offerings for which the underwriter identity, proceeds, and gross spread were known. When U underwriters led an offering, each underwriter was credited with $1/U$ of the proceeds. (This means that these statistics are less than those touted by the underwriters themselves.) Proceeds are measured in millions of U.S. dollars. Quoted fees are the proceeds-weighted average of gross spread, quoted as a fraction of proceeds. N is the number of lead underwriters in offerings. (Because an offering can have more than one lead underwriter, this number is larger than the number of offerings.) Data Source: Thomson Financial.

	Convertible			Preferred Equity			Seasoned Equity			IP
Underwriter	**Proceeds**	**Fees**	**N**	**Proceeds**	**Fees**	**N**	**Proceeds**	**Fees**	**N**	**Proceeds**
JP Morgan	$1,995	2.4%	14	$2,778	2.6%	19	$17,129	3.2%	125	$8,086
Citigroup	$3,438	1.8%	11	$8,404	2.6%	36	$18,057	3.3%	127	$21,234
Merrill Lynch	$2,030	2.0%	12	$7,888	2.9%	42	$20,810	3.7%	151	$24,149
Goldman Sachs	$5,242	1.9%	11	$5,202	2.7%	18	$16,675	3.2%	91	$8,781
Lehman Brothers	$3,072	1.5%	13	$4,237	2.1%	27	$19,645	2.8%	132	$6,972
Morgan Stanley	$1,438	2.5%	8	$3,863	2.9%	33	$18,365	3.2%	109	$13,853
UBS	$1,167	2.4%	9	$1,749	2.9%	23	$15,900	3.7%	156	$9,180
Bank of America	$698	2.2%	5	$2,897	2.0%	15	$7,253	3.7%	80	$4,449
Deutsche Bank	$2,670	2.3%	10	$697	2.7%	9	$8,067	3.3%	74	$3,719
CFSB	$2,452	2.1%	16	$1,745	2.6%	9	$10,957	3.6%	85	$7,743
HSBC				$825	3.1%	3	$110	4.9%	2	$600
Wachovia	$1,012	1.5%	5	$6,989	3.1%	47	$6,211	3.4%	79	$12,657
Barclays	$200	2.2%	1	$15	2.0%	1				
Bear Stearns	$233	0.8%	2	$1,237	2.9%	18	$6,333	3.9%	61	$3,088
All Others	$1,607	3.4%	8	$3,980	2.4%	44	$23,260	4.8%	466	$21,478
Grand Sum	$27,255	2.1%	125	$52,515	2.7%	344	$188,771	3.5%	1,738	$145,989

not play well with the investors that the bank had solicited. After a couple of such bankruptcy repeats, the underwriter will probably no longer be able to find IPO investors easily. Therefore, when companies first sell shares in an initial public offering—which is the most risky investment banking business around—the underwriting costs are usually highest. Table 25.5 shows this fact quite nicely.

In addition, IPOs require unusually cumbersome legal procedures and impose extra legal liabilities on underwriters, above and beyond what is required for other offerings. They also require significantly more marketing to investors than ordinary SEOs.

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question
Is the underwriting very competitive or dominated by a small number of firms?

answer
It seems rather competitive to me.

question
Why is it more expensive to place equity than debt?

answer
There is more capital at risk, which in turn means that the underwriter has to put more of its reputation on the line and work harder to place the securities. In the extreme, if the debt is risk free, it should be very easy to place.

The Merger & Acquisition Advice Business

Let's move on to M&A activity. Again, our main interest is to determine how much of a market was served by investment banks. Advice for the typical deal can cost the transacting firms anywhere between 0.5% and 1% of the acquisition size. x

M&A activity can be measured in many different ways: as all completed and attempted offerings (or just completed acquisitions), as full or partial acquisitions (in which the target remains an independent publicly traded entity), as U.S. or worldwide acquisitions, and so on. Fortunately, the trends tend to be similar no matter what measures are used. However, the absolute magnitudes can be quite different. With this caveat, Figure 25.1 gives you a first impression of M&A activity over the decades. The top graph shows that successfully completed M&A activity, adjusted for inflation, peaked in the United States just before the

Figure 25.1: M&A Activity in Perspective, from 1970 to 2007

— These graphs put U.S. M&A activity in the context of the size of the U.S. public equity markets. Years in which the S&P 500 declined are drawn in magenta. Years in which it increased by more than 10% are drawn in blue. Years in which the S&P 500 did not decline, but did not increase by more than 10%, are drawn in gray. The bars are statistics about the number of firms; lines are statistics about the value of target firms (in 2000 dollars). **The top graph** shows the number and inflation-adjusted dollar value of publicly traded U.S. firms. For example, the number of publicly traded firms peaked at 9,113 in 1997. The dollar value peaked at $17.6 trillion in 1999. **The bottom graph** shows that takeover activity was generally higher in bull markets than in bear markets. For example, by the measures used here, about 8.8% of all publicly traded firms were targeted in 2000, representing about 7.6% of the public equity value. (**Warning 1:** These fractions may be understating the ratio, because deal value includes both debt and equity of the acquirer, and the denominator here is all publicly traded equity only. **Warning 2:** These fractions may be overstating the ratio, because they include activity that did not result in a full takeover of the target. Other published estimates have included only full acquisitions [and used different definitions and data vendors] and reported numbers only about half this large.). Data Source: Thomson Financial.

Update

Natural Width Figure wel23f02

turn of the millennium. (This graph includes partial acquisitions, in which the target or parts of it could remain publicly traded. If we require full acquisitions, the reported activity roughly halves.) This graph represents over $1 trillion in acquisitions—a staggering amount by any measure. The color of the bars indicates the performance of the stock market in each year. It shows that takeover activity is procyclical—there are more acquisitions in bull markets than in bear markets. (Although not shown, takeover activity also relates to interest rate conditions. When interest rates are low, there are more acquisitions.) The bottom graph expands your perspective to foreign target acquisitions and includes attempted but not completed acquisitions. The United States typically accounts for about a quarter of worldwide acquisition activity in dollar value. Foreign and U.S. acquisitions seem to move in sync. (Incidentally and not reported, firms' equity issuing activity also synchronizes with the acquisition activity.)

x

To give some more perspective on the magnitude of takeover activity, the top graph in Figure 25.2 provides important background: It shows the value and

Figure 25.2: M&A, from 1970 to 2007

—These graphs show M&A activity from 1970 to 2007. Dollar values are in trillions, adjusted to 2000 levels using the CPI. Years in which the S&P 500 declined are drawn in magenta. Years in which the S&P 500 increased by more than 10% are drawn in blue. Years in which the S&P 500 did not decline, but did not increase by more than 10%, are drawn in gray. Bars indicate the number of deals; lines indicate dollar values of deals. **The top graph** shows completed U.S. M&A activity. (Targets need not be fully acquired, however. Some of the parts may remain publicly traded.) For example, in 1998, the number of transactions peaked at 722. In 2000, the value of transactions peaked at just over $1 trillion. **The bottom graph** shows all foreign M&A activity, including transactions that were not concluded. In addition, it relies on the dollar value of activity in global markets, not just in the U.S. markets. The graph shows that foreign acquisition activity is in sync with U.S. activity, and that U.S. activity accounts for about a quarter of worldwide activity. For example, in 1999, there were 11,288 foreign completed or attempted deals, with about $2.5 trillion in value. Adding the equivalent U.S. activity brings this number to over $4 trillion. Data Source: Thomson Financial.

Update

Natural Width Figure wel23f01

Figure 25.3: Hostile Takeover Activity in the United States

—These graphs show hostile M&A activity in the United States. Years in which the S&P 500 declined are drawn in magenta. Years in which it increased by more than 10% are drawn in blue. Years in which the S&P 500 did not decline, but did not increase by more than 10%, are drawn in gray. The bars are statistics about the number of firms; lines are statistics about the value of target firms (in 2000 dollars). **The top graph** shows that hostile acquisitions were quite rare. The number of hostile takeovers in the United States peaked at 27 in 1988. The value peaked in 1999 at around $130 billion, primarily because of Pfizer's hostile acquisition of Warner-Lambert for $89.6 billion. **The bottom graph** shows this hostile takeover activity in the context of all publicly traded companies. Hostile activity was generally high in the 1980s. Thereafter, only 1999 stood out due to the aforementioned Pfizer acquisition of Warner-Lambert. Data Source: Thomson Financial.

Natural Width Figure wel23f03

number of all publicly traded firms in the U.S. markets. Figure 25.1 shows that in 2007, there were about 7,000 publicly traded firms with over $18 trillion in equity market capitalization. (U.S. GDP was under $14 trillion in 2007, which came to $44,000 per capita). The bottom graph of Figure 25.2 is our real interest: Was takeover activity an important economic activity or merely a sideshow? The graph shows that there were three peaks of M&A activity:

1. The late 1980s (the most prominent takeover of the era was the RJR Nabisco hostile acquisition by Kohlberg Kravis Roberts (KKR)).

2. The turn of the millennium (the most prominent takeovers involved Internet firms, especially the acquisition of Time Warner by AOL). At this peak, all or partial acquisitions involved just under 10% of the public equity markets.

3. The mid-2000s (which included the acquisition of Chrysler by Cerberus).

Again, if we restrict ourselves to full rather than partial acquisitions, the numbers roughly halve. Yet even if only, say, 2-5% of all publicly traded firms are acquired, one would still be inclined to conclude that acquisition activity would qualify as an important economic phenomenon. Furthermore, Figure 25.1 shows that both market capitalization and takeover activity tend to increase in bull markets. Is the fraction of firms acquired higher or lower in bull markets? Figure 25.2 shows that even relatively more firms are acquired in bull markets. That is, acquisition activity is procyclical.

Hostile Acquisitions

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Of particular interest are [pl]hostile acquisition—those that are made without the consent of the target's board and management. Hostile acquisitions in the United States are the subject of Figure 25.3. First, you should notice that they are very rare. In a typical year, there are only a handful of them. Second, you should notice that they can be quite large. In particular, 1999 saw the hostile
X takeover of Warner-Lambert by Pfizer for just under $90 billion. With this one exception, hostile activity was far more common from 1983 to 1989 than in other years. This is also visible in the lower graph, where hostile activity is expressed in
X terms of all publicly traded firms. Hostile leveraged buyouts (LBOs) started with the advent of high-yield bonds in the early 1980s—invented by Michael Milken at Drexel Burnham Lambert. It peaked with the takeover of RJR Nabisco by KKR. (The book Barbarians at the Gate explains this takeover much better than I ever could. It is also highly entertaining.) It then took about 5-10 years for targets to
X learn how to better defend themselves against such unwanted approaches. Once

Table 25.6: Top 25 Global Hostile Takeovers (as of Mid-2008)

—The values are in billions of dollars and not adjusted for inflation. U.S.-based firms are boldfaced. Data Source: Thomson Financial.

Announced	Effective	Acquirer	Target	Value
11/14/1999	6/19/2000	Vodafone AirTouch PLC	Mannesmann AG	203.2
4/25/2007	11/2/2007	RFS Holdings BV	ABN-AMRO Holding NV	98.6
11/4/1999	**6/19/2000**	**Pfizer Inc**	**Warner-Lambert Co**	**89.6**
1/26/2004	8/20/2004	Sanofi-Synthelabo SA	Aventis SA	60.7
7/5/1999	3/27/2000	Total Fina SA	Elf Aquitaine	50.5
11/29/1999	3/13/2000	Royal Bank of Scotland Group	National Westminster Bank PLC	38.9
2/20/1999	5/21/1999	Ing C Olivetti	Telecom Italia SpA	35.2
10/24/1988	**4/28/1989**	**Kohlberg Kravis Roberts**	**RJR Nabisco Inc**	**31.0**
5/2/2000	**10/4/2000**	Unilever PLC	**Bestfoods**	**25.5**
5/15/2006	8/25/2006	Xstrata PLC	Falconbridge Ltd	17.8
8/11/2006	11/3/2006	Cia Vale do Rio Doce SA	Inco Ltd	17.6
1/20/1995	**5/1/1995**	**Glaxo Holdings PLC**	**Wellcome PLC**	**14.7**
10/17/1988	**12/7/1988**	**Philip Morris Inc**	**Kraft Inc**	**13.9**
3/9/1999	8/6/1999	BNP	Paribas SA	13.0
10/18/1995	**4/1/1996**	**Wells Fargo Capital Corp**	**First Interstate Bancorp, CA**	**11.4**
6/6/2003	**1/7/2005**	**Oracle Corp**	**PeopleSoft Inc**	**10.9**
9/14/1999	1/13/2000	Assicurazioni Generali SpA	INA	10.6
8/2/1994	**12/21/1994**	**American Home Products Corp**	**American Cyanamid Co**	**10**
12/2/1990	**9/19/1991**	**American Telephone**	**NCR Corp**	**8.3**
11/13/2000	**3/14/2002**	**Weyerhaeuser Co**	Willamette Industries Inc	**8.3**
2/22/2002	**12/11/2002**	**Northrop Grumman Corp**	TRW Inc	**7.1**
1/24/1988	**6/24/1988**	Campeau Corp	**Federated Department Stores**	**7.0**
2/22/2000	**5/31/2000**	**MGM Grand Inc**	**Mirage Resorts Inc**	**6.9**
10/16/1985	**4/17/1986**	**BCI Holdings Corp**	**Beatrice Companies Inc**	**6.5**
8/11/1999	**5/3/2000**	**Alcoa Inc**	**Reynolds Metals Co**	**6.5**

this happened, and with the onset of the recession and bear market of the early 1990s, hostile activity declined again. Table 25.6 shows that, contrary to public perception, hostile takeovers are not principally a U.S. phenomenon. In fact, the largest two hostile acquisitions ever did not even involve U.S. firms on either side. Of the top ten, only two involved U.S. firms. However, for practical purposes, the United States can claim to have pioneered them.

question
Describe how global M&A activity changed over the last four decades.

answer
Figure 25.2 shows that M&A activity rose gradually in the 1980s, starting from scratch and ending just below 4,000 transactions per year. Over the next 10 years, the number roughly tripled and the dollar amount quintupled. From 2000 to 2003 it crashed, but then recovered by 2007 to levels seen in 2000. Not shown here, in 2008, the activity level crashed again.

question
Are hostile takeovers just a U.S. phenomenon?

answer
Hostile takeovers are not just a U.S. phenomenon, but have also appeared outside the United States. In fact, the biggest two hostile takeovers ever (Mannesmann and ABN-Amro) were foreign target acquisitions by foreign raiders.

25.E Underwriting Services from the Firm's Perspective

Now let's look at investment banking services from the perspective of the client firm—starting with underwriting. For most publicly traded firms, there is no way around hiring an underwriter for placing public securities. The expertise and contacts required are too much for most firms.

x

But how should a CFO think about and work with her investment bank? How much should she pay? As I have already hinted, it would be naïve for CFOs to consider investment banks as unconflicted agents working on their behalf. Investment banks make money from transactions. Thus, they will push their clients to engage in activity even if it is value-decreasing (though this is not their goal). Of course, a good investment bank can work hard and create value for its clients by identifying value-increasing acquisitions. Just don't attribute ulterior motives to the advisor (or the client), and remain aware of the conflicts involved.

Underwriter Selection

x

How should you select an underwriter? How do firms usually select underwriters? It is useful to distinguish between the following three situations:

Regulated offerings: Certain firms—principally utilities—are obliged to select underwriters for each offering through a competitive process.

x

Initial public offerings: Firms engaging in IPOs typically interview a number of competing underwriters to select the best one for their particular situation. There is a natural matching process, in that large underwriters (with their higher cost bases) tend to charge higher fees, which makes them worthwhile only for large IPOs. Industry expertise is also very important. Such expertise can help the underwriter navigate the process more smoothly, communicate and better understand the concerns of top management, connect the firm to the right potential investors, and offer the services of specialized analysts who can help cover the offerings after the IPO. For offerings less than $100 million in size, underwriters compete less on a fee basis—they all charge about 7.0% gross spread—and more on a "package basis." This package includes such services as stabilizing the post-IPO trading price, post-IPO market making, marketing, process managing, share placing to particular types of investors, and so on. The firm then selects the team it likes best.

x

Seasoned offerings: As long as the underwriter's expertise and size still match the firm, most of the time firms will select underwriters by simple inertia: They tend to go with the investment bank that they have always done business with. The most common reason for separation between a firm and its "house underwriter" is when the firm "outgrows" its historical underwriter and now needs to select a bigger one. When this happens, the selection process is often similar to that in the initial public offering. Managers will usually investigate the available options and select a team that is best for the firm (and themselves, of course).

x

However, there is a puzzle. There is empirical evidence that suggests that regulated utilities (and on rare occasions also some nonutilities) find it cheaper to ask several investment banks to compete for the underwriting of an issue—but most firms don't bother. They just continue to use their old investment banks. Why do ordinary firms not encourage greater competition in their underwriter choice? There are a number of possible reasons:

- Utilities firms could be intrinsically different. If more regular firms tried competitive bidding, most would end up paying more than they do when they just use standard noncompetitive bidding methods.
- Firms could be willing to pay more because the hired investment banks provide better ongoing service along other dimensions than the lowest-cost bidder. For example, services such as analyst coverage could be very

important to clients. Smaller firms are especially willing to pay more for such coverage, which they can only do by paying generously for other investment banking services and maintaining a relationship over time. Moreover, it may take less management time if the existing underwriter is already well informed about the company through previous interactions.

- A more cynical view is that managers select their underwriters based on convenience and personal relationships.

- The most cynical view is that executives are personally conflicted. For example, they may like underwriters who help them personally. For instance, they may give them better and cheaper personal banking services (such as valuable allocations to underpriced shares in other initial public offerings). Investment banks may also provide a job-placement network that helps executives move to another company. After all, an investment banker who barely knows a CFO, except in the context of tough negotiations that minimize the bank's profits, is not likely to recommend an executive to a bigger and better company.

X

These reasons are not mutually exclusive. In real life, there can be offerings in which fees seem high but they are actually low given the deal characteristics; offerings in which underwriters provide extra services; and still others in which underwriters get business by taking advantage of breakdowns in governance (managerial agency issues) inside their clients' corporations—the subject of our next chapter.

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question
What factors are important when firms select underwriters?

answer
Firms often just use the same underwriter that they have used in the past. Firms also switch underwriters when they "outgrow" their previous underwriters. In this case, industry expertise and other services (such as analyst coverage) matter. There could be personal issues at work, ranging from very positive ones (such as trust) to neutral ones (such as limited time) to negative ones (such as personal bribes).

Figure 25.4: Typical U.S. Underwriter Spreads, 2005-2007

—This figure shows the gross spread charged by the underwriter. The numbers on the lines describe the number of observations used to compute segments of these curves. Data Source: Thomson Financial.

Natural Width Figure wel23f04

Direct Underwriting Fees and Costs

You already know approximately how much specific underwriters charge on average for debt and equity. But this does not tell you how much it will cost you to issue, say, $50 million of a security. Figure 25.4 illuminates the underwriter spread as a fraction of proceeds. The numbers on the lines show the frequency upon which segments of each curve are based. For example, the most frequent IPO and SEO proceeds were around $150 million (with 378 and 628 observations), the most frequent investment-grade offering proceeds were around $300 million. Convertible and preferred offerings and speculative-grade offerings were all fairly rare. x

Figure 25.4 shows that the same rank ordering of spreads from Tables 25.4 and 25.5 applies more generally: The more risk an offering has for sale, the higher the underwriting spread. There is usually more value at risk in a $10 million equity offering than in a $100 million bond offering. Thus, underwriting costs on the former are often higher even in absolute dollar terms (not just in percentage terms) than they are on the latter. x

Underwriter spreads on different types of issues can be summarized as follows:

- Remarkably, there is a strong robust relation between the offering size and the underwriter spread only for equity offerings. The underwriter spread appears fairly unrelated to the amount of proceeds for debt offerings.
- Federal agency–issued debt enjoys the lowest issuing costs, especially when the offering size is over $50 million. Spreads of about 0.1% to 0.2% of proceeds are normal.
- The cost of an investment-grade debt issue is within a narrow band (0.4% to 0.6%).
- Issuing speculative-grade debt is more expensive than issuing investment-grade debt. However, the relation between fees and proceeds is otherwise not too clear, because we have too few issues. Numbers between 0.8% and 2% are reasonable estimates for the underwriter spread, and around 1.5% seems to be a good average.

- There are also too few convertibles and preferred stock to draw strong conclusions, so I have lumped them together. From Table 25.5, you know that convertibles are about the same size, but tend to command a slightly lower underwriter spread than preferred stock. Spreads of around 3% seem about right. Interestingly, spreads are mostly unaffected by offering size; however, for the very largest offerings there does seem to be a small decline in spread.

- Again, the underwriter spreads in seasoned equity offerings show a clear monotonic decline with offer size. A small SEO may cost as much as 6%. A large SEO may cost as little as 2%.

- IPOs below $100 million in proceeds all pay 7.0% in gross spread to their underwriters. Beyond this, the spread declines at about the same rate as the spread on seasoned equity offerings.

  One explanation for this fairly common spread of exactly 7% is that underwriters are colluding, though not necessarily explicitly. (It could merely be industry convention.) The National Association of Securities Dealers (NASD) Rule 97-81 considers direct underwriter compensation above 7.5% in offerings of other types to be excessive. Thus, it may be that numbers around 7% have entered the conscience of underwriters as a reasonable upper limit: Charging less than 7.5% would seem "safe and appropriate." Thus, underwriters may execute even unprofitable small $10 million offerings at 7%, but only because they plan to recoup their costs through other business with the firm.

  Eventually, when equity offerings get sufficiently large, spreads decline with the amount of funding raised. For example, while a $10 million seasoned equity issue requires a spread of about 6%, a $1 billion seasoned equity issue requires only a spread of about 3%.

x

The underwriter spreads plotted in Figure 25.4 are not the only costs that issuers incur:

1. The spread does not include other direct costs. A 1996 paper by Lee, Lochhead, Ritter, and Zhao reported that from 1990 to 1994, direct costs other than the underwriter spread added about $0.5 million for small offerings and up to $2 million for large offerings. (Nowadays, these figures may have quadrupled.)

2. The spread does not account for the time and focus that management spends on the issuing process, which could otherwise have been spent more produc-

tively (an opportunity cost). The effort is relatively more modest in safer bond offerings, but for IPOs, it is a very lengthy and time-consuming task. In addition, any time delay in funding could itself be very costly, too. These costs are conceivably just as important as the underwriter spread, but we cannot assess them because we have no data on the costs of management time and project delay. X

3. There are potentially other indirect costs and benefits that the revised capital structure itself creates—the subject of our earlier Chapters **??** and **??** and of Section 22.I. These would manifest themselves in more dilution. X

anecdote

Prior to 2003, federal securities laws had just three "nationally recognized statistical rating organizations" (NRSRO): Moody's, Standard & Poor's, and Fitch. (In 2003, the SEC added Dominion; in 2005, it added A.M. Best; as of 2007, there were about 10 organizations.) In the second half of the twentieth century, the SEC began to rely on ratings to determine what sort of securities certain regulated financial institutions could own. The raters had not always enjoyed such privileged status. At the beginning of the twentieth century, they were simply investment service agencies that provided investors with research for a fee. In the 1970s, the revenue model changed, and Moody's and S&P (by far the larger and more important agencies) began to charge issuers instead of investors.

In 1994, the Jefferson County School District No. R-1 of Colorado decided not to obtain a Moody's ranking. To their surprise, Moody's decided to publish an unsolicited and unusually detailed "Special Comment" anyway. It was a negative rating that downgraded the school district, and interestingly, it occurred on the day of the pricing of the bond. Although Jefferson County sued, a judge later ruled that Moody's was protected by the First Amendment's freedom of speech clause.

This legal protection also helped the three major credit rating agencies in Enron's case. Most other service providers were sued by investors—investment bankers and auditors, in particular. But all three credit rating agencies had received substantial fees from Enron, too. Nevertheless, even when Enron was already trading at $3 per share and the market was aware of Enron's trouble, all three major agencies still failed to respond and instead held onto investment-grade ratings for Enron's debt for a while.

On June 4, 2008, the Wall Street Journal reported that the bond firms had finally agreed with the New York attorney general to reform their payment structure to make "agency shopping"—whereby issuers would select and pay only when receiving a good rating—more difficult. Now, agencies would have to require payment before issuing a rating. As of 2008, various government agencies and financial publications continue to scrutinize the rating agencies' practices.

Bond Rating Costs

There is one additional direct cost to issuing debt that is worth mentioning. You already learned about bond rating agencies in Section **??**. Issuers can pay Moody's, Standard & Poor's, or Fitch to rate their bonds. This typically costs $5,000 to $25,000 per bond issue. Having a public bond rating helps potential investors gauge the risk. Indeed, many institutions are prohibited from buying any unrated bond, making ratings a necessity for many large bond offerings. Only the largest and most stable firms can issue investment-grade bonds, and having this rating is also a requirement to participate in the much shorter-term commercial paper market. All other firms can only issue speculative-grade bond, that is, bonds rated BB or worse. To get a better impression of issuing activity, please browse the issuing calendar in the Wall Street Journal, as well as Moody's Bond Record or the S&P Bond Guide in your local library. (The Moody's descriptions are now published by Mergent, a sister company of Moody's.)

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question

A firm wants to raise $200 million. Compare the costs of issuing $20 million in seasoned equity versus those of issuing $100 million in speculative-grade debt and $100 million in seasoned equity. Which one is more expensive? Why?

answer

Look at Figure 25.4. The $100 million seasoned equity offering would cost about 5% in spread. The $100 million speculative-grade debt offering would cost about 1.5%. The total underwriter spread would be 3.25% ($6.5 million). Issuing $200 million in seasoned equity would cost around 4.5%, which comes to about $9 million. The reason why the all equity offering would be more expensive is because it would be riskier and harder to place.

25.F M&A from the Firm's Perspective

The second main function of investment banks—advice—arises principally in the context of M&A. A **merger** occurs when two corporations agree to marry on an equal basis. An **acquisition** occurs when one company purchases another. Conceptually, the two are sufficiently similar that most analysts commonly use the terms interchangeably. (Note that buyers can be smaller than the targets, especially if buyers rely on leverage to finance the acquisition.) The typical method of execution is the **tender offer**, which simply invites shareholders to present their shares in exchange for cash or stock. Its execution can be contingent on enough

shares being tendered. The role of the investment bank is not only to advise, but also to facilitate and handle the legal parts of the M&A processes. These M&A functions also overlap with the world of underwriting, because much issuing—and almost all seasoned equity issuing by older Fortune 100 companies—occurs in M&A contexts. However, successful M&A advising does not require an underwriting department. There are some prominent M&A advisors that have no underwriting business—most prominently, the two boutique firms of Lazard and Rothschild.

One particular form of acquisition is the **leveraged buyout** (**LBO**), in which the acquirer is financing the buyout mostly with debt. Thus, the acquirer usually ends up owning only a small slice of the firm in the form of very high-powered equity. Consequently, even modest post-LBO underperformance could result in a total investment loss for the LBO buyer. This gives the acquirer enormous incentives to get everything right. Indeed, it is generally believed that the two most important sources of value in a leveraged buyout are these:

1. Better control of agency conflicts.
2. The reduction of corporate income tax obligations through the use of debt (explained in Chapter **??**).

There are many **private equity** firms that specialize in leveraged buyouts. The most prominent firm of the 1980s was Kohlberg Kravis Roberts (having purchased, among many other firms, RJR Nabisco). The most prominent firm today may well be Cerberus Capital (having purchased, among many other firms, Chrysler). In the typical LBO, the acquirer either fires existing management or completely restructures the existing management-compensation contracts in order to dramatically improve managerial incentives. In a **management buyout** (**MBO**), the existing management itself becomes the LBO buyer.

The overwhelming majority of M&A is friendly—that is, the transactions are solicited by or occur with the blessing of target management. However, this is not always the case. In a hostile takeover (formally called an **unsolicited bid**), a **corporate raider** makes a tender offer to purchase shares in order to obtain either the whole firm or a voting majority. If the acquirer succeeds, he can appoint new board members. They in turn can oust management, allowing the acquirer to take control.

anecdote

The bestseller Barbarians at the Gate, also made into a movie, describes the epic takeover battle for RJR Nabisco between Kohlberg Kravis Roberts and RJR management (supported by Shearson Lehman [now Lehman Brothers]). In October 1988, RJR's CEO Ross Johnson and his predecessors had mismanaged the company long enough to allow him to offer RJR shareholders the premium price of $17.6 billion in

a leveraged management buyout. Because of a conflict of interest, Johnson had to resign from the board when it contemplated Johnson's buyout offer. This, in turn, opened the door to a $20.6 billion counteroffer by KKR. Eventually, KKR purchased RJR for $25 billion, and Johnson got a $53 million golden parachute. This takeover was also probably KKR's biggest miscalculation, in that it overpaid for RJR. The prime reasons were personal egos and animosities, which fueled an irrational bidding war—all to the benefit of RJR shareholders.

Reasons for M&A

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Managers are often enthusiastic about acquiring more companies. It is often not a necessary condition (though usually a welcome one) that the acquisition benefit the acquirer's shareholders. As far as managers are concerned, running a bigger company usually means more prestige and more compensation down the line. In some cases, however, this enthusiasm is short-lived. If an acquirer underperforms significantly in the years after the acquisition, existing management may face a larger risk of being ousted. If an acquisition is bad enough, it can contribute to such poor performance and thus management dismissals. In contrast, target managers are often reluctant participants. They often lose not just their independence but also their jobs. Thus, unless adequately "bribed," target management naturally often wants to resist (the subject of the next section)—even if their shareholders would be better off.

x

An extreme example of this conflict of interest was the merger between Chase and Bank One. The Wall Street Journal reported:

X

> The negotiation took place between the Bank One CEO, Dimon, and JP Morgan Chase CEO Harrison, both of whom wanted to become CEO immediately. The original plan was for Dimon to succeed Harrison after two years. Dimon offered to sell Bank One at a zero premium if he just were to become the merged company's CEO immediately. Harrison rejected this offer, and instead paid a $7 billion premium from Chase shareholders to Bank One shareholders in order to retain his post for these two extra years.

Let me rephrase this for you: Dimon offered to pay $7 billion of Chase shareholders' money to Bank One shareholders simply for the privilege of not having to wait just 2 years before becoming CEO—and, not to be outdone, Harrison refused to accept the $7 billion on behalf of Bank One's shareholders in order to be the boss for just 2 more years! The conflicts of interest between shareholders and managers are the subject of the next chapter. (Incidentally, Jamie Dimon may have come out of the financial crisis of 2008-9 as the single-most powerful banker in the industry today.)

X

Value Changes

x

The fact that managers like acquisitions does not mean that M&As are value neutral or exist only for the benefit of acquiring managers. M&A transactions can create or destroy value for shareholders, too. The combined or acquired entity could be worth more than the two original units. The most important causes of corporate value gains (though not in order of importance) are the following:

Scale synergies: The merging of systems, skills, structures, departments, and staff can improve operating efficiency. Efficiency gains due to economies of scale can result from a number of sources: X

- Elimination of duplicate departments and fixed overhead can lower operating costs. For example, headquarters, legal, human resources, and IT departments may be combinable.
- Production and distribution efficiencies, for example, in the merging of ATM networks, can attract more bank customers.
- Reduction of market imperfections: Smaller firms may also find it easier to tap the public financial markets and thus gain financing efficiencies by linking with other firms. (From 1996 to 1999, so-called [pl]rollup were popular, in which multiple small firms were combined into one entity that was then large enough to be taken public.) More generally, by reducing the idiosyncratic risks, some mergers may also reduce bankruptcy costs, information disagreements, share illiquidity, and so on, thereby making the financial market more perfect.

Reduction of competition: The elimination of the target from competition with the acquirer can make it easier to raise prices.

Expertise: An acquirer may find it easier to purchase a firm than to build up the expertise of the target. Although this may not raise the overall value of the new entity, doing this could still be the cheapest option for the acquirer. (This was the prime reason in the attempted Yahoo takeover by Microsoft described in Section 25.F.)

Elimination of poor target management: It may simply be that current management is running the firm into the ground, and replacing it (kicking and screaming) could provide value gains.

Shutdown efficiencies: Sometimes it is better to shrink or liquidate a firm, but the current management is unwilling or unable to execute drastic measures.

A takeover by individuals with less of an institutional history often makes this easier.

X

Expropriation: A transfer of management can allow breaking implicit promises that firms have made but not put into writing. All companies rely on at least some employee loyalty, and all employees rely on at least some company loyalty. It is impossible to contract out every small promise that employers make to employees, and vice versa. Usually, this is a fair, efficient, and trustworthy arrangement.

But it also leaves firms vulnerable, because a takeover can generate value by breaking implicit promises. For example, consider a company that, although it pays lower salaries than the rest of the industry, attracts employees by implicitly promising long-term employment stability and generous pension and health benefits. This makes early operations especially profitable. Yet as the company and its workers age, these liabilities can become quite significant, and a takeover could allow new management to save money by firing now older and more expensive employees or by replacing an overfunded pension fund and health care plan with a less costly and less safe alternative. (In the 1980s, there were some prominent examples in which the substitute low-cost insurance provider then promptly went bankrupt.)

It is also often difficult to distinguish expropriation from shutdown efficiencies. If an older worker has foregone better opportunities elsewhere in order to receive a pension, is his firing and the elimination of his pension an expropriation or efficient (value-enhancing) governance?

x

There are two more very important value gains that come about through the higher leverage often assumed in acquisitions, especially in leveraged or management buyouts:

X **Tax benefits:** Higher debt ratios reduce the amount of taxes collected by the IRS.

Better governance: The need to service debt usually makes it easier to convince both managers and employees that they have to work harder and spend less on pet projects—or the firm will go bankrupt. Ironically, management buyouts are often contemplated by the most wasteful managers, who themselves have the incentives to make their own corporations look bad, so that they can buy them cheaply and then magically improve them.

All of these can be important M&A value drivers, though not equally important in each and every takeover. In some takeovers, the important driver may be primarily synergies; in others, it may be primarily better governance.

x

However, many takeovers also fail in delivering value enhancements. The most common negatives when a larger company takes over a smaller company are less focus, more bureaucracy, and poorer management. (The canonical example here may be Quaker's acquisition of Snapple for $1.7 billion in 1994 and its resale for only $300 million just 2 years later. You can read sordid tales by googling for the history of this acquisition.) There is good evidence that takeover activity in the 1960s and 1970s was driven by the desires of managers to increase firm size and form conglomerates, many of which were then run more poorly after the acquisition than before. That is, a company that suffers from poor governance may see its managers purchase other companies for management's sake rather than for the shareholders' sake. As noted at the outset of this section, acquiring managers can benefit by the following: X

Idiosyncratic risk reduction: Takeovers naturally increase the scale of the firm. This typically reduces the idiosyncratic risk of the firm and increases the firm's revenues and earnings. However, this need not create any value. Risk reduction can be achieved by investors themselves holding the shares of both companies; and they would just as well hold their shares of the combined firm's revenues and earnings.

Larger empire: Acquiring managers tend to like running bigger firms not only because it makes them more important but also because managers of bigger firms usually receive more compensation. X

Ironically, in the 1980s, the situation reversed: Many of these large conglomerates were themselves taken over by smaller firms and promptly dismembered. However, it is not without cost when smaller firms take over larger firms, either. The most common negatives are the loss of the benefits of easy access to more capital (meaning that projects are cut back if they do not generate cash to service debt in the immediate future), and the lack of diversification by the new owner. Many LBOs will cut positive-NPV projects, especially if they are risky and long-term— risk-shifting incentives notwithstanding. X

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question

If the firm fires workers that cost more than they are producing, is this always a sign of better governance that is in the interest of society?

answer

Yes and no. Clearly, the firm could operate more productively by replacing these workers. However, it could be that these fired workers had implicit promises that they did not have to be as productive in their old age. This would be a form of expropriation.

question
What are the main sources of value generated in most M&A? Are all of them in the interest of society as a whole?

answer
Sources of value in M&A are synergies, reduction of competition, acquisition of expertise, elimination of poor management, shutdown efficiencies, expropriation, tax benefits, and improved corporate governance. Not all are in the interest of society—expropriation and tax reduction, in particular, could help the firm but not society as a whole.

Value-Change Beneficiaries

x

I have not yet answered one important question: Who benefits from the net value changes (hopefully positive value gains)—the acquiring shareholders or the target shareholders? Conceptually, this is easiest to think of in terms of an efficient market, in which the target was priced as if the acquirer had not yet appeared:

X

- If the acquirer purchases the target at the original market price, then all gains and losses that the acquisition itself produces would accrue to the acquirer.
- If the acquirer purchases the target at a price above the previously prevailing one, then some merger benefits would accrue to target shareholders.
- If the price fully includes the value of all net benefits, only the target shareholders gain from the net benefits, and the acquiring shareholders end up indifferent.
- If the price is even higher, the acquiring shareholders lose money to the target shareholders.

Here is an extreme example of the issues involved. The poster child for the end of the LBO wave of the 1980s was Campeau's 1988 purchase of Federated Department Stores (which owns Macy's and Bloomingdales) for $7.67 billion. Before the buyout, it had traded for $4.35 billion. Thus, Campeau paid a $3.32 billion windfall to target shareholders. They did well. However, Campeau did not. When Campeau emerged from bankruptcy in 1992, it became clear that Campeau had created value—just not for itself. It had managed to raise Federated's value from $4.35 to $5.85 billion (adjusting for market movements over the same period)—a $1.5 billion value increase during a recession! Unfortunately for Campeau, this

x

was still well below the $7.67 billion purchase price.

Of course, a single anecdote is not systematic evidence. However, it appears that the Campeau evidence is extreme, but not isolated. The empirical evidence suggests that on average (i.e., not in each and every takeover), the following holds:

Target shareholders: They almost always make out like bandits. The average takeover premium seems to be around 20-30% above the public pre-takeover price. A study by Ernst and Young showed that this premium even shot up to between 40% and 50% from 1996 to 2000. Moreover, when target management succeeded in scuttling the takeover attempt, the target's average share price usually declined significantly, often back to the original pre-takeover price.

Acquiring shareholders: With acquiring managers eager to take over other companies, it should perhaps not come as a surprise, then, that most of the takeover value gains have not accrued to the acquirer's shareholders. On the contrary, many acquirers have been overpaying. A study by Moeller, Schlingemann, and Stulz (2005) looked at publicly trading acquirers. They found that the average acquirer from 1980 to 1998 lost about 1.6 cents in value for every acquisition dollar. From 1998 to 2001, this shot up to 12 cents per acquisition dollar. As usual, there was a lot of heterogeneity across M&As. Much of the 12 cent figure was driven by some really bad outlier acquisitions. Again, this was an average. There were also many acquisitions that were greeted positively by the share price of the announcing acquirer. You have to judge acquisitions on a one-by-one basis.

With large average gains to the usually smaller target and small average losses to the usually larger acquirer, is there a net loss or a net gain? Such evidence could speak to the question about whether there are synergies or efficiency gains. The evidence is mixed. Net in net, the dollar benefit to target shareholders plus the dollar cost to acquiring shareholders (the acquirer is usually larger!) seems to be just about zero. Again, be warned that there is great heterogeneity here.

Summary

In sum, target managers are almost always worse off if the acquisition succeeds (absent any side payment to them personally); acquiring managers are often, though not always, better off if the acquisition succeeds. The opposite appears to be the case for shareholders. Target shareholders are almost always better off; acquiring shareholders may be worse off. If there ever was a situation rife with agency conflicts between managers and shareholders, M&As are it.

Before we leave the subject of who gains and who loses, let's mention that there are also some other parties involved in takeover transactions. First, there are the investment banks. They make good fees both from M&A financing and from M&A advice. Naturally, they are eager to push potential acquirers into such transactions. Other investment banks make money by "defending" the target. They, too, can earn good fees. Second, there are other stakeholders in the firm: employees, suppliers, customers, and so on. It is not clear whether they tend to gain or lose. It is correct that they are often squeezed in the initial stages of a completed takeover, but if a target is better managed after the acquisition, it may actually grow more in the long run. In some cases, the long-run beneficial effects can be much higher than the short-run pain.

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question
Can an acquisition that is value increasing be a bad deal for the acquirer?

answer
Yes, even if the net value gain is positive, if the acquirer overpays, the acquirer's shareholders can lose.

question
Why do many firms like to acquire other firms?

answer
Firms may want to acquire other firms either because it is in the interest of the firm (creating value), or because it is in the interest of managers (and advising bankers).

Resistance to Corporate Control Activity

x

Target management is not helpless. On the contrary, when approached by an unwelcome outsider, they can resist a hostile takeover through so-called [pl]shark repellent. Among the more prominent defenses are the following:

Greenmail: Management uses shareholders' money to "buy off" the shares of a potential acquirer at a premium. This has become rare due to bad publicity.

Golden parachute: Management lets itself be bought off with a large bonus by the acquirer. (It is a defense only if it is large enough to deter the acquirer.)

Acquisitions: The target management buys other companies, because a bigger company is more difficult to take over. (This is called the "blowfish" defense.)

Scorched earth: Management can threaten to sell off corporate assets that are of particular interest to the acquirer.

Poison pill: When triggered, a poison pill entitles other shareholders to purchase more shares at a discount. The potential raider would then have to repurchase these shares at the acquisition price, too. The emergence of poison pills in the 1990s essentially shut down all hostile acquisition activity.

New share issuance (without the poison pill): Management issues more shares to employees and themselves. Similar alternatives are accelerating the vesting of existing shares and options, and promising high severance packages for any employees wanting to leave if the firm is taken over. The acquirer would then have to repurchase more shares and pay employees more.

Fair value provision: A fair value provision forces an acquirer to pay every shareholder the same price, that is, the highest price at which any share can be acquired. In other words, the effective share acquisition price changes from the lower average price to the higher marginal price.

Supermajority rule: An acquirer is required to obtain more than just a majority of votes to replace the board. (Moreover, Delaware law [where most large publicly traded firms are incorporated] restricts what raiders can do if they control between 15% and 85% of the shares for up to 2 years.)

Litigation: Management can delay a potential takeover in the courts, especially if the potential acquirer is in the same industry, in which case antitrust litigation issues can come into play.

x

However, by far the most effective takeover prevention strategy is the following:

Staggered board: Each year, only a fraction of the directors are up for reelection. (Another Delaware provision requires this fraction to be at least one-third). X Therefore, even an outsider owning 100% of the shares on the day of the annual shareholder meetings cannot take control of the board. Only one-third of the board will be replaced; the other two-thirds will remain in office. This means that the company will continue to be under the control of the existing board for at least 1 more year, during which the existing management can do a lot of harm.

The refinement in defensive weaponry is probably the prime reason why hostile takeovers have become so infrequent after the 1990s.

The Indirect Effects of (the Possibilities of) Attack and Defense

Not all managerial resistance by the target is necessarily value reducing. For example, resistance can, and often has, forced acquirers to pay more for the firm. To the extent that target management resists, it has often forced the acquirer to sweeten the offer—a good thing for target shareholders if it raises the price, a bad thing for target shareholders if it leads the acquirer to abandon the offer.

Acquirers also have other tools at their disposal. To get target management to cooperate—to make it "friendly"—acquirers usually pay a (perfectly legal) personal bribe to target management, called a **golden parachute**. But even the golden parachute has often been argued to be a good thing for target shareholders. If it is not too large, it may help induce target management not to resist to the point where the acquisition is aborted.

(The moral argument that target managers deserve it because they have invested so much of their human capital in the firm rings hollow, though. The same management rarely insists on the same kinds of golden parachutes for their ordinary long-term employees, many of whom are unceremoniously laid off without fanfare or extra compensation after the acquisition.) Unfortunately, despite much research, it is still not clear when the presence of a golden parachute is good on average and when it is bad for shareholders.

It is also important that you realize that even if hostile takeovers are rare and even if defense mechanisms are rarely triggered, they set a much broader stage for the company. (Think about how nuclear weapons were never used in Europe but still determined how the Cold War between the United States and the Soviet Union played out.) First, they dictate the attitudes in negotiations between the parties for potential friendly acquisitions. The target is well aware that the acquirer could become a lot more nasty; the acquirer is well aware that the target could trigger defenses. This influences the outcome of the negotiations—or the lack of negotiations—depending on the relative strengths of the parties. Second, even if target management ultimately wins (or is never approached by an outside offer to begin with), it may still have to shape up—for example, by making a competing tender repurchase offer for its own shares or by paying more of its free cash back to shareholders (e.g., in the form of a repurchase or extraordinary dividend).

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question
What can an executive do to resist a takeover?

answer
The list of resistance measures in takeovers can be found in Section 25.F: greenmail, golden parachutes, acquisitions, scorched earth strategies,

poison pills, new share issues, fair value provisions, supermajority rules, litigation, and staggered boards.

question
Is it true that if hostile takeovers are rare, they should not matter very much?

answer
Even though hostile takeovers are rare, they matter greatly. They are the fallback position if "friendly" negotiations fail. A hostile offer is the (quiet) gorilla in the backroom that can always be called out.

Proxy Contests and Shareholder Resolutions

If target management is not helpless, neither is the potential raider. In addition to the outright assault of a hostile takeover attempt, raiders have some other weapons. In a **proxy contest**, a large shareholder (with enough shares to care to spend a lot of time and money) can actively solicit other shareholders to vote against management's own board slate and in favor of an alternative board slate. Often, a hostile would-be acquirer launches both a hostile offer and a proxy contest to eliminate the board and any charter provisions that would prevent him from purchasing all shares. The most prominent recent proxy contest may be Hewlett-Packard's in 2002 and Yahoo's in 2008, which is narrated below. Very few proxy contests without a simultaneous takeover are ultimately successful, and though they are cheaper than a full-blown takeover, they are still not cheap.

A more modest and dirt-cheap form of the proxy contest is the **shareholder proposal**. Any shareholder can put forth a shareholder proposal for vote by all shareholders. The SEC judges whether shareholder proxy suggestions are appropriate for a shareholder vote. (The rules by which the SEC accepts or rejects shareholder proposals are explained at http://www.sec.gov/interps/legal/cfslb14.htm.) Shareholder proposals are usually not binding and can therefore be ignored by the board. The Delaware court has declared that if a shareholder resolution were binding, it would infringe on the board's prerogatives, which therefore would allow the board to exclude the resolution from a vote altogether. To avoid triggering this clause, shareholder proposals must not be binding.

Nevertheless, shareholder proposals carry both moral sway and signaling value: If a large number of shares vote in favor of a proposal, it is more difficult for the board to pretend that this proposal is not in the shareholders' interest. Moreover, if a majority of shareholders votes in favor, chances are that a full-blown proxy contest revisiting the same question would succeed. Any sane management would naturally fear that a positive outcome would encourage such a proxy contest, and

thus many boards have followed some of the recommendations of shareholder proposals, even though they were not binding.

- Shareholder proposals have been particularly useful in removing antitakeover defenses. The most frequent shareholder proposal concerns the staggering of the board. This can set the stage for later takeovers if the management continues to perform poorly. For example, Lucian Bebchuk (a leading corporate governance researcher from Harvard) offered a shareholder proposal in March 2008 that Safeway change its bylaws to limit its poison pills. In response, Safeway adopted the provision and Bebchuk withdrew the proposal.

- Other boards have ignored shareholder proposals. For example, in May 2007 and again in May 2008, shareholders holding 40% of Exxon's shares voted for a resolution that Exxon invest in alternative energy and separate the position of chairman and CEO. The chairman and CEO, Rex Tillerson, promptly announced that he would ignore the resolution, defending his action with the public remark that Exxon already paid 49% of its earnings to tax authorities. (This is a bizarre defense: Wasting 49% of shareholders' money through poor tax management is not a good argument against either better investment policies or better corporate governance.)

- Many other shareholder proposals are brought by special interest groups, such as churches or labor unions, and are not necessarily in the interest of shareholders. They are almost always voted down. For example, in May 2008, Google shareholders voted down proposals about instituting a board on human rights and doing business in China.

Nowadays, many less-than-friendly takeovers begin with shareholder proposals a few years prior and/or immediate proxy contests that seek to eliminate the takeover defenses.

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question
What are some of the reasons why the fear of proxy and takeover contests may not control all CEOs?

answer
It is very costly to execute a proxy and takeover contest. A typical takeover premium may be as high as 20%—worthwhile only if the current management commits the most egregious breach of appropriate behavior. A proxy contest costs "only" a few million dollars to execute.

question
How is a shareholder proposal different from a proxy contest?

answer
With a few legal exceptions, shareholder proposals are not binding. (If they were binding, they would fall under the management authority of the board of directors, who therefore would have the power to exclude them from being voted on. To get a proposal on the ballot, the proposing shareholder therefore needs to give up the right for the proposal to be binding.)

More Empirical Evidence about M&A Activity

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Before we look at the systematic empirical evidence, let's have some fun and start with a juicy tale. The Wall Street Journal featured an article in its Weekend edition (January 19-20, 2008, p. B16) called "Yahoo's Ripe for Shake-Up":

> Yahoo chief Jerry Yang recently summarized a plan to turn the company around by becoming the start page for every Internet user across the globe. What Mr. Yang failed to provide, however, was a convincing solution to Yahoo's existential crisis. The Hamlet of the Web won't succeed by simply trying to become a start page. Yahoo is navigating the waters of Internet advertising like a goldfish evading a shark, in the form of Google. Activist investors ought to take heed—Yahoo is ready for a shake-up.
>
> Yahoo, based in Sunnyvale, Calif., has many ingredients that make it a tantalizing target for uppity investors. There's a discredited management team, a corporate strategy in need of a makeover, stock-price underperformance, a large free float with no controlling shareholder, cash on the balance sheet and many moving parts whose values don't appear to be adequately reflected in the Yahoo share price—particularly its investments in two hot Asian Internet firms.
>
> Consider the management question. A month after Mr. Yang, a Yahoo founder, took over from former Hollywood studio boss Terry Semel in June, he promised action to turn around the flailing Internet titan within 100 days. Nearly 200 days later, there is little sign of this. Since he took over, Yahoo stock has dropped 23%, while Google's has added roughly 10%. In the past two years, the company's value has been halved, so it is hard to see how investors would oppose a management shake-up.
>
> On strategy, Yahoo has many strengths, but its primary weakness remains in search, where its U.S. market share has dropped to 17%

> from 22% a year ago, despite investing mightily to catch up to Google. An activist would almost certainly pressure Yahoo to swallow its pride and hand its search traffic over to Microsoft, or even Google, for a fat fee. Outsourcing search could boost Yahoo's revenue from the business by at least 30% to $3.5 billion, according to some analyst estimates.
>
> Then there are Yahoo's stakes in Yahoo Japan and Alibaba. Although they fluctuate in value, they currently are valued at $8.4 billion and $4 billion, respectively. If monetized, the two stakes, which represent a huge chunk of Yahoo's $28 billion of market value, could provide a windfall for the company's shareholders. But there is a problem: Yahoo would incur steep capital-gains taxes in a sale.
>
> That is, unless Yahoo gets creative with its finances. And this may be where an activist with a little corporate finance up his sleeve could make a big difference. According to Sanford Bernstein analyst Jeffrey Lindsay, the company could, for example, employ what is known as a reverse Morris Trust structure. This would essentially allow Yahoo to put the stakes into a new listed entity, let's call it Yahoo Asian Investment Co. (Yaico), which could then be spun off to Yahoo's shareholders tax-free.

Given Yahoo's low share price, an external offer was a real possibility. Remarkably, when it came, it was not from an acquirer seeking to break it up to improve its operations. Instead, it came from an unexpected corner.

On February 1, 2008, Microsoft extended an unsolicited (i.e., hostile) acquisition offer for Yahoo at $31 per share ($44.6 billion for the company)—a 62% premium over Yahoo's $19 stock price before the offer. For Microsoft, Yahoo was worth more than just its breakup value. It was the potential synergy that a quick acquisition could provide in Microsoft's attempt to take on Google on the World Wide Web.

Google was obviously less than thrilled. A Microsoft merger with Yahoo could resuscitate the latter as a Web competitor. Thus, just one day after the announcement, a Google executive blogged that "a Microsoft-Yahoo merger could threaten the openness on which the Internet is based." Despite a history of a cold and competitive relationship vis-à-vis Yahoo, Google CEO Eric Schmidt even called Jerry Yang to offer help—most probably in the form of a partnership between the companies, in order to thwart Microsoft.

By February 11, Yahoo had rebuffed the Microsoft offer as being too low. In a letter to shareholders, Yang was claiming a value for Yahoo of at least $40 per share. It also began a search for a "white knight." (A **white knight** is a company that

offers a friendly takeover to another company under threat of a hostile takeover from an unwelcome bidder, sometimes known as a **black knight**.) It began talks with News Corp, but almost exactly one month later, News Corp had dropped out.

After having informed Yahoo that it was willing to raise its offer to $33 per share, Microsoft withdrew its bid on May 4 when Yahoo demanded $37. At the opening of the stock market on May 5, Yahoo's price dropped in value by about $8.5 billion (a 20% drop, from $29 to $23). On the other hand, Microsoft's stockholders were ecstatic: Microsoft's share price increased by about $5 billion (2%). Remarkably, Google was another big winner—its equity value also increased by about $4 billion (also 2%).

On May 3, Carl Icahn (a well-known corporate raider) announced that he had begun to accumulate shares with the goal of forcing Yahoo to sell out to Microsoft. He started a proxy contest, proposing his own slate of directors for the next Yahoo shareholder meeting, set for August 1, and then also proposed firing Yahoo's Jerry Yang as CEO. At the same time but independently, a large shareholder filed suit in Delaware against the board (Police and Fire Retirement System of the City of Detroit v. Yahoo, CA3561). On June 3, 2008, the Delaware court refused to keep papers sealed that revealed that Microsoft had in fact offered $40 per share in January. Apparently, Yang had also effectively torpedoed the Microsoft offer by insisting that all employees receive a severance plan that would incentivize them to quit rather than stay on under different management. (This applied even more so to Yahoo executives.) The pension fund then amended its suit, because this severance plan could also be triggered if Icahn were to take control of the board first. On June 13, Yang announced that all continuing talks with Microsoft had ended, because Microsoft had withdrawn from the $47.5 billion offer that it had put on the table the previous month. Yahoo also announced a search partnership with Google that it hoped would raise its advertising revenue. On these news announcements, Yahoo shares dropped 3.6%, and Microsoft shares increased 1.9%.

On July 25, Icahn and Yahoo came to a surprising agreement: Icahn and two of his associates would join the 11-member Yahoo board, but Yang would continue to control the board. This new board was elected (with some shareholder grumblings) on August 1. It is anybody's guess at this point what will happen next.

More about Takeover Characteristics and the Role of Investment Banks

x

Let's learn more about the systematic characteristics of deals and investment banking fees now. Table 25.7 presents the key table from a recent academic study. It gives detailed statistics for (almost) all domestic acquisitions that involved a publicly traded corporation between 1980 and 2003. It classifies deals by the quality of advisor (within the industry in which the takeover occurred). Still,

Table 25.7: Average Characteristics of U.S. M&A Transactions from 1980 to 2003

—Rows report means (except where noted otherwise) and can be based on different numbers of observations. In the top and middle panels, there are typically about 15,000 acquisitions. These are roughly equally split across categories. However, in the bottom panels, there is fee information for only about 6,000 acquisitions, and the distribution is somewhat biased, which is why *N* is reported in the last row, and why the deal values here do not match deal values above. Source: Walter, Yawson, Young, "The Role of Investment Banks in M&A Transactions: Fees and Services," Table 1 (June 2005).

	Tier of Acquirer Advisor				Tier of Target Advisor		
	Top	**Middle**	**Bottom**	**All**	**Top**	**Middle**	**Bott**
Firm Value (in millions)	$7,642	$5,084	$1,020	$4,916	$2,106	$1,237	$
Median (in millions)	$1,765	$711	$213	$736	$440	$251	
Acq and Tgt in Same Industry	63.6%	62.7%	65.9%	64.0%	49.0%	45.5%	60
Proportion of Public Acquirers					64.5%	62.0%	72
Proportion of Public Targets	58.5%	50.4%	43.3%	51.3%			
Deal (Tgt) value (in millions)	$1,357	$659	$127	$761	$1,821	$663	$
Median (in millions)	$275	$132	$37	$120	$403	$138	
Proportion of Tender Offers	19.7%	17.7%	9.7%	16.1%	24.9%	23.1%	15
Proportion of Hostile Deals	3.6%	3.9%	0.8%	2.9%	10.4%	5.3%	2
Number of Acquirer Advisors	1.20	1.11	1.03	1.12	0.84	0.67	0
Number of Target Advisors	0.90	0.77	0.59	0.76	1.34	1.16	1
Probability of Completion	88.9%	89.2%	91.8%	90.0%	73.6%	79.5%	85
Days to Completion	116	100	102	106	141	132	
Proportion of All-Cash Deals	37.6%	38.3%	32.8%	36.3%	42.8%	48.6%	42
Proportion of All-Stock Deals	28.8%	27.8%	39.1%	31.6%	23.4%	22.1%	38
Percentage of Cash	47.3%	48.7%	42.2%	46.2%	53.0%	58.2%	48
Percentage of Other	14.5%	14.3%	10.1%	13.1%	16.1%	14.0%	6
Percentage of Stock	38.1%	36.9%	47.7%	40.7%	30.9%	27.8%	44
	Fees Paid to Advisors (in millions)						
Mean	$4.83	$2.65	$0.77	$2.89	$6.47	$2.79	$0
Median	$2.38	$1.00	$0.25	$1.00	$3.70	$1.40	$0
	Deal Value (in millions)						
Mean	$2,494	$1,092	$208	$1,345	$2,177	$749	$
Median	$416	$195	$55	$177	$525	$181	
	Fees Paid, as Percentage of Deal Value						
Mean	0.91%	0.90%	0.93%	0.91%	0.87%	1.13%	1.1
Median	0.47%	0.58%	0.52%	0.52%	0.67%	0.80%	0.8
Number of Observations (*N*)	733	672	591	1,996	1,124	1,113	1,

this data is not as complete as our earlier data. There were many mergers and acquisitions among firms that were not public, and even for the roughly 15,000 acquisitions involving a public corporation, they had good data on advisory fees for only 6,000 acquisitions. x

Table 25.7 shows that the typical acquirer in this sample was about three to four times as large as the typical target. Also, the mean firm size was much larger than the median firm size, suggesting some disproportionally large firms were in the sample. About one-half to two-thirds of M&As occurred between firms in the same industry (classified by the "two-digit SIC [standard industry classification] code"). About one-half to two-thirds of M&As involved public acquirers or targets. x

The average deal size was about $800 million, but the top-tier investment banks advised on disproportionally larger deals. About 1 in 5 takeovers occurred through a tender offer (the alternative being a negotiated merger with the target, not involving an offer to shareholders). Only a small fraction of all deals were classified as hostile, where the target management resisted. (Acquisitions are also often classified by whether the acquirer pays with cash [a **cash offer**] or with the corporation's shares as currency [a **stock offer**].) About one-third to one-half of all deals were paid for in "all cash," and about one-third were paid for with "all stock" (in which the acquirer paid target shareholders with its own shares). Somewhere between about 10% and 15% of acquisitions were abandoned. If successful, it took the typical deal about 4 months to complete. Note that when the deal was hostile, a much larger fraction of targets seem to have engaged top-tier advisors. x

The median advising fees were just about 0.5-1% of the amount of the transaction (usually the target size), on average. The mean fee was much larger, suggesting that there were a few large fee outliers. Remarkably, top-tier investment bankers charged about the same proportional fees as their lower-tier brethren—the reason why they earned more fees is simply that their deals were larger.

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question
What are the two main payment methods in acquisition offers?

answer
The two main methods of payments in acquisitions are cash offers and stock offers.

question
How large is the typical acquirer relative to the typical target?

answer
The typical acquirer is about three to four times as large as the target.

question
What is the typical commission for M&A advice that investment bankers earn? How does it differ across the tier of investment bank retained, and across acquirer and target?

answer
The mean M&A advising commission is about 1% (0.9% for acquirer, 1.1% for target). The median is about 0.6% (0.5% for the acquirer, 0.8% for the target). The differences across tiers and between target and acquirer seem fairly small.

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wideonecolumn

Summary

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This chapter covered the following major points:

- Investment banking consists of underwriting and advisory services. Many so-called investment banks are engaged more in non-investment-banking services (such as proprietary trading and asset management) than in investment-banking services.
- Nowadays, securities underwriting is primarily the facilitation of public offerings. A typical underwriter syndicate may have a handful of participants.
- Advisory services are mostly about the facilitation of mergers & acquisitions—from start to finish.
- The investment banking market is an agent market. It contrasts with ordinary commercial banking, in which loans are made by the bank itself.
- The equity capital markets in the United States, Europe, and Asia are now about equal in equity size. The debt market in the United States is still larger than that in Europe or Asia.
- The U.S. investment banks are still the top dogs, primarily because of their ability to attract the best talent from all over the world. Commercial banking is more diffuse.
- No investment bank has more than a 10% share of the market. In 2007, in the United States, a typical top 15 investment bank may have underwritten about $70 billion in investment-grade bonds, $20 billion in non-investment-grade bonds, $80 billion in government bonds, $10 billion in seasoned equity, and $8 billion in IPOs.

- Equity underwriting is a more profitable activity than debt underwriting. The securities are riskier, and due diligence and placement are more difficult. Somewhat unusual, for many investment banks, M&A advice was a lot more profitable than underwriting in 2007.
- M&A activity comes in waves—more when the stock market has gone up. It reached its highest peak around 2000, though 2006 was close.
- Hostile acquisitions are very rare. Still, they are important because they set the stage for managerial behavior. Hostile acquisitions are no longer primarily a U.S. phenomenon.
- Competitive bidding seems to result in lower underwriter spreads. However, few firms bid out their issuing.
- Underwriter spreads can be characterized as follows:
  - Remarkably, there is a strong relation between the offering size and the underwriter spread only for equity offerings. The underwriter spread seems unrelated to offering size for debt offerings.
  - For IPOs smaller than $100 million in proceeds, it is almost always 7%. Other direct costs can add 2-3%. IPOs above $100 million have lower underwriter spreads reaching down to 5%.
  - Larger SEOs have lower spreads. The range is from about 6% for $20 million offerings to 3% for $1 billion offerings.
  - Convertible debt and preferred stock command underwriter spreads of around 3%.
  - Speculative-grade bonds command underwriter spreads of about 1.5%.
  - Investment-grade bonds command underwriter spreads of about 0.5%.
- M&As can create shareholder value through scale synergies, reduction of competition, provision of expertise, elimination of poor management, shutdown efficiencies, better corporate governance, stakeholder expropriation, and/or tax benefits. It can destroy value if governance and operations become worse. Absent a golden parachute for target managers, acquiring managers tend to end up better off than target managers.
- Most of the value gains tend to accrue to target shareholders, not acquiring shareholders. In many cases, acquiring managers overpay for targets. However, there is a lot of heterogeneity.
- Target management can resist acquisitions through various shark repellents, such as greenmail, excessive golden parachutes, acquisitions by the target itself, scorched earth strategies, poison pills, new share issues, fair value provisions, supermajority rules, litigation, and staggered boards.
- Even though shareholder resolutions are not binding (as full-blown proxy contests are), they are much cheaper. In addition, they often nudge management into doing the right thing.
- Based on information from M&A deals among publicly traded corporations between 1980 and 2003, one study found that:
  - Average advisory fees are about 1% of the target (transaction) size.

- Median advising fees are about 0.5-0.7% of the transaction size.
- The 80-90% of proposed deals that ultimately carry through take about four months to complete.
- Fewer than 5% of acquisitions are hostile (and most of these occurred in the 1980s).
- The typical acquirer is about three or four times larger than the target.
- Between one-half and two-thirds of acquisitions are within the same industry.
- About one-third to one-half of acquisitions are paid for with all cash, and about one-third are paid for with all stock.

The next chapter will discuss the role of corporate governance. Not surprisingly, corporate control activity and M&A activity play an important role in that chapter, too.

EOC MATTER

eocproblems

question
How important is the guarantee of securities placement success that underwriters provide their clients?

answer
The guarantee of securities placement sales success is usually fairly unimportant, because it is only given on the day of the offering.

question
What are the most important services and functions of underwriters today?

answer
This is a repeat of a Solve Now! question. Issue origination, issue placement, reputation and signaling, and a host of less formal tasks (such as analyst coverage).

question
Look up five recent IPOs. (Google is your friend.) How many book runners and underwriters can you identify?

answer
The answer will depend upon when the student completes this question.

question
Describe the functions of M&A advisory services.

answer

Identify clients, provide valuation services, better position a business, find potential acquirers of targets, provide expertise, conduct due diligence, structure deals to be tax efficient, arrange financing (bridge financing), and navigate the legal aspects.

question

How do client assets under management and Tier 1 capital translate into market value? That is, are U.S. and U.K. banks relatively more valuable than their foreign competitors?

answer

Table 23.1 provides statistics as of 2007. The question is really about computing comparables ratios for these banks where the market value is either the numerator or denominator. Tier 1: The spreadsheet shows that the U.S. banks generally had about the same market value per dollar of Tier 1 capital as the non-U.K. banks. The U.K. banks had markedly less value per dollar of Tier 1 capital. Assets: U.S. banks had more market value for every dollar of client assets than they managed relative to foreign banks. (The exception is the one Chinese bank with known client assets, which was worth a whopping 22 cents on each client dollar it managed.) The United Kingdom was pretty average in this respect compared to other non-U.S. banks.

question

In relative terms, how important is the American market in equity underwriting compared to the European market?

answer

The American market is about equal, although slightly smaller, than the European market.

question

Is it appropriate to call Goldman Sachs principally an investment bank? Why?

answer

It may no longer be right to call Goldman an investment bank. It has become primarily a principal trading and asset management firm.

question

How are underwriting and M&A linked? Do investment banks have to have both?

answer

A lot of underwriting happens in the context of M&A. It is not necessary to have both. There are very prominent M&A

advisors that are not underwriters, such as Lazard and Rothschild.

question
Look at the Thomson Financial League tables on the Web (http://www.thomsonreuters.com/). Who are the top debt underwriters, top equity underwriters, and top M&A advisors this year?

answer
The answer will depend upon when the student completes this question. However, as of mid-2008, the top three U.S. debt underwriters were, respectively: J.P. Morgan, Deutsche Bank, and Citi. The top three U.S. equity underwriters were, respectively, Citi, Lehman Brothers, and J.P. Morgan. The top three U.S. M&A advisors were, respectively: Goldman Sachs, Citi, and J.P. Morgan.

question
In the context of all takeovers, are hostile takeovers rare?

answer
Yes, hostile takeovers are fairly rare. Since 1990, about 1% of all publicly traded firms are taken over in a hostile manner.

question
How are the interests of investment banks different from those of their clients (investors and firms)?

answer
Investment bankers like transaction volume and fees, not value creation for their clients. The latter matters primarily to the extent that it helps the former. An investment banker who continually costs its clients money will eventually lose many. For investors, investment bankers are often interested merely in selling securities, regardless of whether they are good or bad investments. For firms, investment bankers are often interested in restructuring, whether it makes sense or not. Furthermore, investment banks sometimes structure issues in a way that makes it hard for firms to value what they are giving away.

question
What is the main institutional difference between equity issues by regulated utilities firms and equity issues by nonregulated ordinary firms? Which of these two types of firms seems to raise capital at a cheaper rate?

answer
Utilities firms have to engage in competitive bidding to award issuing contracts. They cannot do it via personal relationship (i.e., negotiated) bidding. The utilities firms seem to enjoy lower issuing costs.

question
Do competitive bids for underwriting services end up cheaper or more expensive than noncompetitive bids? Which one is more prevalent and why?

answer
Non-competitive bids are more prevalent among ordinary firms, even though they are more expensive. The reasons why this could be the case, both conflicted and non-conflicted reasons, are described in the text: Utilities firms could be intrinsically different, the more expensive investment banks may provide better services, underwriters may be selected because of personal reasons, and underwriters may effectively bribe management.

question
A firm wants to raise $500 million. Compare the costs of issuing $500 million in convertible equity versus those of issuing $250 million in speculative-grade debt and $250 million in seasoned equity.

answer
Look at Figure 25.4. The $500 million convertible should cost a little under 3% in spread ($15 million). The $250 million ($11.25 million) equity issue should cost around 4.5%; the $250 million junk issue should cost about 1.5% ($3.75 million). The cost of the two is just about the same.

question
Look up the debt ratings for Goldman Sachs. Is all its debt ranked identically?

answer
The answer will depend upon when students complete this question. However, you can likely find Goldman's debt ratings on its website: Go to "Our Firm", then "Investors", and then "Creditor Information". You will find that all of its debt is not ranked identically. As of June 2008, all of its debt (with the exception of Cogentrix Energy) was investment grade.

question
Search the financial websites to determine what the biggest three acquisitions in the last 12 months were. Can you describe each deal in a page or less? Where does the value come from?

answer
The question will depend upon when the student completes this question.

question
Research Cerberus Capital's portfolio companies on the Web. When did Cerberus take these companies over? Did interest rates seem to have had an effect on Cerberus's takeover activities?

answer

Some of Cerberus's notable takeovers include ANC Rental (owner of National and Alamo car rentals) in 2003, Bushmaster Firearms in 2006, television station group Four Points Media Group in 2007, Albertson's Inc. grocery stores in 2007, a controlling stake in GMAC financial services in 2007, and so on. Perhaps its most notable takeover is that of automaker Chrysler in 2007. It seems as though Cerberus's major takeover activities have occurred when interest rates were low.

question

What are the main sources of value generation in most mergers and acquisitions? Are all of them in the interest of society as a whole?

answer

This is a repeat of a Solve Now! question. Sources of value in M&A are synergies, shutdown efficiencies, expropriation, tax benefits, and corporate governance. Not all are in the interest of society—expropriation and tax reduction, in particular, could help the firm, but not society as a whole.

question

What sources of value in an acquisition are strongest in leveraged buyouts? Is this different from ordinary acquisitions?

answer

Leveraged buyouts increase leverage dramatically. This tends to bring corporate income tax benefits and better governance benefits.

question

On average, do acquiring or target shareholders gain more from the acquisition? On average, does acquiring or target management gain more from an acquisition?

answer

The target shareholders do better than the acquiring shareholders. The target management usually does better than the target management (absent and side payment to the target management's personal offers).

question

What has been the most effective antitakeover device? Explain how it works, and why it works so well. What does a raider have to do to take over a company that has deployed this device?

answer

By far, the most effective antitakeover device has been a staggered board. With a staggered board, only one-third of the existing board can be replaced at the annual shareholder

meeting. This means that the existing board will still be in control of the company for at least one more year. The potential raider could wage a proxy contest or set forth a shareholder proposal to fight back against a staggered board.

question
Is a golden parachute always/never in the interest of shareholders? Explain.

answer
A golden parachute can make a manager more eager to allow someone else to acquire the firm, which is in the interest of the shareholders. However, too big a golden parachute could harm the shareholders because it may prevent the deal from taking place.

question
Is there a moral dilemma when it comes to golden parachutes? Do long-standing workers who lose their jobs also deserve and receive golden parachutes?

answer
A golden parachute also smells wrong—after all, management is supposed to act in the interest of the firm without extra bribes. Workers tend not to get much compensation in a takeover if they are fired, even though they may deserve it just as much as management does.

question
When one firm acquires another, what form of payment do the shareholders of the target firm usually receive?

answer
The stockholders usually receive a cash offer or a stock offer. The empirical evidence suggests that $1/3$ of the deals were "all cash;" $1/3$ were "all stock';' and $1/3$ were mixed.

Chapter 26

Corporate Governance

you want to do business with a company? better vote in favor of management...

intro

Agency Conflicts Galore

For the most part, we have assumed that managers act on behalf of owners and maximize firm value. This fits conveniently into a perfect-market perspective, but there are situations in which this is not a good representation of reality. Like everyone else, managers are self-interested. This causes conflicts of interest, some of which were already covered in Chapters **??** and **??**. But we now drill deeper into the specific conflict between corporate investors (the "owners," usually shareholders and sometimes also the creditors) and those in day-to-day control of the company (the corporate board and the corporate managers).

26.A What is Governance?

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You already know the theory: Debt should be paid first, equity should receive the residual, and managers should be compensated according to their marginal contribution to the value of the firm. But we have not yet asked the simplest of all questions: Why do managers in charge return any money to investors? After all, what do investors contribute after the corporation has their money? What harm would come to the managers if they simply ignored investors? Outside the United States, large shareholders often control the firm. In such cases, why do they allow the firm to return any money to small shareholders? x

These questions fall into the domain of **corporate governance**, which concerns itself with the conflict of interest between those who control the corporation and

those who provide the capital and thus own it. James Madison's words are as applicable to firms today as they were to governments in the eighteenth century:

> If men were angels, no government would be necessary. If angels were to govern men, neither external nor internal controls would be necessary. In framing a government which is to be administered by men over men, the great difficulty lies in this: You must first enable the government to control the governed; and in the next place oblige it to control itself.

x

It is also important for you to understand what corporate governance is not—it is not good management. Instead, governance is the set of mechanisms that can discipline management if it wanted to become bad. If the sanctions are strong enough or if management is good enough, then governance sanctions may never have to spring into action. Of course, controls are never free. Better governance has its cost. Remarkably, many good managers—even those who are intent on, and good at, maximizing firm value—argue reflexively and publicly against tougher governance controls. They do not point out that governance is costly (which is a good argument); rather, they argue that they are good at what they are doing and that the very presence of controls would damage their integrity (which is not a good argument). Perhaps they believe themselves to be angels—but even if they are (and many are), their successors may not be!

x

A great example of the difference between good management and bad governance is Apple. There is no question that Steve Jobs, the mercurial CEO of Apple, almost single-handedly transformed Apple from a moribund computer manufacturer into the world's most valuable technology firm. Jobs was the best corporate manager any firm could have had. However, Apple had very little effective corporate governance—Steve Jobs was practically King of Apple. This did not manifest itself in excessive pay. On the contrary—from 2007 to 2010, Jobs' salary was $1/year and he was not awarded any new shares. (He owned more than 5 million Apple shares, worth around $2 billion, and Apple reimbursed him for expenses.) Although the absence of effective corporate governance was not a problem with Jobs at the helm, now that he has died, it could become a big problem if his successors, perhaps less competent and more greedy, will have such a degree of control.

26.B Separation of Ownership and Control

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A **conflict of interest** is a situation in which different parties have competing interests. Most companies start out with few such conflicts—if only because the

entrepreneur owns the entire firm, provides most capital, works alone, and makes all decisions. (One cannot be self-conflicted in our sense.) Eventually, the founder's personal role begins to fade. Management becomes more and more "professional" in the sense that it becomes a contracted resource. Unfortunately, professional managers bring with them not only novel qualifications and specialization benefits but also new problems. They are only **agents** who have a position of trust that requires them to act on behalf of the owners. Yet, like everyone else, they want to maximize their own wealth, not necessarily the wealth of the owner. This is called an **agency problem** or a **principal-agent problem**. (The entrepreneur is the firm's **principal**.) It is in the principal's self-interest to oversee management. x

Eventually, most entrepreneurs want to raise more funds to expand operations or enjoy the riches. This usually happens in the form of debt. Eventually, they also get older and are no longer able to run the firm and control managers. Thus, many owners sell shares to external investors, who share the principal's role with the entrepreneur. Together, the principals appoint a corporate board, which is supposed to coordinate the desires of shareholders, especially vis-à-vis managers. X Over time, in many firms, external shareholders become the majority owners of the firm. x

Unfortunately, as the separation between those who provide capital, those who oversee management, and those who manage the firm itself grows over time, so do the conflict-of-interest problems. Multitudes of shareholders are just not capable of constantly voting and communicating their desires to their agent-managers, much less checking over what their managers are doing day to day. The same may apply to multitudes of different creditors—and creditors and shareholders may not always see eye to eye, either. Managers are quite aware of this situation, too. x

Even if managers are purely altruistic, it may not always be easy for them to act based on one entrepreneur's wishes. It may be outright impossible for them to act based on the interests of many different shareholders. The reason is that conflicts of interest can develop not just between owners and managers, but also among owners themselves. Even two or three co-owners can squabble, but when there are thousands of shareholders, as in a publicly traded company, the coordination problems take on an entirely new dimension. Fortunately, even if they agree on little else, most investors agree that they prefer more money to less money. Thus, maximizing their investors' wealth is the marching order for management in most publicly traded corporations in the United States. Outside the United States, this is usually true, too, although in some European countries, managers are also legally obliged to look after the interests of employees and other stakeholders of the firm. x

In general, the conflict between managers and shareholders looms as the most important governance problem in the United States. Shareholders of all types and sizes are typically in the same boat. Outside the United States, the

voting rights in many firms are held in a way that gives one or just a few large shareholders a lot of influence. In these cases, large shareholders often control the managers—or become the managers themselves. In turn, this means that the conflict between investors and managers turns primarily into a conflict between the large investors—in control of the corporate board and management—and other smaller investors.

Control Rights and Corporate Design

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Let's start at the beginning. When an entrepreneur needs to raise more outside capital, he wants to do so at terms that leave him well off. If you recall Chapters **??** X and **??**, you learned why it is ultimately the entrepreneur who bears the price of a bad capital structure. In a competitive market, new investors have many other opportunities. To attract them, the entrepreneur's price must be appropriate, given whatever structure he sets into place. This applies not only to the capital structure—where a better debt/equity ratio allows the entrepreneur to sell the firm for a higher price—but also to a better governance structure. Simply put, if an entrepreneur designs a firm in which he (or his managers) can later steal all of the external investors' money, no investors would want to provide capital in the first place. Ultimately, this would leave the entrepreneur worse off.

> **important**
> Investors provide capital at more favorable terms if they are better protected against future mishaps. Consequently, the entrepreneur selling shares in the firm today ultimately internalizes any potential future failures caused by an inadequate corporate design today. And, thus, to raise money on good terms in the first place, entrepreneurs want to design their firms and their firms' governance structures so that investors will be protected.

x

To be able to induce investors to part with their cash, the entrepreneur must create a corporate charter and install safeguards that satisfy potential investors, legal requirements, and common practice. Solemn promises alone of both corporate value maximization and eventual profit participation are simply not enough. So, how will investors be able to coerce the agents—appointed by the entrepreneur (first, the entrepreneur himself, later the corporate board and management)—to honor their promises? The answer is that entrepreneurs can give investors power by granting them [pl]control right. It is these control rights that later allow investors to get their due. Again, it is in the interest of entrepreneur-owners to grant new investors strong control rights, because these rights improve the terms under X which they can obtain capital in the first place.
x

You already know that debt and equity are different in terms of their [pl]cash flow right. (Debt has first dibs on the promised payments; equity owns the residual.) Their control rights are very different, too:

Equity: Shareholders are (usually) the nominal owners of the firm. Their primary power is their ability to vote and appoint the **corporate board**, usually once a year during the annual meeting. During the year, the corporate board is an agent that is supposed to act on behalf of the firm's owners, which are the principals in economic terms. (Legally, it is the board that is the principal of the corporation.) Most importantly, the board has the power to hire and fire managers.

Debt: Creditors enjoy the right to demand performance and payments on terms specified when the debt is originally extended. The bond contract not only specifies how much the firm obligates itself to repay in the future, but also specifies the immediate legal remedy if the lender fails to pay or fails to meet any number of prespecified covenants. This often means that the lender receives possession of the firm or specific collateral to satisfy her claims—(almost) no ifs, ands, or buts.

x

A firm that has no independent corporate board control may not find investors willing to purchase equity shares. A firm in which a large shareholder can influence the firm to "tunnel" assets from the public corporation into her private pockets may not find minority shareholders willing to contribute capital. A firm that does not give creditors the right to force bankruptcy upon default may not find any creditors willing to lend money. x

But control rights are not all black-and-white. If the firm does not offer perfect protection to its capital providers, it may still be able to obtain capital. However, this would be on worse terms that would require the surrender of a higher percentage of the firm's shares or the payment of a higher interest rate. In real life, control rights are never perfect. It would be impractical to protect capital providers perfectly, because the cost of preventing all managerial opportunism would be prohibitive. It would not maximize firm value if the firm spent $10 in audits to prevent $1 in fraud. Thus, by necessity, corporations and capital providers must live with [pl]second-best outcome, in which there is a constant tension between investor protection and managerial self-enrichment. x

The rest of this section explains why governance incentives and mechanisms are strong when entrepreneurs first want to raise external capital. Briefly, their desire to raise capital is the most important reason why they want good corporate governance. But it also explains when corporate governance is likely to weaken or break down:

1. It can break down after the entrepreneur has already received the funds and finds a loophole to wiggle out of his obligations to external capital providers. Of course, if an entrepreneur still needs to sell a lot of shares, treating existing investors badly will not make it easy to attract new ones.

2. As decades go by and firms grow, professional management eventually wrests more and more control from owners. Managers' desire to obtain reasonable costs of capital may no longer be enough to restrain their self-interests. After all, once they have taken control, they may care more for themselves than for the wealth of the owners. In this case, they may not even care if they have to give away a larger fraction of the firm from the pockets of the existing shareholders in order to get control of more money (from new shareholders).

3. Older companies often have enough projects generating cash so that they may not even need to tap the capital markets any longer. If shareholders cannot effectively challenge managerial control, managers could simply spend this internal cash on themselves rather than return it to their shareholders.

The last two points suggest that managers in old firms are no longer constrained by their needs to raise capital at advantageous rates (as was the case for the entrepreneur). Thus, any limits to what managers will do most likely would have to come from their desire not to lose control.

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question
What are the main control rights of debt and equity?

answer
For debt, the main control right is the right to force bankruptcy if covenants are violated or payments are not made. For equity, the main control right is the right to elect the corporate board at the annual meeting.

The Entrepreneur's Original Incentives

x

Let's assume you are the owner of an invention that requires a $25 million investment. If undertaken, its present value is $100 million. If you could borrow or had $25 million in cash, you would not need to raise any external funds and have to deal with any governance issues. Your net project wealth contribution would be

x

$75 million.

Governance comes into play only if you have some good reason to raise external money. In our example, we assume that if you cannot sell shares to raise the money to start the project, then you cannot undertake the project and you have nothing. Consequently, you can enjoy large gains only if you can find investors. This is why companies go public to begin with: The gains from diversification for the owner and the provision of external capital outweigh the costs of agency conflicts. Now let's consider different scenarios:

- What if your investors believe that you will not act opportunistically? In this case, they would be satisfied with your promise of 25% of the company (worth \$25 million), leaving you with 75%, worth \$75 million.
- What if your investors believe that your incentives will change the moment that you have their money? For example, you could pay yourself an excessive executive salary of \$30 million. Let's call this theft, even if it is not so in the legal, criminal sense. Assume you cannot restrain yourself from stealing this \$30 million. Actually, this is still not a problem. Potential investors now believe the firm's value is \$70 million. They would part with \$25 million in exchange for $\$25/\$70 \approx 35.7\%$ of the firm. You would keep 64.3% of the firm. In total, you would have 64.3% of \$70 million (\$45 million), plus the \$30 million you would have "stolen" in salary. You would still end up with the full \$75 million.
- What if you will have to waste an additional \$10 million when the time comes to hide your \$30 million of theft? For example, you may have to hire expensive compensation consultants, spend your time "engineering" your corporate board instead of finding good projects, and perhaps even change the firm's projects to make you indispensable. Would your outside investors still be satisfied with a 35.7% stake in the company for their \$25 million investment? No! Again, they expect you to steal the money when the time comes. But now they value the company only at $\$100 - \$30 - \$10 = \$60$ million. Raising \$25 million requires you to part with $\$25/\$60 \approx 41.7\%$ of your company now, not 35.7%. Unfortunately, your net worth is now only $58.3\% \cdot \$60 \approx \$35$ million, which you will own in stock, plus the \$30 million that you can steal. This \$65 million is \$10 million less than what you could have gotten if you could have committed yourself not to steal in the future. The lesson is that it is you who must carry the full brunt of your inability to commit yourself not to steal. You have effectively "internalized" the \$10 million in waste.

  The same argument applies to any managerial agency problems other than theft—the more you can limit future agency costs, the more your firm is

worth today. To the extent that you cannot fully restrain yourself from destroying value in the future, you are worth less than $75 million today. Nevertheless, you may not have another alternative. You may just have to grin and bear it. You are still better off taking money from investors at unfavorable terms (41.7% for $25 million, leaving you with $65 million) than you would be with $0 if you could not raise any external funding.

x

- What if your project's duration exceeds your lifetime and you must hand the firm to professional managers (who will also waste the $10 million in pursuit of higher compensation)? In this case, the $30 million in excessive compensation will go to them. Your 58.3% remaining stake will still only be worth $35 million. In a perfect market, you could charge the new management $30 million for the right to run the firm. Unfortunately, in the real and imperfect market, this may not be possible. If you can charge your management successors only $10 million in reduced future salary and they keep the right to expropriate $30 million, then you would own $58.3\% \cdot \$60 + \$10 \approx \$45$ million—even less than the $65 million worked out above.

x

- What if you can steal more than $75 million from the $100 million project in the future? Assuming you cannot borrow and you cannot sell more than 100% of the firm, then no investor would give you the $25 million in the first place. In this worst case, you would not be able to take the project, and would lose it all.

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In sum, if corporate governance is costless and (thus) perfect, you are in a **first-best outcome** in which you have instituted perfect corporate governance. You are worse off if you cannot commit yourself to avoid future wasteful conflicts of interest. You may be even worse off if you cannot commit your firm's future managers to prevent future wasteful conflicts of interest. And you may be worst off if you cannot raise the funds to be able to take the project. The main insight from this example is that, from the perspective of a 100% owner-entrepreneur, the better you control all future agency conflicts, the more you are worth today.

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question

Reconsider the example in which you have to waste $10 million in order to get $30 million in loot. External shareholders receive 41.7% of the firm in exchange for $25 million in funding. Would it be in your interest after the fact (ex-post) to avoid the $10 million deadweight loss and thus forego the $30 million in theft, if your investors do not fully trust you?

answer

It would not be in your interest to avoid wasting the $10 million. If

you did not try to steal the $30 million, you would own 58.3% of $100 million, that is, $58.3 million. This is less than the $65 million that you receive if you proceeded with the loot-and-waste plan.

question

When are the incentives to control agency conflict strongest? Why? Can you give a numerical example?

answer

The incentives to control agency conflicts are strongest around the time the firm goes public. The entrepreneur internalizes all future agency conflicts. To the extent that money will be diverted from owners in the future, these owners will be willing to pay less for the firm today. For a numerical example, see the text.

Costs versus Benefits of the Entrepreneur's Control Incentives

To what extent would 100% owner-entrepreneurs write contracts up front (ex-ante) in the real world to control all possible future agency conflicts? There are definitely some limiting factors:

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1. **Ex-ante cost of governance:** You can use our example to think about the role of the costs of control. If it costs $1 million to commit yourself not to steal and you thereby avoid wasting $10 million, you should pay for it. Your net wealth would be $74 million—less than the $75 million that you could have if governance were free but more than the $65 million that you could have if you could not commit yourself. On the other hand, if the control were to cost $12 million, you may as well live with the theft and the waste of $10 million.

   In the real world, you would prevent only some conflicts of interest. As a practicing economist, you know that you should balance the marginal cost of each control against its marginal benefit. Your new investors would demand more shares to compensate them for those agency conflicts that you have not prevented.

x

   In the extreme, it could even be infinitely expensive to institute control. It may be impossible to write contracts for all future contingencies that prevent you from enriching yourself, especially insofar as future managerial schemes are concerned—the human mind can be very creative. Indeed, the typical firm charter does not even try to account for all future contingencies—most are simple boilerplate. Worse, many agency control clauses could even end

up being counterproductive if they rob the firm of flexibility that managers could use to increase the firm's value under unforeseen circumstances in the future.

One alternative to detailed formal governance provisions and clauses, which prescribe what managers can and cannot do, is to rely on laws or mechanisms that do not specify a lot of details but allow shareholders to regain control if management gets really bad. Of course, once in charge, managers would have all the incentives to try to eliminate these mechanisms.

x

2. **Ex-ante magnitudes of far-away conflicts:** Even if you can write perfect preventative contracts, your incentive to do so may sometimes be surprisingly modest. In particular, few companies are designed at the outset for greatness in the far future. When Walt Disney designed the corporate charter of Disney in 1957, he probably did not do so with an eye toward Disney managers in the twenty-first century. Indeed, most companies that go public will never face any large agency problems—most will simply end up acquired or bankrupt!

   How important is it for the entrepreneur to prevent agency conflicts in the distant future? A quick back-of-the-envelope calculation may help you see that it cannot be too important. Assume that only 1 out of 100 firms becomes large enough to indulge significant agency conflict of, say, 0.5% of firm value. This 0.5% of a $100 billion company is $500 million (say, a 10% perpetuity of $50 million a year in excessive managerial compensation, theft, or mismanagement). However, from the original entrepreneur's perspective, in ex-ante terms, this imperfect control represents only a cost of $1/100 \cdot 0.5\% \approx 0.005\%$ of the firm's net worth.

   This argument has assumed that investors are perfectly rational and would be willing to pay the entrepreneur this 0.005% more if the contract is designed to prevent bad behavior. More likely, entrepreneurs would not even capture this 0.005% by writing anticipatory contracts. Would real-world investors fully understand better corporate governance controls and be willing to pay for them? How many investors would have paid Walt Disney more money for their shares in the year 1957 if he had put better incentives into place for the year 2000? Even the most sophisticated investors may not have bothered to understand fully the far-off repercussions. If anything, with detailed covenants and controls that go far beyond the ordinary, investors may even think they "smell a rat" (wondering whether they should infer something about the entrepreneur's character and designs) and demand more, not less, compensation.

question
What limits are there to writing a corporate charter that eliminates future agency conflicts?

answer
The following are limits to how charters can eliminate all future agency conflicts: First, there is the cost of eliminating future conflict. It may even be impossible (infinitely costly): Who can think of all future contingencies that could happen and that should be considered in the charter? Second, reasonable entrepreneurs care primarily about agency conflicts soon after the IPO and pretty much ignore what may happen many decades later. The magnitude of far-away conflicts, in the unlikely case that the firm will still exist, is just too small for them to bother with.

Do Future Capital Needs Protect Shareholders?

Our focus so far has been about agency controls when a 100% owner first raises capital. This has created the incentive for the entrepreneur to protect investors. It was in his interest (even if only mildly so). But does the need to raise capital protect the current shareholders after the firm is already public?

Unfortunately, no. In fact, quite the opposite can happen. Let me demonstrate. Revise our scenario by assuming that the entrepreneur is no longer both the decision maker and the sole shareholder. Instead, assume the opposite for a $60 million firm: You are the manager firmly in charge and are the one benefitting from agency conflicts, but you own zero shares. Let's say you now come across a project that costs $50 million, which produces cash flows of $30 million in shareholder value plus $10 million in perks for you. (Actually, the example would also work with $10 in perks.) Would you raise $50 million in capital to fund this miserable project?

Without the new project, the firm is worth $60 million. If you raise funds and take the new project, shareholders will own a claim on a $90 million firm—$30 million of new project plus $60 million of old project. To raise $50 million in capital requires issuing them shares worth $\$50/\$90 \approx 55.6\%$ of the company. These shares are sold into the market at the appropriate price, and new shareholders always pay only the fair price. However, your previous shareholders now own only $1-55.6\% \approx 44.4\%$ of the company for a net of $44.4\% \cdot \$90 \approx \$40$ million in the new firm, down from $60 million. In effect, your $10 million in perks is paid for with $20 million from your existing shareholders. This example may even understate the problem. In fact, fearing similar expropriation in the future, the

new shareholders may demand even more than 55.6% of the company—and you have the incentive to give your new shareholders even larger stakes in order to x get your $10 million of perks.

In sum, the need to raise capital is not a guarantee that the management of a publicly traded corporation will want to control agency problems. On the contrary, raising capital can become yet another mechanism that helps managers extract shareholder wealth for themselves. Old capital in effect allows new capital to be raised and thereby allows managers to expand the firm again and again. Even if managerial theft has reduced the value of $10 million of old equity into just $1 million now, managers might still want to raise another $1 million in capital for their personal consumption by promising 51% of the new firm, leaving old x shareholders with only $490,000.

This behavior is not as far-fetched as you might think. There are some fairly prominent companies that have grown tremendously and yet have not delivered for their shareholders. For example, firm growth (in terms of market capitalization) and stock price performance for four such companies were as follows:

Company	From/To	Growth (in billions)	Shareholders' Rate of Return
Rite-Aid	1987-2007	from $1.486 to $2.218	–59%
Reebok	1989-2007	from $0.003 to $3.722	–50%
AOL (Time-Warner)	1999-2007	from $1.163 to $2.962	–59%
Del Monte	1999-2007	from $0.644 to $1.898	–21%

Of course, growth that results in poor performance could also have been an accident, although it would not change the fact that managers would not have x ended up as badly as their shareholders.

If you now think that having management own a large share of the company (like an entrepreneur holding 100% of the company) reduces this problem, you are right and wrong. You are right because a larger share indeed mitigates managers' desire to waste funds. You are wrong because it creates a novel problem that could be just as bad or even worse: It could create a situation in which other shareholders are even less likely to ever wrest control of the firm away from misbehaving management. This is effectively the situation in many foreign countries, in which X a large external shareholder is solidly in charge of the firm. Such shareholders can then use this control to siphon funds from the firm into their own pockets.

important
The theory suggests the following:

- The firm's incentives to control conflicts of interest are probably strong at the outset. The need to raise capital at favorable terms protects shareholders early on.
- As the firm gets older, corporate control generally deteriorates. The need to raise capital loses its power as a managerial-control device. Managers become restrained primarily by their desires not to lose this control.

The empirical evidence generally supports these predictions. We rarely hear of governance breakdowns in young firms that have strapped cash flows and that still have large shareholders with a control influence that is separate from those of management.

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question

Assume that the CEO is firmly in charge of a $100 million firm. The CEO finds a new project that costs $30 million and returns $25 million next year. The CEO can only raise equity to fund this project.

1. Is it possible that the CEO wants to take such a project?
2. If the CEO does take this project, what will happen to the voting power of the existing shareholders?
3. Would existing shareholders be better off if the CEO were to finance this new project with debt instead of equity?
4. Does the need to raise equity always impose a "capital market discipline" on the CEO?
5. Under what circumstances could the need to raise equity impose a "capital market discipline" on the CEO?

answer

For the $100 million firm with the $30 million project that will return $25 million:

1. Yes, it is possible that the CEO wants to take this project if she gets personal control benefits.
2. The voting power of existing shareholders will go down. They will no longer hold 100%. New shareholders will demand $\$25/[\$125/(1+r)]$, leaving old shareholders with $1-\$25/[\$125/(1+r)]$ of the firm's shares. (This assumes that the new shareholders do not believe something like this will happen to them later, too. If they do, old shareholders are even worse off.)
3. No. Equity holders would still bear the brunt if the CEO took a bad project. It would still be the existing equity that would pay for the folly of this project. New creditors would simply get a fair value. In the end, it is not the process of raising external equity that destroys value, but the taking of negative-NPV projects.

4. No, raising equity does not always impose market discipline that controls management, as this example shows.
5. If the CEO is not fully entrenched, the need to execute such bad transactions may induce the board or an external raider to come into action and get rid of the CEO. This is especially likely if the project is very bad and the capital markets are not willing to provide favorable financing terms. Alternatively, if the CEO owns a large stake in the firm (effectively making her equivalent to the entrepreneur in our examples), the CEO may not want to take projects that have a negative value impact on her existing ownership stake.

26.C Managerial Temptations

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Although the legal fiction is that managers act solely on behalf of the firm and that shareholders own the firm after creditors are paid off, the fact is that all parties act primarily in their own interests. But exactly how do managers enrich themselves? Unfortunately, there is a whole battery of tactics managers can employ to enrich themselves at the expense of shareholders, and to understand governance, you need to know what they are. Don't believe that such behavior is necessarily common in the real world—the point is to recognize the possibilities. We will then discuss the institutions and mechanisms that seek to restrain much of it.

Illegal Temptations

Let's first consider some criminal acts, in order of their complexity, starting with the simplest.

Theft

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The simplest method is theft. For example, in April 2004, 58-year-old C. Gregory Earls, head of an investment company called USV Partners, was convicted for simply funneling investor money into a trust fund for his children. What prevents corporate managers from taking corporate diamonds out of the corporate safe? For the most part, it is the law, which criminalizes simple theft. Therefore, such behavior is fairly rare. (Mr. Earls could compete for a Darwin prize for the "dumbest criminal"—it is hard to leave a paper trail any clearer than his.)

Fraud

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The next step up is fraud. It is more complex and therefore more difficult to detect and prove. For example, in 2003, Hop-on Wireless claimed to sell disposable

cell phones. It turns out that the prototypes were Nokia phones with plastic cases around them. The CEO raised funding, promising not to take a salary—but promptly used the funds to pay off his credit card debts (see theft above) and gave a company he owned a $500,000 contract (see transfer payments below). x

Usually, fraud involves manipulation of financials. Unlike Hop-on's extreme case, many accounting choices are not so black-and-white—the line between illegal accounting manipulation and legal earnings management can be more of a gray spectrum. Corporate executives have to make many judgment calls. For example, X there is empirical evidence that legal corporate earnings management is particularly aggressive just before the corporation issues more equity, for obvious reasons (and also that firms that are more aggressive in their accounting perform worse later on). Even conservatism may or may not be in the interest of existing owners. Painting too bleak a picture may make the business collapse. And what prevents rosy picture painting? Again, it is mostly the law and regulations. GAAP and SEC scrutiny limit the discretion of managers to legally manipulate the financials. And X again, there are criminal penalties against fraud.

Insider Trading

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One more step up—and a surprisingly common form of agency conflict—is insider trading. For example, a well-publicized insider trading scandal in late 2001 X involved Sam Waksal, CEO of ImClone (IMCL). Waksal received advance bad news about clinical tests of an ImClone cancer drug and proceeded to tip off his family and friends (including Martha Stewart) that they should immediately sell their shares. (Waksal began serving his 7-year prison term in 2003. Martha Stewart followed in September 2004.) x

Like earnings management, insider trading can be either legal or illegal—and again, there is a wide gray spectrum. Managers almost always have more information than shareholders. They would love to trade on it before the public learns of it, and naturally, this would not make other shareholders better off. Yet it would be unwise to prohibit all insider trading, because insiders do need to be able to sell and buy shares just like the rest of us, if only to diversify some of their wealth. Formally, it is illegal for them to trade on information that is not yet public. In real life, illegal trading is only easy to prove if the situation entails an impending news release. (It is surprising how someone as smart as Waksal could have made such a big mistake, because his illegal trades were so easy to detect and prove.) More often, the information that executives have is "soft." The empirical evidence shows that they indeed do well in their private, legal insider trading. They generally tend to buy before the firm gets better and sell before the firm gets worse.

Tunneling

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The next step up in criminal acts is yet more difficult to detect and prove. Since the 1990s, the colloquial (and also academic) name for transfers of assets from the corporation to an insider (such as to management or to a large or controlling stakeholder) is **tunneling**. The idea is that the insiders of a public company can own other private companies that do business with the public company on very favorable terms. As long as the tunneling is not excessive and the corporate board is informed and has consented, it is very difficult to prove. It is only occasionally that the terms become so egregiously favorable that they warrant criminal indictment. This was the case, for example, for Andrew Fastow, former CFO of Enron. On May 1, 2003, the U.S. Department of Justice alleged that "in 1997, Fastow conspired with others, including his wife, to create an [entity owned by the Fastows] in order to reap for themselves the profits generated by certain Enron wind farms, while simultaneously enabling Enron to fraudulently receive government financial benefits to which it was not entitled." Naturally, the smarter the manager, the more complex the tunneling arrangements, so that the true costs and true benefits to the public company are more difficult to assess. Again, criminal prosecution of such schemes is fairly rare, especially if the corporate executive has followed legal procedures to the letter. Note that tunneling must not necessarily be to the manager himself. It can also be made to "friends" of management or to large

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shareholders, who then owe more loyalty to the CEO. The ambiguous role of large shareholders in corporate governance will be explained in Section 26.F.

anecdote

The PBS series Frontline episode "The Wall Street Fix" (http://www.pbs.org) illuminates many of the conflicts of interest between ordinary shareholders and larger stakeholders. It details how Jack Grubman, star analyst for the investment bank of Salomon Smith Barney, hyped WorldCom in 2000 to its brokerage's small retail investors. At the same time, the CEO of WorldCom, Bernie Ebbers, held a personal $1 billion mortgage from Travelers. Both SSB and Travelers are owned by Citigroup. Ebbers' wealth (and therefore his $1 billion mortgage) was closely tied to the WorldCom stock value. (In 2005, Ebbers was convicted of corporate fraud.)

In a display of less-than-extraordinary courage, after the indictment of Citigroup for a variety of such questionable activities, the Citigroup board voted its full support and confidence in its CEO, Sandy Weill. Business Week was not so generous: In January 2003, it ranked Sandy Weill as the worst manager in America.

Bribes

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Yet another way for executives to get rich at the expense of shareholders, and again one step more difficult to detect, is that of bribes. Managers of publicly

traded companies need not even solicit them: They practically come to them. For example, during the 1998-2000 technology bubble, receiving IPO share allocations was almost like getting free money. (Normal first-day rates of return were around X
50%. Ordinary brokerage clients would rarely receive any allocations.) In one infamous example, Citigroup was eager to do investment-banking business with WorldCom, a publicly traded telecom company. Citigroup allocated $17 million in 21 offerings into WorldCom CEO Bernie Ebbers's personal account. In one IPO (Rhythms Net Connections) alone, Ebbers was allegedly handed $16 million. X
Ebbers was in effect "courted" to direct the business of the shareholders of the publicly traded company WorldCom to Citigroup. (If he had not been conflicted, he could have solicited the shares on WorldCom's behalf instead.) x

Preferential allocations to, and treatment of, executives' personal accounts have been, and continue to be, common practice. Ebbers was an extreme case, but not a rare one. Lesser methods of bribing executives are so commonplace that they are considered almost ordinary. For example, there is evidence that competitive bids for high-level professional services (such as the hiring of a search firm or the placement of a bond or equity issue) usually result in better contract terms than negotiated contracts for the firm—and yet most companies negotiate rather than bid out contracts. Although negotiation can be better for other reasons, more X
commonly the reason lies elsewhere: Executives of smaller firms naturally want to be on the candidacy list to become executives of bigger companies. It is therefore in their interests to form good relationships with investment banks and executive search firms. An executive who uses competitive bids, which minimize the profits of the professional service firms, and who constantly switches from one low bidder to the next, is unlikely to build much loyalty and subsequent quid pro quo support.

Legal Temptations

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If you now have the impression that fraud, theft, insider trading, tunneling, and bribes are the most important agency conflicts between shareholders and managers, then you are wrong. The most important conflicts arise in the day-to-day execution of business and are of a type in which managerial misbehavior is not illegal. Even more so, there are many decisions that are judgment calls and not even outright unethical—few CEOs actively seek out behavior that is obviously unethical, and almost none seek out behavior that is obviously illegal or criminal. Simply put, many executives are really the "good guys" and want to be seen as such. x

You have already encountered a number of legal temptations. For example, in Section **??**, you learned that managers like capital structures that are biased X
toward equity, because this reduces the pressure for them to perform and the likelihood of going bankrupt or being fired. It also makes it easier for them to take

over other firms. Let's look at common agency conflicts that are not illegal and arise in the ordinary course of business.

Misallocation of Resources and Empire Building

Many academics believe that the highest agency costs in American companies today (in terms of expected costs to shareholders) have to do with the failure to direct corporate assets toward the activities that maximize shareholder wealth. These agency costs are particularly high for firms that have lots of cash and cash flow (e.g., from prior profitable activities) but few good new growth opportunities. Thus, it is no accident that I am first listing the sin of **empire building**—the tendency to acquire greater resources.

Most managers see it as their natural task to grow, or at least prevent the shrinking of, the firm's business. Unfortunately, corporate growth is not necessarily shareholder value–maximizing. For example, many airlines have been notorious money sinks for investors for decades. Every time an airline has enjoyed a brief spike in profitability, its three unions (pilots, flight attendants, and mechanics) have negotiated higher pay packages that quickly eliminated the profits. For years, these airlines have stumbled from one calamity to the next. The shareholders of many big airlines would have been better off if management had just decided to sell off all the airplanes and landing slots, and return the funds to investors. Instead, the typical such airline just ran down all the available funds until there was nothing left worth liquidating.

From the managers' perspective, it may also seem counterintuitive that the best course of action is to sell off assets and return more to shareholders than the normal trickle of cash that the firm pays out in ordinary dividends. Generally, managers believe that they are paid for operating the company well—executing difficult tasks such as handling employees and customers, growing the firm, and acquiring other companies. It must seem odd to a manager that her best actions might be to drastically shrink the firm, sell off the assets, or be taken over by another company. Would selling off the firm's assets not admit personal defeat—that someone else can do better with the assets than the current management?

Note that it is also all too human for managers to convince themselves that what is most in their own interest is also in the best interest of the company. Although the reward for shrinking the firm could well be unemployment, the reward for growing it is running a bigger company. Executives of bigger companies are more prominent, have higher social status, and usually receive more compensation. Some decades ago, this was even explicit: Managerial compensation schemes were often directly tied to sales, not earnings.

These issues apply both to healthy and to dying companies. Dying companies may use up all their assets in futile attempts to rescue failing businesses. Healthy, profitable companies may use their plentiful internal cash to enter new businesses or acquire other firms. Recall from Section 25.F that acquiring shareholders typically do not gain in M&A.

Conflicts: Friendship, Loyalty, and Ethics

Almost all managers are less loyal to an abstract, ever-changing shareholder than they are to what they see as their very real company, with flesh-and-blood employees that they talk to every day. Like all human beings, they become friends with those whom they are working with. Managers prize such loyalty and return the favor. Few managers like to be surrounded by gadflies, naysayers, adversaries, or, much worse, by potential replacements. Critics who argue for reducing executive compensation or for firing existing management are rarely welcome on corporate boards. Natural human tendencies and self-interest promote nepotism (in the broad sense) that is not in the interest of capital providers.

Even managers of the highest ethical integrity often face difficult choices. For example, as a manager, should you feel any loyalty toward employees, customers, and suppliers that used to be, but are no longer, important to shareholders? This includes the town in which your factories are located, the workers who spent their whole lives working for the company, the charitable and worthwhile causes the company contributed to, and so on. Do managers have the right (or perhaps even the moral duty) to donate explicitly or implicitly the shareholders' money, especially when those good causes seem more ethical and worthwhile than the paying of dividends? If you still don't see the problem, consider what you should do if you can make your shareholders richer if you break some contracts that your firm has made in the past. Or if you can sell misleading, inferior, defective, or dangerous products. Is it really your duty to act purely in the interests of shareholders without concern for anything else of moral value?

If not forced, most managers would likely put the interests of diffuse and remote shareholders not only behind their own interests, but also behind the interests of their friends and coworkers. If need be, they can also probably come up with some good excuse as to why, in their executive judgments, it would be in the interests of shareholders to reward their friends and coworkers (and, of course, most of all themselves).

In a sense, strong governance mechanisms that leave managers no choice may even save them from the temptations of harsh moral dilemmas. (Incidentally, this is also the reason why professors like to have no influence over university admissions.)

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Entrenchment

Not surprisingly, managers and employees also like to be indispensable. If they decide to take projects for which they will be indispensable, their own personal value to the firm, and therefore their compensation, will likely go up. If they decide to build redundancy—that is, hire someone who can step in for them, thereby making themselves dispensable—their own value to the firm will likely go down. In fact, they may even be replaced by the board. On the other hand, if they make themselves very difficult to replace, their ability to "hold up" the company will force the company to compensate the managers very generously. The board will have no choice but to retain the executive and will award high compensation packages quite "voluntarily."

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Bureaucracy often helps promote entrenchment. It can discourage shareholder wealth maximization but help managers become indispensable (knowledgeable of the internal processes). It can even lead firms to undertake opaque and bizarre projects, internally justified by "proper procedure." In contrast, fighting bureaucratization on behalf of shareholders is a painful and never-ending process, with few rewards for the executives involved (unless the firm is in such dire straits that the executives fear for their own jobs).

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Corporate Perks

One step higher on the ladder of actions that are nothing but self-interest are expenses on corporate perks. For example, consider a public company that may buy a corporate jet that costs shareholders $100 million and that increases productivity of management by the equivalent of $10 million. This is obviously a bad deal. However, if avoiding public airports and flying in style gives the CEO a lot of extra pleasure—worth, say, the equivalent of $1 million in salary—then he may direct the company to buy the jet anyway. Plush corporate headquarters, fleets of corporate aircraft, and lavish expense accounts are usually "symptoms" of publicly traded companies, especially in slow-growth industries in which firms are flush with cash. Excessive spending on corporate perks is extremely common, but fortunately the amount of money spent on them is usually much less than the amount of money that can be wasted in operational issues, such as futile attempts to build empires.

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Work Incentives and Perverse Incentives

Some economists' models assume that executives prefer working less (called **shirking**). However, others (including myself) believe that lack of work ethics among executives is rarely a problem in the real world. It is not uncommon for many executives to work 80 hours a week.

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In exceedingly rare circumstances, managers can even have the incentive to drive down firm value. They can then negotiate better incentive compensation contracts or even buy the firm, either of which is often followed by seemingly miraculous turnarounds. The most prominent example is that of the attempted X
management buyout of RJR Nabisco by its CEO Ross Johnson. His actions are chronicled in the best-selling book, Barbarians at the Gate.

The Biggest Legal Temptation: Executive Compensation

Naturally, executives are most conflicted when it comes to higher pay for themselves. However, in the United States, there are some legal limits as to how much influence they are allowed to exert in this respect. For example, the corporate board's executive compensation committee must consist of independent directors.

Empirical Magnitudes

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Executive compensation comes in many forms: salaries, bonuses, stock grants, option grants, retirement benefits, perks, and severance packages. The most visible components are salary and bonus compensation and stock and option grants. For example, Forbes reported that the average CEO of America's largest firms earned over $15 million in 2006, about half of which was due to stock or option gains. The latter component is responsible for some of the fantastic salaries of the highest paid executives: Steve Jobs earned $647 million in 2006—and arguably, he deserved every penny of it, having single-handedly transformed the once moribund Apple Corporation into the most admired brand in the world today. On the other hand, Ray Irani of Occidental Petroleum earned $322 million in pay, but the increased oil price that raised Occidental's value was hardly his personal accomplishment. Not surprisingly, when firms have performed poorly, executive compensation is only salary and bonus. For example, from 2000 to 2006, H. Lee Scott, CEO of Wal-Mart, earned $63 million while Wal-Mart shareholders earned a 7-year stock return of under 1% (less than inflation); Kevin Sharer of Amgen earned $98 million while Amgen shareholders earned less than 7%; and Sidney Taurel of Eli Lilly earned $50 million while shareholders lost 21%. x

Other components of executive compensation are often less visible. For example, in December 2005, the Wall Street Journal reported that the income taxes on corporate perks (e.g., cars, jets, loan forgiveness) that many CEOs receive are often paid by the corporations and reported only as relatively obscure "tax gross-ups." (More than half [52%] of companies report some gross-ups.) Other recent empirical evidence from Lucian Bebcuk at Harvard shows that pension packages that usually escape public scrutiny are often larger than reported ex-

ecutive compensation. Finally, the majority of managers even get paid for poor performance. In 2001 and 2002, the average exit golden parachute in the United States when a manager was terminated "for cause" was $16.5 million.

Dilbert on CEO Severance: 2013-05-30

Why is executive pay so high? This question should be divided into two issues: First, is the average level of compensation, regardless of corporate performance, (too) high? Second, is the link between corporate performance and managerial compensation, often called the "slope," (too) high? Let's tackle these issues one at a time.

Pay Level

In a perfect market, demand and supply should determine executive pay levels. An economist's first question would be: How much better is the current manager than the next-best potential replacement, and how much would this replacement cost? This points to the following first two explanations:

1. Being CEO could be a much harder job than being second-in-command. Thus, high compensation is required to find willing candidates. Empirical evidence suggests that the difference between the top CEO and her immediate employees (who are more likely to leave and thus under high pressures, too) is so large that this explanation seems unlikely. Executive pay packages do not seem low enough to leave CEOs relatively indifferent. Indeed, anecdotal evidence suggests that internal candidates would likely accept the CEO position even if it did not come with a pay raise.

2. Executive talent could be scarce—that is, the supply could be very limited. Even though there may be hundreds of potential CEOs, the specific challenges in a specific company and industry may limit viable candidates to just a few. Moreover, the marginal impact of a CEO could be huge. Let me explain: It would not matter much whether the firm hires an assistant who can type 10% faster than another one. The firm could simply pay the slower typist 10% less. The pay per unit of performance would be the same. In contrast, a CEO with just a little higher ability could have a huge marginal impact on the performance of the entire firm. In such cases, the economics of superstars (or, if you wish, rock stars or NBA players) applies to CEOs, too. The best performer may be just a little better than the second-best performer and yet play a very different role and command a lot more compensation.

   Competitive pricing is likely to be a good explanation in cases where the firm first needs to attract a new CEO from the outside. It is also likely to be a good explanation in cases such as Apple's Steve Jobs, in which the next-best alternative would probably be much worse.

   (However, even here, there are some puzzles. First, is Jobs the exception or the norm? Second, if Apple paid Jobs only $200 million instead of $650 million, would he have left? Did shareholders really have to pay so much to get Jobs to perform well for them?)

In the above two explanations, CEO compensation does not contain pay that goes beyond the normal. (Economists call such excess pay "rent.") Instead, executive pay is simply fair and appropriate. However, there are also economic explanations that allow for excessive CEO compensation on the grounds of economic efficiency:

1. Becoming a CEO could be a prize for which everyone is competing. It motivates everyone below the CEO position to work hard in order to become the CEO. Thus, the marginal effect of the CEO's pay is not just its effect on the CEO's work, but also on many other executives' work.

2. CEOs need something to lose in order to care about the future, to not commit mistakes, and to not defect to the competition and spill the beans. This "something" is their (high) future wages. In economics, this is called an **efficiency wage**.

These are all sound economic arguments. Unfortunately, there is one fact that is difficult to reconcile with these arguments: Executives in Europe, Singapore, Australia, and Japan earn a lot less (often merely 10%) than their counterparts in the United States. It is hard to believe that being CEO is much harder in the United States, that executive talent is much scarcer, that CEOs matter more, that becoming a CEO is more needed as a prize, and that CEOs here would be relatively more careless than their foreign counterparts if not in fear of losing their future wages.

There are other explanations as to why CEO compensation in the United States is so much higher than that elsewhere:

1. It could be that American CEOs are operating in a governance structure that has allowed them to receive higher salaries than their foreign counterparts. Indeed, there are at least three important differences:

   - CEOs in the United States are more likely to obtain control over their corporate boards. The United States is unusual in the fact that the CEO is also commonly the chairman.

- It is more common for foreign companies to have a large, active, and possibly controlling shareholder. This is consistent with the view that the important governance problem elsewhere is not so much the self-interest of the CEO as the self-interest of large, controlling shareholders.
- The cultural, ethical, and legal constraints on managerial compensation in other countries are different from those in the United States. Of course, from a shareholder perspective, those social norms and regulations also have a flip side. For example, in Europe, it is more difficult for managers to take drastic actions on behalf of shareholders (e.g., when it comes to downsizing and employee layoffs).

  Dilbert on M&A? Layoffs: 2012-12-10

2. It could be a simple error that is not corrected by the market for executives— this market may simply not be perfect. Maybe foreign companies have it wrong and are simply paying their CEOs too little. Or maybe Americans have it wrong and are simply paying their CEOs too much.

The truth probably has aspects of all six points to it.

Pay Slope: Pay-for-Performance Sensitivity

How much more are CEOs of publicly traded companies rewarded when they perform better for their shareholders? There is clear evidence that managers earn higher bonuses, and receive more in valuable shares and options, when the firm does better. We also know that if the corporation performs extremely poorly, managers are more likely to be fired. Moreover, this slope is probably higher in the United States than it is in many foreign countries.

Yet there is an important puzzle in the slope, too. Most executive compensation in the United States does not even make an attempt to distinguish between firm performance to which the CEO has not contributed and firm performance for which the CEO is primarily responsible. One easy way to reward only the latter would be to tie executive compensation to the corporation's performance relative to its industry. Instead, even executive stock and option grants are always tied to the firm's unadjusted share price. This means that stocks and options reward not only the executive's leadership but also external factors beyond the CEO's control. For example, Lee Raymond, CEO of Exxon, earned $400 million as a retirement package in 2005, primarily because Exxon had earned $36 billion in profit in 2005. Yet it was hardly Mr. Raymond's leadership ability that made the oil price triple in 2005. If Raymond's compensation had been about Exxon's performance relative to the oil price or Exxon's share price performance relative to those of other oil companies, his compensation would have almost surely be an order of magnitude lower. Similarly, a manager who avoids the worst in bad times, perhaps earning negative returns that are less negative than peer companies, should really earn more pay, not less.

An alternative view of shares and options is that they are a form of compensation that is easier to defend from a public relations perspective or that is more advantageous from a tax perspective. In 2006, a number of firms were caught having granted to their CEOs backdated options after the stock price had already gone up. This made it appear (wrongly so) that the CEO received pay for executive performance, when it really was just pay. As of 2008, a number of executives have been indicted for backdating, and the SEC now requires firms to disclose their incentive compensation schemes up front.

The Darkest Side of Pay-for-Performance

Although economists' and businessmen's gut reaction is that "pay-for-performance" is a good thing, this is not always the case. Pay-for-performance works well if the manager has control primarily over the mean of the outcome distribution. For example, if the manager has to work hard to shift the profits from the company from –$40 or $60 (with equal probability) to –$20 or $80, then paying her more if the firm earns more is a good idea. The typical way to do this is to pay the manager a bonus that is a fraction of the firm's performance, say 10% or $8, if this performance is positive. In addition, the manager may be fired if performance i bad. However, if the manager can choose to make the firm riskier, e.g., by gambling, pay-for-performance works poorly. For example, if the manager can shift the profits from –$40 or $60 to, say, –$500 or $400, paying a bonus for good performance is a terrible idea. It then pays the manager to take on riskier and riskier projects. One way to counteract this problem is to risk-adjust the compensation. However, risk is often difficult to measure, and risk-adjustment is often entirely absent in practice.

important

Employees almost never suffer a proportional share of downside returns. Consequently:

- Pay-for-performance is a great idea when employees can influence the realization of upside returns primarily or only by working harder—shifting the payoff distribution and thus its mean to the right.

- Pay-for-performance can be a terrible idea when employees can influence the realization of upside returns by taking on more risky projects—widening the variance of the payoff distribution. In this case, they may take high-variance projects even when these projects are have negative NPV.

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Incidentally, excessive risk-taking is precisely the problem in financial services firms. Employees, from traders to executives, are awarded fabulous bonuses for good performance. In financial companies, taking on more risk and leverage is much easier than it is elsewhere. (As I write this, a rogue 31-year-old trader was just caught speculating away $2 billion of HSBC's capital. Now imagine how much easier excessive risk-taking is for the CEO!) Not surprisingly, financial service firms indeed usually end up taking huge risks with as much leverage as they can. Many economists have argued that huge risk-taking may well be in the interest of shareholders, too, because much of the downside cost are social externalities. In the –$500 example, if society suffers a $400 loss if the bank fails (the government may have to bail out such banks in order to avoid a financial domino effect or a an economic depression if the bank(s) are large enough), then it may well be in the interest of shareholders to allow or encourage their managers to take huge risks.

Private Equity Compensation Benchmarks

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Does the evidence suggest that managers are overpaid, or that managers are not paid appropriately for performance? Compelling evidence comes from firms that were taken private in a leveraged buyout. In this context, you can think of private equity funds as a large shareholder wresting control back from management, thereby significantly reducing the agency conflict between shareholders and managers. When a public firm is taken over, the private equity owners usually tie the executive compensation even more closely to the corporate performance than ever before. Indeed, if the firm does well, executives of newly private firms are paid even more than they ever were when the firm was still publicly traded. This suggests that the big problem is not so much that executives in publicly traded firms are overpaid, but that they are not rewarded enough for good performance and not penalized enough for bad performance. (However, an alternative explanation for more equity participation is that it makes more sense for managers to share the risk in privately held companies.)

Dilbert on Manager Pay Benchmarking: 2013-07-03

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question

What are possible explanations for high CEO pay?

answer

Possible explanations for high CEO pay are (1) the job is enormously more difficult (implausible); (2) talent is scarce, and even a little more CEO talent can make a lot of value difference; (3) becoming CEO is a prize that motivates everyone; (4) high salary is required to ensure that CEOs care; (5) the CEO has "captured" the board; and (6) it is an error that an imperfect market has not corrected.

question

Describe the main illegal and legal temptations that managers face in their duty to maximize shareholder wealth.

answer

Illegal: theft, fraud, insider trading, tunneling, bribes. Legal: empire building, friendship and loyalty, excessive entrenchment, perks and the incentives to drive down the firm value in order to purchase the company on the cheap. Executive pay is particularly prominent.

26.D The Role of Social Institutions

We now turn to the institutions that reduce these conflicts of interest. In this section, we look at the most basic social economic institutions that aid entrepreneurs in setting up their corporate governance. In the next two sections, we will look at contracted rights that are more specific to creditors and shareholders, respectively. X

The most basic provision a functioning capitalist economy conveys on its subjects is the right to write and enforce contracts. This creates [pl]property right, which can be transferred from one party to another. In addition, society also imposes limits on what managers can do, both formal (laws and regulations) and informal (ethical considerations, social norms, and potential adverse publicity). Unlike the contractual agreements that are discussed in the next sections, many of these social and legal constraints are difficult to escape. (But it is not impossible. For example, a firm could reincorporate itself in a foreign country.)

The Formal Environment: Laws and Regulations

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In the United States, investors are protected by a set of federal and state laws, many regulations, and appropriate legal enforcement—both criminal and civil. Yet, most of our body of law has come about not through formal legislation but through court rulings and judicial precedence. The evidence suggests that our mixed process seems to have more flexibility to evolve than its counterparts that rely purely on statutory laws. In civil-law countries, like France or Belgium, where almost all regulations are legislated from the top, investor protections tend to be worse and less flexible.

State Regulations, Especially in Delaware

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In the United States, it is the individual states that set most of the rules under which both public and private companies operate. The majority of large U.S. corporations are incorporated in the state of Delaware, which has developed an impressive set of case laws and expertise in resolving corporate issues in the courts. The **Delaware General Corporation Law** prescribes such arrangements as follows:

- The role of directors and officers
- Meetings, elections, voting, and notice
- How to amend the charter
- How to execute mergers, consolidation, conversions, asset sales, and so on
- How to handle insolvency (bankruptcy itself is handled by the federal code, however)
- Suits against corporations, directors, officers, or stockholders

Not surprisingly, most novel governance issues often play out in the Delaware courts. X

Shareholders' single most important and broadest legal protection is management's legal **fiduciary responsibility** to act on behalf of the shareholders. Black's Law Dictionary defines a fiduciary relationship as one "in which one person is under a duty to act for the benefit of the others." The seminal opinion on fiduciary duty was written by the New York Court of Appeals in 1984:

> Because the power to manage the affairs of a corporation is vested in the directors and majority shareholders, they are cast in the fiduciary role of "guardians of the corporate welfare." In this position of trust, they have an obligation to all shareholders to adhere to fiduciary standards of conduct and to exercise their responsibilities in good faith when undertaking any corporate action. Actions that may accord with statutory requirements are still subject to the limitation that such conduct may not be for the aggrandizement or undue advantage of the fiduciary to the exclusion or detriment of the stockholders.
>
> The fiduciary must treat all shareholders, majority and minority, fairly. Moreover, all corporate responsibilities must be discharged in good faith and with "conscientious fairness, morality and honesty in purpose." Also imposed are the obligations of candor and of good and prudent management of the corporation. When a breach of fiduciary duty occurs, that action will be considered unlawful and the aggrieved shareholder may be entitled to equitable relief.

In other words, fiduciary responsibility is intended to limit excessive self-dealing, especially transactions between those in charge of a public company and the public company itself. It does not extend to ordinary business decisions that do not preferentially enrich the parties in control. In fact, the **business judgment rule** protects the corporate board and in turn its managers against lawsuits if they make poor choices in the execution of most other company affairs. (Otherwise, the litigious climate in the United States would paralyze them!) Virtually every U.S. state has legislated both a fiduciary responsibility and a business judgment rule.

Other Mechanisms: Federal Law, Enforcement, and Private Lawsuits

Federal law applies primarily to publicly traded companies, not privately owned companies. It mostly concerns itself with regulating appropriate information disclosure, although it does contain some self-dealing and insider-trading restrictions, too. Congress has delegated most of the day-to-day handling of these laws to the Securities and Exchange Commission (SEC). The SEC has further delegated some of its tasks to professional associations (for example, the National Association of Securities Dealers, NASD), stock exchanges, bond rating agencies, the Financial Accounting Standards Board (FASB), and private auditing firms. In addition to congressional law, the U.S. Constitution gives the federal government control over all bankruptcies, both personal and corporate.

The importance of enforcement of laws (rather than just what is on the books) is not to be overlooked, either. The United States has strong civil (financial) and criminal penalties and enforcement. (Although the wheels of American justice are not perfect and only grind slowly, usually taking years to resolve even clear-cut cases, they do grind.) In contrast, some other countries have stronger laws but weaker enforcement. For example, by a common governance measure, Indonesia has theoretical protections and self-dealing restrictions that are just as good as those in the United States—yet it takes over four times as long to enforce one's rights (e.g., collecting on a bounced check) in Indonesia as it does in the United States.

Of course, if an executive has no scruples, even the best legal and corporate system is unlikely to succeed in curbing all misbehavior. This applies to society just as it applies to corporations. The system still needs vigilance, the ability to respond to new crimes, and prisons, despite all the laws against bad behavior.

Firms also have to try to avoid class-action lawsuits (by shareholders or customers), which have bankrupted more than one company. The desire to reduce the frequency of lawsuits could play a beneficial role from a corporate governance perspective. Firms can be sued in any state in which they are operating. Being sued has become so common in some states that it is now considered part of the ordinary cost of doing business. Nevertheless, despite some positive aspects, the corporate costs of class-action lawsuits likely outweigh their governance benefits.

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question

Does the rule of law have limited ability to control the CEO?

answer

The rule of law (regulations, laws, rulings, etc.) regulates only the most egregious violations of fiduciary duty. It does not extend to "business judgment" calls.

question

Could there be good corporate governance in the absence of government rules and regulations?

answer

Probably not: Without laws that allow the enforcement of written contracts, for example, no corporation would be able to contract with anyone.

The Informal Environment: Ethics, Publicity, and Reputation

Fortunately, managers are like many other social groups. Most managers are ethical, but there is a great deal of heterogeneity among them. Thus, for most CEOs, social norms and ethical standards are also important constraints. They want to do well for themselves but also remain within the bounds of what is considered normal, ethical, and acceptable. Staying "normal" also reduces the chance that behavior will draw negative publicity and create legal liability for violation of fiduciary duty.

Yet ethical standards and norms are themselves defined by CEOs as a group. If a practice is commonplace, it is unlikely to violate a manager's sense of appropriateness. Naturally, these standards change over time. On some dimensions, the race seems to have been to the bottom. For example, 100 years ago, the financier J. P. Morgan argued that no CEO should make more than 20 times what the average company employee earns. By 2000, the average CEO earned 525 times the average worker's pay. Consequently, being paid 500 times an average worker's pay would not violate the ethical boundary of any CEO today—on the contrary, it may prove executive acumen and convey more social prestige through the power that wealth brings.

Dilbert on CEO vs Employee Pay: 2012-12-07

Social norms can be different for different constituencies. Although excessive compensation may be something worth bragging about to other executives at the local country club, managers rarely find it desirable to broadcast it to the press. Their

desire to avoid negative publicity seems to be one constraint on executive compensation. Indeed, managerial compensation has come to consist of ever more complex components, which render them rather opaque to analysts. Researchers are often similarly bewildered when they try to determine whether high pay is primarily due to the need to retain or incentivize a manager, or to the fact that a manager has fired all critics and taken control of the corporate board and so is merely enriching himself. Both may matter, but there is some empirical evidence that intentional obfuscation—which points toward the latter—is important. For example, consider the following:

- The more obscure parts of executive pay packages (retirement packages, golden parachutes, sign-on bonuses, etc.) are often higher than the more transparent and publicly reported parts of the compensation packages (salary, bonus, and options) that are printed in popular business magazine rankings.
- Boards often change the terms of executive options after the fact if they would otherwise expire worthless.
- A number of companies were caught backdating option grants in a way that increased CEO compensation without risk but made it appear as if it were performance pay.

These facts indicate that the structure of many pay packages is determined more by the desire to pay large sums and still avoid public scrutiny, and less by the need to incentivize executives. X

In some cases, managerial reputation can be a useful corporate governance mechanism, too. For example, a manager may not want to treat shareholders badly if she is running only a small company and has her sights set on being selected manager of a larger company in the future. To receive a higher call (with more opportunities to become richer), the manager must constrain her self-interest for a while. One problem with reputation as an agency control mechanism is that managers close to retirement tend not to care as much about their reputations as they care about their severance packages. Most CEOs retire, rather than graduate to bigger companies.

anecdote

Until 2005, the New York Stock Exchange (NYSE) was a "mutual" that was owned by its members, primarily by investment banks like Goldman Sachs. These members were appointed to the NYSE board. (Nowadays, the NYSE is a publicly traded firm.)

The NYSE is an odd creature in one other respect. It is both a stock exchange and a regulatory agency, because the SEC relies on the NYSE to execute some corporate governance rules. This is the case both for the NYSE members and its traded firms, which represent almost all large U.S. corporations (with the exception of the technology sector).

As guardian of good corporate governance, the NYSE should have been a beacon of good arrangements—but it was remarkably conflicted. The NYSE board decided on its chairman's compensation package. The chairman regulated its members. The NYSE members appointed the board. The board appointed the chairman and set the chairman's pay package. The chairman regulated the members who appointed the board. The board paid the chairman. The governance chain was circular! (And, to some extent, it still is today.)

In August 2003, the media found out that NYSE Chairman Richard Grasso held a retirement package worth $140 million—about four times the annual profits of the NYSE. The media later found an additional $48 million in pay due Grasso, but Grasso then publicly and graciously declined this. (But he never did so in writing.) After more press digging, it was revealed that Grasso also helped pick the executive compensation committee. Many large institutional shareholders then joined the chorus, publicly demanding Grasso's resignation. On September 17, 2003, Grasso finally bowed to the board's discontent—but he did not resign outright. Meeting with his lawyers, he learned that by forcing the board to terminate him (rather than by resigning), he would receive an additional $57.7 million on top of the $140 million deferred compensation—which he did.

In 2004, Grasso sued the NYSE for $50 million more, because his contract of 2003 contained a clause that forbade exchange executives from making any statement against Grasso if he left the NYSE. In March 2005, Grasso further sued the former chairman of his compensation committee for having overseen the approval of Grasso's pay package. Ultimately Grasso received a total of $193 million in compensation and pension benefits. In 2004, Elliot Spitzer, then attorney general of New York, sought to recover $100 million from Grasso as "excessive compensation" paid by a non-profit. However, in 2008, NY State abandoned this lawsuit, because the court ruled that only the NYSE itself could sue Grasso, because the NYSE had become a for-profit afterwards. The NYSE never sued.

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question

What are some of the reasons why ethical standards may have a limited ability to control the CEO?

answer

The standards are themselves set by the behavior of CEOs as a group. Moreover, ethical standards tend to be higher when information is publicly available, but not all managerial actions are publicly reported.

26.E Debt: The Right of Creditors to Force Default

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The governance constraints in the previous section arise more or less by default, and they are not easy to evade. However, entrepreneurs can also create specific contractual protections, and, like the legal constraints, these rights usually differ across different types of securities. This section starts with the easy one: debt.

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Creditors do not need to play a large role in the day-to-day operations of the company in order to receive their due. Ascertaining the value of collateral is cheap and easy most of the time. If a firm fails to pay principal or interest when promised—regardless of whether it is because the market environment is bad, because management has performed poorly, or because management just hides assets—the company falls into automatic default (usually bankruptcy).

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Moreover, we have already learned (in Chapter **??**) that creditors usually demand and receive covenants, by which the firm must live. Covenants may include collateral, priority, the naming of an auditor, the specification of limits on financial ratios (for example, on dividend payout ratios), and many more terms. Default occurs when covenants are not met. Importantly, coordinated creditor action upon delinquency is not required, because such mechanisms are designed at inception. In the case of a public bond, the covenants designate a trustee to oversee performance of these covenants. The trustee has the obligation to declare a bond in default when the covenants are not met. (The process is mechanical.) In the case of a single large bank creditor, this is not even necessary. Therefore, lenders do not commonly suffer from free-rider problems, where one wants to shift the work of enforcement to the other.

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After some institutional delay, caused primarily by Chapter 11 bankruptcy protection, creditors usually can take control of the company and/or the collateral. Therefore, creditors need not spend much time or money investigating managers in ordinary circumstances. In many, but not all, OECD countries, creditor protection is even stronger than it is in the United States. For example, there is no Chapter 11 bankruptcy protection for firms in Germany, liquidation is often instantaneous, and violations of the absolute priority rule are almost unheard of. Even in the United States, management typically avoids default on debt as if it were the plague. The reason is not just that equity owners (on whose behalves managers supposedly act) lose the firm's future projects, but more importantly, that corporate management is replaced in virtually all bankrupt companies. Looming bankruptcy gives management strong incentives to maximize firm value.

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Creditor Expropriation

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Although there are some escape mechanisms that permit management to manipulate the covenants, these are rare and slow. The first such mechanism is a "forced exchange offer," in which managers set up a "prisoner's dilemma" that makes it in the interest of every bondholder to exchange their current bonds for bonds that are worth less but have higher seniority—even though it is

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not in the bondholders' collective interest. The second mechanism is a covenant amendment, which must be approved by the bond trustee and voted on by bondholders. The third mechanism is asset sales or divisional splits. They require major corporate surgery and are often produced by bond covenants. For example, when Marriott Corporation announced that it would split into two companies (hotel operator Marriott International and a real-estate investment trust Host Marriott) in 1992, its share price rose by 10%. Marriott's bondholders sued, however, because the old Marriott debt now would be owed only by one descendent, Host Marriott. X

The fourth mechanism is bankruptcy. The costs of enforcing their claims in bankruptcy and delay or violations of APR could leave creditors less well off. In the United States, management can file for Chapter 11 protection, which can delay the turning over of assets to creditors. This option does not exist in many other countries. For example, in Germany, creditors can practically force immediate liquidation of the firm upon nonpayment. As a result of strong creditor protection (and poor shareholder protection), many German companies are heavily creditor-financed: It is far more difficult for German companies to find shareholders than it is to find creditors. Many of the largest German companies remain financed by the families who founded them. X

In sum, creditor violations are the exceptions rather than the rule. It is generally hard for management to escape bondholder discipline. In turn, this could even help shareholders—even though liquidation almost always hurts shareholders, the threat of future liquidation upon poor managerial performance can motivate managers and thereby help dispersed public shareholders from an ex-ante perspective.

anecdote

There is very little other than a country's desire for a good name and its foreign assets that prevents it from simply repudiating its debt. For example, Argentina owed about $220 billion in 2001, with required repayments of $22 billion a year—during the worst economic crisis the country had ever experienced. It repudiated its debt in a very interesting fashion. In July 2000, an Argentinian judge named Jorge Ballestero sent down an intriguing ruling on the foreign debt: The ruling attributed responsibility for the debt to the civil servants during the previous dictatorship and co-responsibility to international organizations like the IMF, which approved the loans—now declared illegal and fraudulent.

However, don't think this is just a foreign phenomenon. There have been instances in the past in which individual U.S. states have repudiated their debt. For example, the Arkansas state constitution even has a specific clause that repudiates repayments for its 1868 bonds, in effect making it impossible for creditors to reverse this default by legislation. Creditors have no legal recourse in this case—the federal courts will not intervene.

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Although we have discussed primarily the case in which creditors cannot trust corporations, the opposite could also be the case. (And it can just as much prevent a firm from asking for debt financing.) A creditor may be able to turn the tables, pull its line of credit, and thereby threaten management or expropriate the firm's equity (receiving control of the firm). Banks would often be in a strong position to pull this off, but if they did, they would acquire a reputation for doing this, which would make it more difficult for them to find new borrowers.

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question

Why does management usually want to avoid bankruptcy?

answer

Even if the company continues to exist (Chapter 11), management is usually replaced.

26.F Equity: The Right of Shareholders to Vote

The more challenging governance issues confront equity. The value of equity, unlike that of debt, is highly sensitive to project cash flows and to managerial performance. Consequently, when managers waste money, it is primarily coming from the top—off shareholders' hides. Moreover, shareholders may not even know whether management is acting in their interests unless the firm is transparent and releases a lot of information and the owners do a lot of verification and checking. And even if shareholders are firmly in charge of the firm and have all the information possible, they still have the unenviable task of determining whether any poor performance is the fault of management, the market, or both. In sum, most of the tough questions in corporate governance are primarily in the domain of equity.

The Corporate Board

As already noted, the majority of publicly traded corporations are incorporated in Delaware. Delaware law and stock exchange regulations set down the basic rules for the relationship between companies and their shareholders.

Firms must have a **corporate board**, which is the ruling body of the firm. This board is supposed to represent the owners, principally the shareholders. Normal boards meet about 5 to 10 times during the year for 1 day each. It is the board's responsibility to appoint management and to oversee it—to ensure that management is acting in the best interests of shareholders. Although in economics we deem the investors as the principals of the firm, it is the board that is the principal of the corporation from a legal perspective. Legally, the board is the backbone of our system of corporate governance.

The most important control right that entrepreneurs (must) grant shareholders is the **right to vote** on the appointment of the board. This happens normally once a year at the **annual meeting**, which is itself orchestrated by the existing board.

The Role of the Chairman of the Board

The most important individual on the board is the **chairman of the board**. He controls the board's meeting agenda and directs management to produce the necessary information. Of course, the chairman ultimately has to rely on management to receive the right information to present for discussion. The power to set the agenda and filter the information flow should not be underestimated. After all, with only a couple of days per year on the job, and with their own full-time jobs elsewhere to attend to, board members cannot possibly know the business in great detail. Having thousands of pages of reading as preparation for a board meeting is just about as useful to board members as having zero pages. And board members know that if they do not stick to the specific agenda, they run the risk that the discussion will degenerate into long-winded, unfocused conversations. Not surprisingly, boards with more than a dozen members are usually not very effective.

In theory, the board appoints the management and then oversees and protects shareholders against conflicting interests by the management. If the CEO acts in her self-interest, the board can dismiss her. Unfortunately, in practice, corporate boards rarely play such a role under ordinary circumstances. The reason is simple: In most U.S. corporations, the CEO is also the chairman of the board. For example, here is the breakdown of the 30 Dow Jones Industrial Average companies as of April 2008:

- In 24 cases, the CEO was also the chairman of the board.
- In three cases (AIG, Citigroup, and Disney), a separation of the two positions occurred recently because of scandals and shareholder revolts.
- In one case (McDonald's), the CEO and chairman of the board died of a sudden heart attack in 2004. His successor, an avid McDonald's eater himself, died of colon cancer at the age of 44 within the year.
- In two cases (Microsoft and Wal-Mart), corporate control was effectively still in the hands of the firm's founders, who remained large, concentrated shareholders.

Clearly, if the CEO is also the chairman of the board, it makes it highly unlikely that the chairman will objectively evaluate, control, and, if necessary, discipline or even fire the CEO. Who wouldn't like to have himself as a boss?

Board Constitution

Of course, the chairman of the board is not alone in making decisions. The other board members could potentially outvote the chairman and oust both the chairman and management. Thus, you should understand how the rest of the board is typically constituted. Nowadays, the most common board composition is about one-third "inside directors" and two-thirds "outside directors."

Inside directors are typically other managers at the firm itself (i.e., employees under the direct day-to-day control of the CEO). Obviously, it is rare that a direct subordinate of a chairman-CEO would revolt or undermine her—if the coup fails, this subordinate would almost surely lose his job.

Outside directors ([pl]independent director) are individuals who have no current or recent material relationship with the company. (However, although independent directors are not allowed to have a relationship with the company, they are allowed to have a relationship with the CEO or the chairman. For example, from 1993 to 2002, Disney's CEO Michael Eisner appointed his children's primary-school teacher to Disney's board. In 2001, four of Disney's independent directors had relatives employed by Disney. The head of Disney's compensation committee was Eisner's personal lawyer.)

Presumably, it is not the inside but the outside directors who would serve as a control function. Let's look at their independence in more detail. How does the typical corporate board come about? X

Formally, the existing board first creates a subcommittee of independent board members, which then identifies suitable candidates. Nominated board candidates must then be approved by the full board, including the chairman and inside directors. After the existing board is comfortable with its planned next incarnation, a complete slate is put forth for an up-or-down vote at the annual shareholder meeting. Many corporate board elections are about as democratic and thrilling as elections in North Korea. However, after 2006, a number of companies have voluntarily improved their bylaws and now require individual directors to be approved, too. (Unfortunately, these are rarely the companies with the worst boards to begin with.) In some other firms, large and active shareholder-investors (often from the founding family) or large creditors have great influence on the board. In such firms, governance often works well, especially if the CEO is not a part of this group. X

In many large and old publicly-traded firms, board selection is more sinister. The most common qualification for being nominated to the board is being, or having been, an executive at a similarly sized company. (Of course, such individuals sympathize with the need to pamper the executives of the firm.) The second most common qualification is based on political considerations—almost all boards of large corporations have minority and women representation. (This explains why Lehman Brothers, the most prominent victim of excessive leverage during the 2008 financial crisis, had on its roster of independent directors Dina Merrill, an octogenarian actress that appeared in CaddyShack 2.) The third most common qualification is prominence, and many boards include some entertainment, sports, or political celebrities. However, it is not all bleak—with the advent of more public scrutiny in the 2000s, many boards have been improving their constitution. Still, I am not aware of even a single U.S. corporation in which a board member was recruited from the ranks of known scholars (much less public advocates) that write on the rights of shareholders, corporate governance, or executive compensation. X

Executive compensation must be determined by a committee of independent directors. However, most members of such committees are themselves CEOs. In effect, as a group, CEOs mostly determine their compensation themselves. As a CEO, would you be inclined to believe that CEOs should be dearly compensated or held on a short leash? And, as CEO, would you like to argue to your own board that you should be paid more if you have recently been involved (on the executive committee) in cutting the compensation of the CEO of a comparable company? It is not clear if it would be better to require non-CEO directors to determine the compensation, simply because such directors may depend more on the current CEO for their appointment and reappointment to the board. There is no easy solution here.

anecdote

The CEO-chairman has considerable influence over which board members should retire and who the next board members should be. Of course, these board members in turn nominate the executive compensation committee, who in turn decide on the CEO-chairman's compensation.

The Corporate Library's study of compensation committee membership found that when a director sits on executive compensation committees of multiple firms, these firms tend to have similar executive severance pay packages. There are at least some anecdotes of exit package imitation and possibly mutual back-scratching in the CEO community:

- Charles Knight was the CEO of Emerson Electric Co. from 1973 to 2000 and chairman from 1974 to 2004. David Farr first succeeded him as CEO, then as chairman. (Farr was probably not opposed to nice exit packages for his predecessor from both jobs.) Remarkably, Knight's exit package was not only unusually generous, but it also contained unusual provisions that were similar to those in Jack Welch's package from General Electric.

  Here is where it gets interesting: Knight was the chair of IBM's compensation committee in 2002, when IBM CEO Lou Gerstner retired. Would you expect Gerstner's exit package to have been similar in both generosity and unusual provisions to Knight's own exit package? (The answer is that it was indeed so.)

- Ivan Seidenberg, CEO of Verizon, was singled out by the report for enjoying one of the most egregious severance packages. Seidenberg sits on Honeywell's compensation committee. How do you think the report judged Honeywell's CEO's exit package? Yes, it was also singled out for being among the most egregious.

Empirical Evidence of Board Constitution and Effectiveness

There are only a few studies of board effectiveness—perhaps because it is so difficult to find something that is not there. Michael Weisbach studied 495 corporate boards from 1974 to 1983 and classified directors as insiders if they were full employees of the company. This would necessarily put them under the direct control of the CEO. This was an era in which only about one-half of the 495 NYSE corporate boards even had a majority of outside directors! Only 128 had boards with clear majorities of outside directors, though many of these had their own dealings with the company and were thus also conflicted. Although no one has repeated this study, the majority of directors in most corporations these days would be outsiders.

In the Weisbach study's 10-year period, the probability that a CEO would depart was about 5% per year. It increased to 6% when a company lost 33% (!) of its stock market value (adjusted for general market movements)—and the causality in these cases may even have been the reverse. That is, the CEO may have acted worse because she was planning her retirement for the following year. What was the effect of an independent board? Firms with more than 60% outside directors had an additional 1% resignation frequency if they had this high of a loss. However, for firms that lost "only" 10% to 25% of their values, the presence of a majority of outside directors did not increase the CEO resignation frequency at all.

In sum, there is little reason to believe, and little evidence to support, the hypothesis that most corporate boards are effective monitors on behalf of shareholders in the ordinary conduct of business. Indeed, in most of this chapter, and most of the press, the use of the term "management" and "board" are just as interchangeable as the term "CEO" and "chairman."

The Positive Role of the Board

When it comes to proactive control of managerial misbehavior, most corporate boardrooms in the United States today are more theatrical stages than effective corporate control mechanisms. It is usually the case that it is not the board that controls the CEO, but the CEO who controls the board. This is not to say that corporate boards never serve a useful control function:

1. When there is a large influential and active shareholder to whom some board members owe independent loyalty, these board members could take sides and vote against the CEO-chairman.

2. When the CEO-chairman is fairly new and has not yet taken full control of the board, the board may have enough residual independent directors who could constitute a threat to the new CEO-chairman.

3. When a CEO-chairman unexpectedly disappears, the board can often take charge and select the successor. A good successor can make it less likely that the firm will have to deal later with many more agency conflicts.

4. When an external offer to buy shares at a much higher price arrives, the board has the legal obligation to weigh the offer in the interest of shareholders. In such an extreme situation, some boards split into factions between those who support the incumbent management and those who believe that shareholders are entitled to the windfall gain even if current management is displaced.

5. When the CEO's performance or misbehavior is so egregious that board members begin to fear negative publicity and personal legal liability, they can and have engineered successful coups.

In fact, over the last decade, boards have become outright activist, compared to how it used to be. There have been a number of prominent firings of underperforming CEOs.

Boards can also serve other useful noncontrol functions. They can advise executives, they can signal a commitment to diversity, they can help build relationships with suppliers and customers, and they can help to run the firm if the current CEO unexpectedly "evaporates."

The discrepancy between the supposed and the actual control role for many boards is so large that many reform ideas focus on trying to improve the independence of corporate boards. If legal reform could reduce the cozy relationship between board and management, management would indeed be better controlled—but it would come with a cost. It might allow large shareholders to extort more value for themselves at the expense of small shareholders, it might reduce other beneficial functions of the board (e.g., better relations with suppliers), and it could even destroy the company if the relationship between management and the board were to degenerate into a cold war.

question

What are some of the reasons why corporate boards have limited ability to control the CEO? What other roles may boards serve?

answer

The CEO knows the firm the best and, through judicious choice of information, controls the agenda. The CEO is often the chairman of the board. Elections for the board are often by slate and rarely contested. Inside directors are under the control of the CEO. Independent directors are often CEOs themselves. Corporate boards also have other roles: advice, a commitment to diversity, the building of corporate relationships, as well as support and backup during management successions.

Large Shareholders and Founders

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At this point, you should wonder about the natural next question: Why do shareholders not vote to oust poor boards? The main reason is that fights between (small) shareholders and the corporate board and management are unfair contests. While the board and managers have all the incentives in the world to spend a lot of time engineering the ballots and lining up the votes in a way that makes their choices likely to pass, and all the corporate resources at their disposal to sway specific shareholders with favors, individual shareholders have only their own votes. For small, diverse shareholders, it would not be worth the time to attempt to vote and/or to influence management. The costs of meaningful action and coordination are too high, and the benefits to each individual small shareholder are too low. This is an example of the **tragedy of the commons**, in which each individual acts in his or her own personal interest, preferring that other individuals would band together to correct the problems that they all jointly face. Instead, it is in the interest of all individuals to "free-ride," and the hope of every shareholder that others will put in the effort inevitably ends up in vain.

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The Benevolent Role

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The only kinds of shareholders who could reasonably play a role in the governance of publicly traded firms are large-block shareholders. They could have enough value at stake to take an active interest and enough votes to scare management. However, their influence is limited, too:

1. To become a large shareholder and/or increase share holdings is costly, because it foregoes the benefit of risk diversification—and the larger the firm, the more costly it is to become a large shareholder. Not surprisingly, in large firms, the stakes of the largest outside shareholders are usually much smaller than they are in small firms. Holding everything else equal, this means that management tends to be less restrained in large firms. Not surprisingly, the empirical evidence suggests that in large firms in which shareholders are more widely dispersed, agency problems are more severe.

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2. Even if large shareholders have some incentives to control management, it is still usually not enough. A shareholder who owns 5% of a firm suffers 100% of the cost of any effort to influence management, yet she reaps only 5% of the benefit.

3. If the large shareholder is a mutual fund, it cannot actively seek to influence corporate behavior. If it did, it could run into insider trading regulations when it wanted to divest itself of its stake upon learning negative information. Therefore, most large institutional shareholders abstain from actively seeking corporate influence.

   There is evidence that it is only primarily public pension funds, like CalPERS (see the anecdote above), that systematically play a beneficial role. Their very presence seems to deter management from undertaking value-reducing takeovers. Newer anecdotal evidence suggests that some individuals and hedge funds also have begun to play such a role. (Other evidence suggests that private pension fund managers and mutual funds do not play such a role. This may be because the incumbent board may tunnel business to these managers and their allied investment banks.) Moreover, there is also evidence that firms with 5% external owners tend to perform better than firms without such owners. There is also evidence that managers in poorly performing companies are more often replaced when there are large shareholders.

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anecdote

The most visible corporate governance activist in the United States is the California Public Employees' Retirement System (CalPERS) with about $240 billion in assets. CalPERS publishes an annual list of worst corporate governance companies (in its portfolio). Among its 2008 winners were the restaurant chain the Cheesecake Factory, the home builder Standard-Pacific, insurance broker Hilb Rogal, and furniture maker La-Z-Boy. (These firms experienced underperformance relative to their peers of at least 40%. In response, their boards focused on establishing rules that made a takeover impossible, such as through staggering the director elections. The detailed corporate governance shortcomings listed by CalPERS make juicy reading.) Unfortunately, CalPERS stopped publishing its list in 2010.

But even CalPERS rarely takes on Fortune 100 companies (which are most prone to suffer from agency conflicts). The reason may be not only political but also due to the fact that CalPERS' ownership share in Fortune 100 companies is too low to make much of a difference.

4. Votes are not anonymous: Managers know exactly how their shareholders vote and can seek retribution later on. If the shareholder is linked to an investment bank, insurance company, or independent pension fund manager, it is unlikely that any corporate business would ever flow to these parties again.

Thus, the primary beneficial governance role of large, passive, institutional shareholders is that they are likely to vote their shares against management if a third party were to seek an active influence. The concentrated presence of large blocks of shares, which could potentially overwhelm the voting power held by management and its allies, is a low-level but constant restraint on management.

The Malevolent Role

Generally, when small and large shareholders sit in the same boat, the presence of large shareholders is beneficial for small shareholders. Unfortunately, this is not always the case. The interests of large shareholders can differ from those of smaller shareholders. With enough voting shares, a large, active shareholder can in effect pressure, appoint, or even become management. This means that many (though not all) of the conflicts of interest that apply to management then apply to a large shareholder, too. From the perspective of minority shareholders, with control of enough votes, the cure (new management acting on behalf of one other shareholder) could be worse than the disease (independent management acting on behalf of themselves).

Fortunately, such conflict between a large shareholder and small shareholders is rarely the most important governance issue in the United States. First, most shares are in the hands of passive funds, which usually have to abstain from active influence. Second, not only management, but also large shareholders, explicitly suffer legal fiduciary duty to all shareholders under U.S. state laws, which makes such expropriation more difficult and easily challengeable in court.

Of course, even in the United States, it is still not in the interest of executives to pick fights with their largest shareholders. Most corporate executives seek a cordial arrangement with their large shareholders. Special treatment of large shareholders is usually more effective than confrontation. Such "VIP" goodies can include special access to information, the sharing of corporate perks (such as golf outings), and special deals (such as sweetheart deals for the firm—or even a private deal for the manager of a mutual fund who is controlling votable public shares of other investors). A noteworthy (and legal) form of preferential treatment of large shareholders, especially threatening ones, is **greenmail** (formally, a **targeted share repurchase**), in which company management uses shareholder money to repurchase pesky investors' shares at a higher price. This has become rare in light of the negative publicity that it has attracted.

In many other countries, however, large shareholders are typically not as benevolent. Small shareholders fear not so much that the managers will expropriate all shareholders, but that large shareholders will expropriate small shareholders. The most prominent method of such expropriation is the aforementioned tunneling. For example, in Europe and Asia, small numbers of families often control large corporate pyramids in which firms often trade with one another. If a family owns 100% of one company and 10% of another company, and it controls both managements, it can engineer the sale of a $100 million factory from the latter to the former in exchange for a sweetheart price of $20 million. This enriches the first company by $80 million, and the large shareholder family nets $72 million.

This is not to say that tunneling never happens in the United States. An example that caught public attention occurred in 2001. Ronald Perelman owned a 35% stake in M&F Worldwide Group (MFW), a publicly traded tobacco ingredient company. Perelman also owned 7.3 million shares of Panavision, trading for about $4 per share. The M&F board then voted to approve a purchase of Perelman's stake in Panavision at $17 per share. (MFW shares fell by 25% throughout this transaction, but so did the market.) After more than a year in court with a minority shareholder (a hedge fund that had to pay for its own court costs), Perelman graciously agreed to reverse the transaction.

The conflict between a large shareholder and many small shareholders in the United States is usually a factor only when the founding family is still in charge. Many founders not only hold enough shares to control the company but also still consider the firm to be their own property. Sometimes this is good; more often it is bad. There is empirical evidence suggesting that founders are often detrimental to shareholders on average: When the founder of a company suddenly dies, the stock price of the company usually goes up, not down! In perspective, the best control of agency problems caused by a founding large shareholder may be his managerial retirement and death. Founders are also usually suspicious enough not to allow the next manager to have as strong a level of control as they themselves enjoyed.

Benevolent or Malevolent?

On the one hand, large block shareholders can incentivize managers to be more eager maximizers of share value. Their stakes make it worthwhile for them to maintain some checks on the actions of the board. This can benefit small shareholders. On the other hand, large shareholders or founder-managers, who both hold a good voting block and are effectively appointing management, may win any shareholder vote. They can use this power to lift everyone's boat, or they can abuse this power to enrich themselves at the expense of small shareholders.

Not surprisingly, in some firms large shareholders serve a useful role in constraining management, thereby aiding small shareholders. In other firms, large shareholders can use their power to help themselves to corporate assets, thereby hurting small shareholders. This is more common in many foreign countries than in the United States, where strong legal protection makes such expropriation relatively more difficult.

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question

What are some of the reasons why large shareholders may have limited ability to control the CEO?

answer

In large, widely held publicly traded corporations, even large shareholders typically hold only a small fraction of the shares. Thus, they will not invest too much effort, because they do not receive 100% of the benefits from lobbying. Some types of shareholders will not invest any activist effort to avoid insider trading regulations. Moreover, management will find out whether a shareholder voted against them.

Takeovers, Proxy Contests, and Shareholder Proposals

The most effective mechanism for controlling corporate management in older firms may well be (the fear of) external corporate control activity. It could displace them. In Chapter 25, we already looked in detail at mergers & acquisitions, so we will describe them only briefly here, and more from a corporate governance perspective. (However, you should also keep in mind that not all acquisitions are driven by poor target management—on the contrary, many are driven by poor acquirer management.)

Dilbert on Bad Acquisitions (writedowns): 2012-10-16

There are essentially three control mechanisms to pressure an existing board and management. In order of the audacity (and cost) of the attempt, they are corporate takeovers, proxy contests, and shareholder proposals.

Corporate Takeovers

In a **corporate takeover**, an external shareholder amasses enough shares, votes, or support to take over the firm. If the management resists, it is called a "hostile"—or at least a "neutral"—takeover, and it is primarily these types that are likely to discipline poor management. If the raider succeeds, he can then oust the board and its management. Of course, some takeovers are classified as friendly, only because target management recognizes that a raider could win and they can get better exit packages if they cooperate. It is important that you realize not only that it is the actual takeovers that discipline management, but also that their mere threat can have a significant positive effect on how incumbent boards operate.

Unfortunately, corporate takeovers are very expensive and thus somewhat rare. It is not uncommon for an acquirer to have to pay a premium of 20-30% above the share price just before the takeover is announced. If executive compensation abuse costs the firm "only" 10% of its value—that is, "only" $10 billion for a $100 billion company—it would still not be enough to make a takeover worthwhile.

Nevertheless, there is evidence that even though they are uncommon, the threat of hostile takeovers has helped to discipline management, at least in certain time periods. Figure 25.3 shows that the era of hostile acquisition was the 1980s. Many of these LBOs created shareholder value through better control of agency problems. The evidence suggests that most of the value gains went to the existing target shareholders in the price they received for tendering their shares. Moreover, the sheer visibility, novelty, and threats of such takeovers were big enough to convince many firms in the 1980s to correct their shortcomings.

However, Figure 25.3 also shows that hostile activity declined significantly in the 1990s. There are a number of reasons for this:

1. Many public firms had curbed their worst agency excesses, which raised their values and thus made a hostile takeover less important. It became harder and harder for raiders to find companies that could be purchased cheaply and then improved.

2. Market valuations generally increased in the 1990s. In addition, a number of high-profile LBOs from the 1980s had failed, inducing lenders to tighten the spigot. Higher interest rates made takeovers of public companies by smaller private acquirers more difficult to engineer.

3. Companies learned how to institute better takeover defenses—especially poison pills and staggered boards—that were too expensive for potential acquirers to overcome.

Thus, throughout the 1990s and early 2000s, corporate governance through external takeovers and leveraged buyouts faded into the background. After 1990, the hostile takeover threat generally receded and was no longer the proverbial sword of Damocles hanging over—and thereby controlling—corporate management.

It took 20 years—until the mid-2000s—before (friendly) leveraged buyouts experienced a renaissance. With nominal costs of capital at historic lows and public sentiment having swung against many managers in the wake of a number of management and executive compensation scandals, private equity firms again began taking over many large publicly traded firms. It became more difficult for boards to fend off offers that were significantly higher than their share prices. In addition, to soften their resistance, most incumbent executives received generous golden parachutes to sweeten the blow of their loss of control. Few companies seemed to be too large to be acquired. In 2005, over $130 billion flowed into such acquisitions. Neiman-Marcus, Toys “R” Us, Sunguard, Hertz, and a host of firms worth double-digit billions are now under the control of private equity firms. The most prominent, though not the largest, may have been the Chrysler buyout by Cerberus Capital. The credit crisis of 2008, however, put an abrupt end to most of this LBO activity.

Proxy Contests and Shareholder Proposals

anecdote

Perhaps the most prominent proxy contest involved Hewlett-Packard (HP) in 2002. It is also a good example of how management can muster all the resources of the firm against a large external shareholder, even to the point of giving away shareholder assets to other parties in order to achieve its goal.

The subject of the proxy vote was the proposed acquisition of Compaq by HP. Walter Hewlett, a corporate director and son of co-founder William Hewlett, was holding 18% of HP. He challenged this acquisition in a proxy fight. However, he lost the proxy vote against the merger after Deutsche Bank (DB) switched 17 million of the 25 million shares it controlled in favor of the $22 billion merger. (Incidentally, these were not shares owned by DB but shares owned by DB clients and held in the DB asset management division.) DB decided to vote for the HP-Compaq merger only after it had become the co-arranger of a new multibillion-dollar line of credit.

In August 2003, the government fined DB $750,000 for having failed to disclose another apparent conflict of interest to DB’s asset management client. In a memo to the CEO of DB in the midst of the fight, HP head Carly Fiorina had suggested HP do something “extraordinary” for DB and another firm. HP paid DB’s investment banking arm $1 million for “market intelligence,” with another $1 million contingent upon success. DB’s investment banking arm then helped to convince DB’s asset management group of DB’s interest—and rightly so. During a conference call with DB money managers, Fiorina then reminded DB that their votes would be “of great importance to our ongoing relationship.”

Some other institutional shareholders held shares in the target, Compaq, and therefore also voted in favor. (CalPERS, the prominent pension fund and advocate of better corporate governance mentioned in the previous anecdote, voted with Hewlett.) In all, 838 million shares voted in favor of the deal, 793 million shares voted against it. Hewlett alleged that HP spent roughly $150 million of shareholders' money on the proxy fight against him (18% of which he had to effectively pay for).

It is little consolation for Walter Hewlett that he was proven right. The acquisition indeed turned out to be a failure. Carly Fiorina was fired by the board in 2005.

In a **proxy contest**, a pesky shareholder does not seek to take over a firm by himself. Instead, he solicits the votes of other shareholders—most of all, the votes of other large-block shareholders. Although proxy contests are much cheaper than takeovers, they are neither cheap nor likely to succeed. For example, Institutional Shareholder Services (a consulting firm advising on votes) reported that there were 17 proxy contests in the first 8 months of 2003, of which only 4 resulted in dissident victories. The average dissident's cost per proxy contest was about $1 million. (The highest cost was over $5 million.) Let's put this in perspective. If management pays itself $100 million too much in a $10 billion firm (for a 1% loss), would a shareholder owning a large block of $200 million in shares find it worthwhile to launch a proxy contest? She would expect to gain $1\% \cdot \$200 = \$2$million with a $4/17 \approx 25\%$ chance of success. Multiply this to calculate a net expected gain of about $500,000. Therefore, she would not find it worthwhile to undertake a proxy contest this year. And the following year, existing management could even vote a shiny new $100 million block of shares against her proxy. Consequently, to launch a proxy contest, there would have to be a financial reason more weighty than just ordinary excessive executive compensation. Such an example occurred in 1988, the year in which Karla Scherer led the only successful proxy contest of a major U.S. publicly held company, Scherer Corporation, founded by her father in 1933. As a result, the company was sold in June 1989 at a price more than double the value of each shareholder's investment the year before, when the proxy contest began. Clearly, the value gains from dislodging management in the Scherer case were large enough to justify the battle.

In sum, "modest" governance problems, such as excessive executive salaries worth $1 billion in a $30 billion company (3% of value), are just not enough to make the expense of a full-blown proxy fight worthwhile for any external party. Nevertheless, the small success ratio could be misleading, because even the threat of a shareholder proxy contest can cause management to seek a compromise to rectify some of the problems. Executives are worried about a sudden cascade of dissent, in which all shareholders suddenly believe that the board will be ousted, which could then become a self-fulfilling prophecy. And, compared to hostile takeovers, proxy contests are outright cheap.

The most important use of proxy contests nowadays is as tools to facilitate a hostile takeover attempt. The proxy contest seeks to remove the takeover defenses put in place to protect the board and its management. The hostile takeover can then follow.

There is an even more modest form of the proxy contest: shareholder proposals. These are fairly cheap but usually not binding. Their most common use is to try to induce management to eliminate the toughest takeover defense—the staggered board provision. Corporate boards follow many such suggestions, even if they are not binding. Some are never even brought to a vote—upon receiving the notice, boards sometimes prefer accommodating the request instead of risking a cascade of public dissent.

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question

What is an LBO? How common are LBOs?

answer

An LBO is a leveraged buyout, that is, one that is financed with a significant amount of debt. They were very common in the 1980s. They receded in the 1990s but made a small comeback in the mid-2000s. With the credit crisis of 2008, they disappeared again.

The Link between Mechanisms

There are also many interactions between corporate control mechanisms. For example, if the board is very poor, it will be more difficult for large shareholders to influence it. If there are no potential raiders, the presence of large shareholders will not have an effect—management will not worry that it could lose control. If there are no large independently owned share blocks, a hostile acquisition will have a lower chance of success. If the board is dominated by the CEO-chairman, she can institute effective antitakeover defenses. This could prevent potential outside acquirers from stepping in. In turn, this could make the stock less attractive for institutions to acquire blocks. And so on.

26.G The Design and Effectiveness of Corporate Governance Systems

So far, we have mostly taken the perspective of entrepreneurs who operate within an existing system of corporate governance. Firms trade off the advantages of being public (such as access to more capital and better diversification) against the disadvantages (the internalized costs of managerial misbehavior). This is not to condone the latter: Just because some shoplifting may be unavoidable does not mean it is either ethically justifiable or efficiency enhancing.

We now take the perspective of engineers of corporate governance systems. How good is our corporate governance system? Arguably, a country that has better corporate governance is likely to match entrepreneurs and funds better, induce management to take more value-enhancing projects, and generally allow it to outcompete other countries. It is a matter of great importance to a nation's economic competitiveness to have a good system. Of course, no governance system is ever perfect. It is impossible to design a system in which corporate contracts and arrangements result in first-best outcomes. In the real and imperfect world, the outcomes are usually second-best. In equilibrium, the system must trade off the costs of governance regulations (such as regulatory costs, administrative costs, compliance costs, enforcement costs, a reduced willingness by managers to take risks, extortion by politicians, etc.) against the benefits (better access to financing by entrepreneurs, less agency waste, etc.).

RunAway Dynamics, Self-Regulation, and the Market

As practicing economists (i.e., business men and women), our first inclination is to ask whether the free market can be put in charge of coming up with a good governance system or whether government intervention is warranted. There is much empirical evidence that governmental supervision often has strong drawbacks, ranging from inflexibility as circumstances change, to useless bureaucracy, to capture of the regulatory agency by the incumbents supposed to be regulated, to the ability of regulators and politicians to shake down regulated firms. Most economists intuitively prefer less government intervention. So, is corporate governance a domain in which we want more or less government intervention than what we have at the moment?

In the very first section of this chapter, you learned that theory predicts that young, upstart companies should be fairly well governed. Thus, society can probably rely on the free market in these cases: It is in the interests of entrepreneurs to write good constitutions that will work well for the first few years after the IPO. It is unlikely that bureaucratic government regulations from the top could do any better.

However, the theory also predicts that many diffusely held, large, old, cash-rich companies are poorly controlled. The problems should be especially bad if the corporate board and management have enjoyed long tenure and there are no large external shareholders willing and able to step in. Neither the entrepreneur's design nor the need to raise capital would play much of a role in shareholders' control over management.

The situation may actually be even worse than I insinuated. A good metaphor for the point that I want to make now is that corporate governance is like a dam holding back a water reservoir. If there is even a tiny crack in the dam, the water's energy focuses quickly on widening this crack. Analogously, if there is even a small crack in the ability of the board to control its manager, this manager can use this crack in order to perpetuate it and to create further weaknesses. For example, once the CEO has appointed a few of his friends to the corporate board, then appointing more friends to the corporate board generally becomes easier. A manager who controls the board can institute stronger takeover defenses to avert external control challenges. A manager who succeeds in obtaining a large executive share grant has more shares to vote in the following year.

But what about the many good CEOs? In this context, they don't matter. This is about governance, not good management. If the manager's intent is intrinsically good, it will make little difference whether the firm has good or bad governance. Such managers won't spend much time searching for chinks in the armor. It is only when the manager is bad and harbors an intent to enrich himself that he will spend a lot of his time on weakening the governance structures that restrain his self-interest. Thus, it is precisely when management is most self-seeking that poor corporate governance really hurts owners the most. Its the "perfect storm."

Given that just a brief lapse in governance can lead to perpetual control of management, it should not come as a surprise that it may not even be possible to design a good charter. Even if it mattered greatly to the entrepreneur to institute a corporate charter that controlled future managers in the long run (which you know is not the case), it probably wouldn't work. No matter what mechanisms an entrepreneur may create, in the long run, management will find ways to neuter them. Ultimately, internal governance provisions, such as the corporate charter alone, can offer only weak protection, because management can amend it.

This runaway dynamic suggests that it is difficult to rely on companies themselves to maintain a balanced governance structure. It also suggests the same two outcomes that the theory in Section 26.B predicted:

- Young, small firms have good governance
- Old, large, cash-rich firms do not have good governance

Both theories imply that early in their lives, firms will be fairly well controlled.They have large shareholders interested in wealth maximization, corporate boards that share the goal of maximizing the owner's welfare, and firm sizes that could make them appetizing targets if they are not well run. Over time, management will seek to gain more and more control. At some point, incumbent management will become powerful enough to systematically dismantle most remaining charter protections. At this point, only laws and regulation that cannot be circumvented—such as fiduciary duty, legal limitations on takeover defenses, and statutory requirements (e.g., shareholder votes)—can be firmly relied upon as defenses against bad management.

Casual observation suggests that when we hear about breakdowns in governance for publicly traded corporations, it is often exactly in the kinds of firms where we would expect them—large, old firms with lots of free cash flow. Although this may not have been a big problem for entrepreneurs and early investors in these companies decades ago (such as Walt Disney in 1957), it could be a big problem from a social perspective. Firms like Disney constitute an important part of our economy, employing millions of people and controlling hundreds of billions of dollars. As an economy and as a society, we do have an interest in keeping these firms running well.

My Opinion: What Works and What Does not in the U.S.?

Fortunately, corporate governance in the United States still seems to work better than it does in many other countries. Nevertheless, it seems broken in many large, publicly traded, old companies. Even when governance is broken, if the management is intrinsically good, the consequences of bad governance may be modest.

Capitalism in the United States will not collapse because of managerial theft and misbehavior, even though our corporate governance system has undeniable problems—perhaps because theft and mismanagement can only be so large. Our problems are not even big enough to destroy most of the wealth created by many of our multibillion-dollar publicly traded companies. But in terms of the wealth siphoned off from the corporate sector into individual pockets and in terms of bad decisions taken, the problem may not be so modest. Again, we are talking not only about billions of dollars but also about millions of jobs. And even though U.S. capitalism will not collapse over poor corporate governance, individual companies could fail and the U.S. economy could fall behind global competitors.

Like the agency problems themselves, the solutions to agency problems are complex. All governance systems rely on a combination of mechanisms. You already know that today's mechanisms involve the combination of legal obligations, informal and ethical obligations, and corporate contractual obligations. Although they all need one another, we can wonder what really works. Of course, there is much disagreement on a subject as broad as that of corporate governance. It does require judgment, and here is my own.

Internal governance: Corporate board governance is not an effective control mechanism in many companies. It cannot be relied on. It works only in extreme cases. Fortunately, with more scrutiny both from the public and (the also conflicted) corporate governance consulting firms, boards have become a little better.

External market for corporate control: External raiders in the United States are sophisticated and have deep pockets. Laws strongly influence this channel. On the plus side, U.S. corporate laws have made it difficult for boards to isolate themselves completely against bids. Thus, external threats continue to be powerful restraints. On the minus side, our corporate laws have also given boards very powerful tools to prevent most takeovers. Moreover, macroeconomic financial market conditions are not always suitable for takeovers.

Informal social constraints: Social norms and the press continue to be important, although the standards of appropriate behavior have shifted over time.

Formal legal constraints: Laws are perhaps our most important bedrock protection, not only because they lay the foundation for private contracting but also because they are least susceptible to being changed over time if a bad corporate board wants to institute rules that give it more and more power.

IMHO, legal protections in the United States are investors' best friends. Not originating from the firm itself, they are simply more difficult for management to dismantle. Our laws do not allow the board to declare shares void, dilute existing shareholders away, eliminate all outside directors, or even to schedule shareholder meetings only once every decade. Delaware and other state laws prescribe that firms have to have directors and an annual meeting, that managers have a fiduciary legal responsibility, and so on. Moreover, as noted, it is our laws and regulations that generally still make it possible for an external shareholder in the typical publicly traded corporation to acquire a majority of shares and take control of the firm even against the will of an incumbent board. This possibility of an external takeover is still among the important restraints on management of old publicly traded corporations. Yet although managers cannot circumvent the law and its regulations completely, many boards can and have managed to blunt it. For example, a staggered corporate board effectively eliminates the possibility of a hostile takeover. There has not been a single successful unfriendly takeover of a firm with a staggered board. It would take an external raider at least a year of suffering from value destruction by an existing hostile board before he could take control of the firm.

In sum, it seems to be the legal structure in the United States that is our saving grace. Our standard of disclosure; our requirement of fiduciary responsibility; our effectively enforced prohibition of theft, fraud, and insider trading; our personalized legal liability; our strong enforcement of laws; and our facilitation of some external pressure by raiders all contribute to a viable governance framework. Surprisingly, this is enough to rank the United States at the top of locales for equity investors.

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If you believe that the U.S. corporate governance situation is imperfect, consider the situation in other countries, such as Germany or Russia.

Germany: In Germany, insider trading was legal until 1994. Disclosure standards are still modest. Minority shareholders have few rights against self-dealing by majority shareholders which are themselves often other corporations. Executives have legal obligations not only to shareholders but also to employees. This means that they may be legally forced to spend investors' money on behalf of the employees instead of returning it to investors. (Would you invest in a business in which a large part of your profits would have to go to employees by law?)

But perhaps most amazing is the fact that many German firms are owned by complex webs of other firms, which in turn are owned by yet other sets of firms, which in turn own themselves. Ultimately, most large, publicly traded German firms are owned by the banks. The banks in turn are owned by. . . themselves! Deutsche Bank holds voting rights for 47.2% of its shares, Dresdner for 59.25%, and Commerzbank for 30.29%. Source: Charkham (1994).

Russia: Germany looks like investor heaven relative to Russia. In Russia, shares can be declared void by the board at any time, majority share owners cannot force an issue onto the corporate agenda, and even physical threats against pesky shareholders are not unheard of. (And do not look to courts and police for protection: Judicial and political corruption in Russia is legendary.)

China: There is no real rule of law in China—it's the Wild West. In May 2011, Yahoo lost about $2 billion of its value when it became clear that its joint venture with Alibaba.com is not protected from the whim of its main owner, Jack Ma. He simply transferred a subsidiary of Alibaba.com—the equivalent of the Chinese Paypal—from company ownership to his personal ownership. (If you recall the Microsoft-Yahoo takeover struggle from Section 25.F, you may find there is no honor among thieves! Of course, it is always the Yahoo shareholders that suffer the consequences the most.)

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This situation is perplexing to me as an economist. Most economists' perspective (or call it our gut instinct) is usually that much of what the government touches comes out for the worse. Private contracting usually tends to do better. Yet it seems that the legal structure in the United States is our most effective mechanism for corporate governance. All in all, I deem it appropriate for the government to take a (more) active role in corporate affairs, despite the drawbacks and risks that government intervention carries. You may disagree.

Where are we going?

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One might be tempted to just leave a system alone that seems to have worked for decades. (In fact, economists are very good at arguing that a current system, whatever it happens to be, is efficient.) But this system has never been static, either. Bad managers have always found new ways to profit, and new mechanisms, regulations, and court rulings have always come about to push them back. There is a real danger that if no action is taken and the balance between the costs and benefits of corporate governance shifts without a good response, then investors (and firms) may leave the United States for greener pastures in other countries.

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I am not the only analyst who feels this way. A whole range of institutions and temporary commissions have proposed "**best practice**" guidelines for corporate governance over the years. The most prominent are the GM Board Guidelines (since 1994), the American Law Institute Principles (since 1992), the Business Roundtable Principles (since 2002), the National Association of Corporate Directors Report (since 1996), the Conference Board Recommendations (since 2002), the CalPERS Principles/Guidelines (since 1998), the Council of Institutional Investors Principles and Positions (since 1998), the TIAA-CREF Policy Statement (since 1997), the AFL-CIO Voting Guidelines (since 1997), and the OECD Principles/Millstein Report (since 1998).

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One big problem with the credibility of these recommendations is that there is not a single authoritative one. My sarcastic view of our situation is that "the nice thing about our standards is that everyone can pick his own." FASB works so well because it is the only official recommender of "generally accepted accounting principles." We really need one clear authoritative standard, not many.

Sarbanes-Oxley

Recent corporate scandals in the United States, especially the Enron scandal of 2001, caused a public outcry that brought with it a number of corporate governance reforms. Ironically, these scandals are not what needed remedy. They were the results of already criminal actions, and many of their perpetrators have ended up in prison under the old laws. Of course, no reform can eliminate all scandals in the future: Just as bank robberies exist despite laws against bank robbery, so will illegal managerial behavior continue despite laws against it.

The **Sarbanes-Oxley Act of 2002** (popularly dubbed **SOX**) was the most important law passed in the wake of a number of spectacular corporate collapses. SOX builds on our multitiered system of corporate regulation (e.g., the SEC, FASB, and direct legal corporate requirements). Most of its provisions seek to strengthen the independence and function of the corporate board, especially insofar as the audit, executive compensation, and nomination committees are concerned. Some are improvements over existing rules, in that they are cheap and eminently sensible. For example:

- There is now a clear definition of what an independent director is: An independent director is an individual who has no current or recent material relationship with the company. (But note that independent board members can still have close relationships with the CEO.)
- Independent directors must meet among themselves in regularly scheduled executive sessions without management.
- Companies can select the members of their executive compensation committee and board-nominating committee, but these committees must be majority independent (NASDAQ) or fully independent (NYSE).
- Section 302 prescribes that the CEO and CFO must certify to the audit committee the accuracy of the company's financial reports/condition. (Interestingly, this was not really a novel feature of SOX. Executives were responsible for the reported financials of their companies even before its enactment. It made for good television, though.)
- Attorneys must alert the SEC if they learn of credible evidence of breaches of fiduciary duty or of securities law.
- A large part of SOX pertains to the audit committee, as the act itself was sparked by accounting scandals:
  - The audit committee, which checks over the company's financial reports, must consist entirely of independent directors. There are additional special rules for the audit committee pertaining to large shareholders.
  - The audit committee must have choice of, oversight of, and compensation responsibility for the company's auditors. It can engage additional advisors, and it must institute procedures to handle both complaints and whistle-blowers.
  - The audit committee must identify which of its members is a financial expert, and at least one expert is required.
  - The audit committee has "code of ethics" responsibility.
- External auditors are now limited in the amount of consulting work they can do for companies. Historically, this has been a great source of conflict for public auditors. In addition, the audit committee must approve any remaining nonaudit consulting work by the auditor.

With the possible exception of the prohibition of consulting work by auditors, none of the above prescriptions are expensive from a corporate perspective and most make common sense. However, other SOX requirements are more controversial because they have increased corporate costs quite significantly:

- Auditors must be rotated on a regular basis in order to reduce the tendencies of relationships between firms and auditors to become too cozy. This may or may not be a good idea—the jury is still out. New auditors have to learn more about the firm first, and they may be less adept at detecting unusual behavior. Moreover, there are now only four big accounting firms competing for Fortune 100 business. In real life, a corporation may only be able to ask for bids for work from three other (busy) accounting firms.
- **Section 404** is SOX's most controversial requirement. It prescribes that the annual report has to explain the internal controls and attest to their effectiveness. (Actual implementation was delegated to the SEC.) Of course, being a part of the internal report, this part has to be audited—and the evidence suggests that this has doubled annual audit fees. Although Section 404 is costly for firms of all sizes, the smaller the firm, the more burdensome this seems to be. Auditing fees are not insignificant for small, publicly traded corporations. It is common for their audit fees to exceed their annual earnings—only the hope of future growth keeps them going. The extra burden may push many of them over the cliff.
- SOX has also added record-keeping requirements that are often not clear how to interpret. Sections 103 and 802 require that all audit-related information be retained for a period of not less than 7 years—any

  electronic messages, emails, and the like. This can be broadly constructed to apply to almost everything and will be a bonanza for IT departments and consulting firms (and later for trial lawyers) for years to come.

Better Alternatives?

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Was SOX a good reform? In my opinion, probably not:

> A good system of corporate governance should be cheap and effective.

SOX is neither. Even its authors Michael Oxley and Paul Sarbanes admit that they would write the act differently today, according to The Economist ("Five Years Under the Thumb," 7/26/2007). SOX was passed too quickly under tremendous public outcry in the wake of corporate scandals. Although well intended and not devoid of positive aspects, it is probably a good example of how corporate governance should not be legislated. For the most part, SOX focused on process over outcome. It added a lot of new compliance and paperwork. Some have even called it the "accountants' windfall profit act"—ironic, because it was accountants' failure that contributed greatly to many of the scandals in the first place. Since 2003, the remaining four accounting firms have enjoyed banner years of high profitability.

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My opinion is not so much that SOX was terrible—though the jury is still out on how the more expensive provisions will hinder young, small firms' access to capital. It could even be that SOX's reforms were a net positive relative to what preceded it. However, my opinion is that the appropriate benchmark should be the law and reforms that could have been passed in SOX's stead. Here are my views on what should have been.

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My first reform suggestion would not even require a law. Today, the SEC is not only a legal enforcement agency (of insider trading) but also our premier corporate regulatory agency. It is charged with putting general legislation into practice with specific rules and often with giving advice and perspective to Congressional committees. However, the SEC has traditionally been run by a lawyer. Lawyers are by nature more inclined to emphasize the legal process and more focused on the first task, enforcement. Instead, we need more emphasis on the second task, regulation, and on instituting effective mechanisms that have low compliance costs. It's time to appoint an economist as SEC chair. Unfortunately, if anything, the SEC has moved farther away from its regulatory rule, in effect disbanding its economic research division, and focused more on its political and enforcement rules.

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Next, the SEC should institute an authoritative independent board, somewhat similar to FASB, that recommends best practice for corporate governance. By placing best practice in the hands of a government-endorsed independent institution, the system would hopefully remain flexible and unpoliticized enough to make changes when the environment demands it. Firms, boards, and managers that follow best practice should receive "safe harbor" legal consideration against regulatory action and investor lawsuits. Having definitive recommended best-practice regulations would also put appropriate legal and moral pressure on firms to follow these practices. However, the system should allow firms to ignore certain recommendations when it makes great financial sense for them. A more flexible "safe harbor nudge" instead of a strict legal requirement can accomplish this.

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I also have a list of what I believe a governance board should recommend as best practice—but these are really better decided by a group than by me alone:

- The position of chairman of the board should be separate from that of chief executive officer. (This was strongly championed by Ira Millstein.) It should be obvious that if the chairman is also the CEO, at best, independent corporate board directors can only struggle to maintain a little influence over management, rather than oversee management in the interest of shareholders. Today, in executive circles, a company that has a separate chairman is viewed as not trusting its CEO. It must become the accepted corporate norm for these two positions to be separate.

  The argument against separation, mustered by many CEOs, is that it would cost them time and effort to deal with a separate chairman. One can view this argument as stating that a benign dictator is better than checks and balances. This is true—checks that always determine that the CEO has acted the right way may be a waste. However, good governance does not come for free. It can cost money if management is good. Good governance can save money to prevent management from turning bad—which is, after all, the whole point of governance. Again, good governance is not good management. Good governance is the mechanism to prevent management from turning to the dark side.

- Inside directors should be allowed to be members, but they should not be allowed to vote on corporate board decisions. This would also help clarify the pecking order and enhance separation between the board overseeing management and management running the firm.

- Directors should be required to be individually approved, not just as part of a slate. This would impose a discipline on the types of directors that boards would propose and allow disgruntled shareholders to express dissent in a manner painful to the board. Many S&P 500 companies have recently voluntarily instituted this. (Presumably this includes few companies where it would really be needed.)

- Staggered board provisions should require extra scrutiny. For example, they could be required to receive approval by $^2/_3$ of all (and not just voting) shareholders.

- Shareholders should have a "say on pay"—that is, a (possibly nonbinding) opportunity to express their views, similar to what shareholder proposals accomplish.

- Any insider trading should be disclosed a few days before a trade, not after it. The cost of such a rule would be that it makes it less desirable for a CEO to own shares. In some situations, this can be a negative. However, anyone who is in favor of restrictions on insider trading should probably also be in favor of upfront disclosure.

- Large, publicly traded companies with more than $100 million in market capitalization should be forced to disclose their tax financials. This would reduce their incentives to overstate earnings. The cost is that companies might lose a competitive edge if they had to disclose more information. However, the same critique applies equally well to all GAAP disclosures.

I believe the above changes could be effective at modest cost—unlike SOX, which is not effective and has high costs. Again, individual firms that find them too expensive could opt out at their own risk. X

In my opinion, these suggestions cannot be implemented by individual companies. There are three reasons:

1. Single firms compete for managerial talent. They cannot go against the arrangements that are common in other firms. (Over time, this competition for managerial talent may even have created a "race to the bottom" in which firms are competing on the least governance.)

2. Having a system different from that of other firms would be viewed with deep suspicion. Do unusual and stricter controls signal something about the board and its desire to institute better rules, or something about the trust that the board has in its own managers?

3. Voluntary restraints would work in precisely the kind of firms that do not need them—those with good CEOs. In firms in which bad management has taken charge, the dynamic has set in that would again eliminate these constraints.

Thus, it is my view that governance improvements generally work better if they are systemwide. X

Most importantly, you should not adopt my view without your own critical consideration of the corporate governance situation in the United States today. Many of my views and suggestions are quite radical, and none are without cost. This means that intelligent people can strongly disagree with my opinions. You should contemplate whether you want to be one of them.

anecdote

Arecent phenomenon is the emergence of corporate governance consultants. For example, Georgeson publishes an interesting year-end wrap-up of shareholder proposals and proxy contests. Unfortunately, some corporate governance consultants not only publish ratings of how well publicly traded companies are governed but also sell "advice services" to companies. Not surprisingly, following the consultants' advice, the client tends to improve in the consultants' rankings. It is clear that the corporate governance consulting industry is creating serious corporate governance issues itself!

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question

What are the main SOX reforms?

answer

Independent directors are now clearly defined. They must meet by themselves regularly without management. Rules concerning the audit committee and the independence of auditors were beefed up. The CEO and CFO must certify the accuracy of the company's financial reports. Attorneys must report certain breaches of fiduciary duty or securities laws. The executive compensation and board-nominating committees must be majority independent. There are also some other reforms that seem to be less beneficial.

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wideonecolumn

Summary

widetwocolumns

This chapter covered the following major points:

- Control rights are necessary components of any security in order to defend investors' cash flow rights. Debt can force bankruptcy in case of violations of covenants or nonpayment. Equity can elect the corporate board.
- It is in the interest of the entrepreneur to set up the firm so that it will not suffer a subsequent breakdown of governance. This increases the value of the firm when first sold. Unfortunately, this incentive to "set it up right" is strong only at the outset when the firm is first taken public.
- Once a firm is public and diffusely held, a "runaway" long-run dynamic can set in: Management will want to exploit any gaps in governance to wrest even more control of governance away from shareholders. Thus, the primary governance sanctions working well in old, cash-rich companies are those that are not at the discretion of the board and management itself.
- Managers have the incentive to act in their own self-interests, not necessarily in the interests of shareholders and creditors. Among the issues that governance must be concerned with are illegal temptations (such as theft, fraud, insider trading, tunneling, and bribes) and legal temptations (such as empire building, entrenchment, corporate perk consumption, excessive executive pay, ethical conflicts, or misaligned incentives).
- There are many mechanisms that reduce or rein in managerial misbehavior. The most prominent are corporate boards, corporate takeovers, the presence of large shareholders, the legal environment (especially that in Delaware), social norms and ethics, and debt (that forces management to perform or go bankrupt).
- The most prominent change in the corporate governance landscape in decades was the Sarbanes-Oxley Act of 2002. However, relative to possible other alternatives, it instituted measures that were very costly for corporations but that improved actual governance only very mildly.

EOC MATTER

eocproblems

question

Go to Edgar, the SEC's website. Look up El Torito's S-4 filing on 2004-06-09. Describe the covenants and requirements to which El Torito is obligated. (Note: This may take a while, but reading this S-4 will introduce you to how these agreements look in the real world. If you already did this exercise in Chapter **??**, pick another company of your choice.)

answer

This particular El Torito SEC filing is for the issuance of new 10% senior debt obligations to be offered in exchange for existing 10% senior debt obligations. The new notes will be collateralized by all inventory and equipment, all accounts receivable, all U.S. trademarks, trade names and some other U.S. intellectual property, all real estate owned in fee by the company and the guarantors, and all proceeds from the sale or other manner of disposition of any of the stipulated collateral. The investors in the new notes, however, will have a junior claim on the proceeds of the specified collateral, which means they will only receive the proceeds after the entities having a senior claim are paid in full. The covenants also indicate that the new notes will be unconditionally guaranteed on a senior secured basis by each of Real Mex Restaurants' restricted subsidiaries. Other provisions, include a callable feature, which allows Real Mex to redeem the notes prior to maturity any time on or after April 1, 2007, or earlier if certain conditions are met, and a puttable feature, which allows the note-holders to sell the notes back to the firm if there is a change in the control of the firm. Still other covenants restrict the firm in its ability to issue more debt, make certain investments, pay dividends, repurchase its stock, issue or sell stock of its subsidiaries, create liens, enter into transactions with affiliates, incur dividend or other payment restrictions, merge or consolidate its operations, and transfer or sell its assets.

question

Thomas Edison took General Electric public in the 1880s. Would it have been in his interest to write a charter that would prevent a self-serving CEO 100 years later to pay himself 1% of the firm's value as compensation? Would it have been possible?

answer

Theoretically, yes. Practically, no. The money 100 years out was too little.

question

Should society worry that executives would unduly enrich themselves, or can society rely on the entrepreneurs' incentives to write corporate charters that prevent this? Under what circumstances does either of these two perspectives seem more powerful?

answer

Theoretically, yes. Practically no. For old, diffusely held firms—which control much of the wealth in the economy—the original entrepreneurial incentives may not be enough.

question

In the example in Section 26.B, the manager of a $60 million firm takes a $30 million project that costs $50 million, just because it produces $10 million in managerial perks. Let's presume this project produces no perks, but managerial compensation is 1% of firm size, every year. This means, for example, that the manager earns $600,000 without the project. Would the manager still want to take this project?

answer

Yes, the manager would still want to take this project. You are paid 1% of the firm value for having managed the firm at the end of each year. If you manage a $90 million firm, you would earn a salary of $900,000, which is $300,000 more than you would earn as the CEO of a $60 million firm. Note that the cost of the project would not enter into the manager's decision to take the project.

question

Does the desire to raise equity capital always control managerial agency conflicts? That is, does it induce managers to do the right thing?

answer

No. Quite the opposite can happen—seasoned equity offerings can be a mechanism by which managers enrich themselves at the expense of the company that they are running.

question

Are all de facto "bribes" of executives illegal?

answer

No. Wining and dining is not, for example. Moreover, even when illegal, as long as there is no clear one-to-one tit-for-tat and/or cash changing hands, even illegal bribing is so difficult to prove, it is almost the same as legal.

question

Discuss when pay-for-performance is a good idea, and when it is not.

answer

Pay-for-performance is a good idea if it is real (and not based on a benchmark that is so low that it will almost surely be met), if it is appropriate risk-adjusted, and if the targets are more likely achieved if the managers perform better. It is a bad idea if it is a way to hide income, if it is not adjusted to take out factors that managers cannot influence, and if managers can influence the risk of the firm.

question
Search the Web to find the executive compensation of the 10 highest-paid executives last year. In which cases would you attribute the salary to superior performance of the executives themselves?

answer
The answer will depend upon when the student completes the question.

question
Make the argument why managers in the United States are paid appropriately.

answer
Although the amount of the compensation they receive may seem extraordinary, if the marginal cost of the compensation exceeded the marginal benefit, we would expect changes to be made. Indeed, when performance is extremely poor, managers get fired. However, if the performance is merely "weak", it may be the case that the costs — both direct and indirect — of replacing management is higher than the perceived benefits associated with doing so. There is, after all, a competitive market place for executive management, and we cannot assume an instant movement of resources when dealing with human capital. Moreover, empirical evidence indicates that when a firm is taken private, managerial compensation is even more closely tied to performance than when the firm was publicly held, and the executives are rewarded even more when the firm does well then they were before.

question
Make the argument that managers in the United States are paid too much.

answer
Consider the fact that European and Japanese CEOs earn only about 10% as much, although the market for managerial talent is likely as competitive in these countries as it is in the United States. Furthermore, the average CEO in the United States earns 2– times as much as the average employee of the firm and considerably more than the second-in-command, as well. It is likely that the second-in-command would be able to do as good a job running the company and would do so for a lot less pay. Moreover, CEOs in the United States receive absurd increases in compensation when the market values of their firms increase, even if the increase is due almost entirely to external forces.

question
Discuss the pros and cons of the government taking a more active role

in determining the corporate governance rules by which corporations operate.

answer

Pros: Some government rules are of course always needed. They are effective. They apply to everyone, so there is no "no race to the bottom".

Cons: Whatever the government touches often comes out for the worse (e.g., due to lobbying. inflexibility. cost, and so on).

question

Search the Web to find 10 bankruptcies that occurred about 3 years ago. In how many cases is the CEO still in charge today? What happened to the CEO afterward—did this CEO get a good job elsewhere?

answer

The answer will depend upon when the student completes this question and upon which bankruptcies are chosen.

question

Search the Web to identify any 30 Fortune 500 companies. In which of these firms is the CEO also the chairman of the board? What fraction of the board are employees of the company who are reporting directly to the CEO?

answer

The answer will depend upon when the student completes this question and upon which companies are chosen. However, more often than not, the CEO will also be the chairman of the board.

question

Under what circumstances would you expect the sudden appearance of large shareholders to be good for minority shareholders? When would their appearance be good for independent executives?

answer

In the United States, the presence of large shareholders tends to be good news for minority shareholders. Certain types of shareholders tend to help control managers and potentially facilitate an external acquisition. However, if the large shareholder also owns many other companies, then tunneling becomes a real incentive that could hurt minority shareholders. The sudden appearance of a large shareholder is rarely good news for managers.

question

Can you recommend other corporate governance reforms that were not described in this chapter? Discuss the pros and cons of your suggestions. Under what circumstances do you think the pros would outweigh the cons, and vice versa?

answer

This answer will vary greatly depending upon the student's own thoughts and recommendations. It is a tough question to answer. Here is an example to one potential response:
Recommendation: Require the board of directors to have a reasonable investment in the stock of the firm.
Pro: This should motivate them to make shareholder-maximizing decisions.
Con: The pool of people will to serve on the board would be smaller and quality would be sacrificed.

Chapter 27

International Finance

intro

With Focus on the Corporate Perspective

This chapter provides a brief introduction to international finance as viewed from the perspective of a domestic CFO, who is dealing (at relative arms-length) with subsidiaries, sales, or the raising of capital in other countries. When a U.S. firm goes multinational, many issues can become more complex. For example, marketing to customers, hiring employees, dealing with suppliers, and accounting rules can all be different in other countries. These issues are not principally the domain of corporate finance, and thus we shall ignore them in this chapter. Similarly, foreign managers of foreign corporations can face a whole slew of novel corporate finance issues that we will also ignore—for example, in some European countries, managers are legally obliged to maximize not just shareholder value, but a broader stakeholder value.

Ultimately, for the financial (but not the operational) side of U.S. firms expanding abroad, there is one primary complication: currencies. Otherwise, you can treat foreign subsidiaries located in other highly developed countries pretty much the same as you treat domestic operations. The problems and solutions look very much alike. Of course, currency issues can pervade multiple areas of finance—exchange rates for trading, foreign investment, capital budgeting, and hedging. These are the subject of our chapter.

27.A Currencies and Exchange Rates

x

The financial markets of the United States are the largest in the world. About half of the world's stock market capitalization and bond market capitalization is in the United States. Europe accounts for about one-quarter, and Japan accounts for about one-eighth. (It is likely that southeast Asia, including China, will soon play a more prominent role.) Corporate borrowing is even more lopsided: U.S. corporations account for about 75% of the world's corporate bond issues.

x

Throughout this chapter, we want to look at the United States vis-à-vis a broad set of other countries. To refer to richer nations with open capital markets, we shall follow the common practice and just call them the OECD countries. (The OECD is the Organization for Economic Cooperation and Development and includes many North American and European countries, Australia, Japan, and Korea.) The most important conceptual difference between a financial transaction within the United States and a financial transaction with another OECD country is often that of currency exchange rates. Thus, this is our first order of business.

Exchange Rates and Currency-Dependent Rates of Return

x

An **exchange rate** is the price of one unit of some country's currency in terms of one unit of another country's currency. It is really no different than the price of a good. For example, your grocery store really posts "exchange rates," too: for example, 0.25 $/apple or 4 apples/1$.

x

There are standardized currency quoting conventions. For example, one convention is to quote the yen-dollar exchange rate (e.g., 105 ¥/$) rather than the dollar-yen exchange rate; and another convention is to quote the dollar-euro exchange rate (e.g., 1.55 $/€) and the dollar-pound exchange rate (e.g., 1.95 $/£). Be careful: The dollar depreciates either when the ¥/$ rate decreases (fewer yen per dollar) or when the $/€ rate increases (more dollars per euro).

x

The exchange rate that you pay when you travel and need physical cash, for example, from your hotel or an airport exchange booth, is usually rather unfavorable. But the financial currency markets, whose exchange rates apply to large financial transactions, are the most liquid and competitive markets in the world, with very low transaction costs and bid-ask spreads. Although there are no solid statistics, the typical currency trading, including forward and futures trading, is around $1.5 trillion a day. To put this into perspective, this is more than 10 times the typical daily trading volume in equities and about 10% of the annual U.S. gross domestic product (GDP). In such liquid and active financial markets, it makes sense to believe in market efficiency. Few, if any, investors should have an unusual ability to predict the exchange rates better than the market itself.

Currency Forwards and Interest Rate Parity

x

Corporations can hedge the risk caused by exchange rate fluctuations by trading currency contracts. The most familiar contract is a **spot contract**, which is for an immediate exchange of a fixed amount of currency based on the **spot currency rate**—the current exchange rate.

Forwards versus Futures

x

In addition to spot transactions, traders can engage in transactions that are based on future spot rates. A **forward contract** is an agreement to exchange a fixed amount of currency on a fixed date in the future at a price that is locked in today. These contracts are usually structured so that they are a fair exchange between parties, and neither party needs to pay anything at the outset. For example, a contract between a buyer and a seller may state a mutual agreement to swap $1.5 million for €1 million in 3 years. x

However, currencies (and many other assets) trade not only as forward contracts but also as [pl]futures contract. A future differs from a forward in that it settles up contract value changes every day. For example, assume you have purchased a futures contract today that commits to exchange (your) $200 for the receipt of (someone else's) £100 next year. Let's say that the dollar depreciates tomorrow and the futures exchange price changes from 2 $/£ to 3 $/£. Your £100 committed receipt is now worth $300. Instead of waiting, the futures contract immediately requires an interim settlement: The seller of your futures contract must pay you the $100 at the end of the same day. After each daily settlement, the contract value of a future (but not of a forward) always resets to zero. x

This immediate settlement arrangement reduces the counterparty credit risk, that is, the probability that one side accumulates losses big enough to default on the contract. This idea of immediate futures settlement has a long history. They were common on the Amsterdam securities exchange as early as the 17th century. This is no accident: Avoiding credit risk is especially important in exchange markets, where all kinds of investors can participate anonymously. Nowadays, currency futures are primarily traded on exchange markets, such as the Chicago Mercantile Exchange. This also means that the prevailing spot and futures currency exchange rates are publicly posted and easily accessible (e.g., on www.barchart.com). x

In contrast to futures, forwards are typically bought and sold in an over-the-counter (OTC) market. As in most OTC markets, there is no such thing as one unique forward rate. Corporations and other interested parties call up various X banks, which will quote them forward rates for their desired horizons—taking into account such factors as the credit risk of the transacting parties and the sophistication of the person on the other end of the telephone line. Therefore, forward rates are similar, but not identical, from bank to bank and from corporation to corporation. The forward market is much larger than the futures market. x

There is usually a small difference in the pricing of equivalent futures and forwards. For example, on March 26, 2008 (around 10:00 am for reference), the euro stood at 1.5725 $/€. The average 6-month forward stood at 1.5570 $/€, while the 6-month future stood at 1.5575 $/€. This 0.0005 $/€ difference was

driven by issues such as the credit risk in the forward and the fact that the along-the-way daily settlement of futures has implications as to which party is likely to receive interim cash (with its consequent interest receipts). For currency traders, the price difference between the future and the forward can matter. For purposes of illustrating corporate finance, however, we can ignore the difference and treat futures and forwards alike.

Covered Interest Rate Parity

x

How are spot and forward rates related? Here is an example of the spot and futures euro versus dollar currency rates on August 22, 2003:

Currency	**Spot**	**Forwards**		**Futures**				
	(Aug 03)	6 Months	1 Year	Sep 03	Dec 03	Mar 04	Jun 04	Sep 04
($/€)	1.0886	1.0823	1.0783	1.0878	1.0850	1.0825	1.0803	1.0783

You could receive 1.0886 dollars for each euro "on the spot." Or you could commit to a dollar-euro forward exchange 12 months later, which would only get you 1.0783 dollars for each euro. Why? Does this mean that the euro will depreciate against the dollar? Not necessarily. There is an arbitrage condition called **covered interest rate parity** (**IRP**), which ties together the currency spot rate, the currency forward rate, and the country Treasury interest rates. (We pretend that the futures price is also the forward price.) Let's call "right now" time 0, and August 22, 2004, time 1.

x

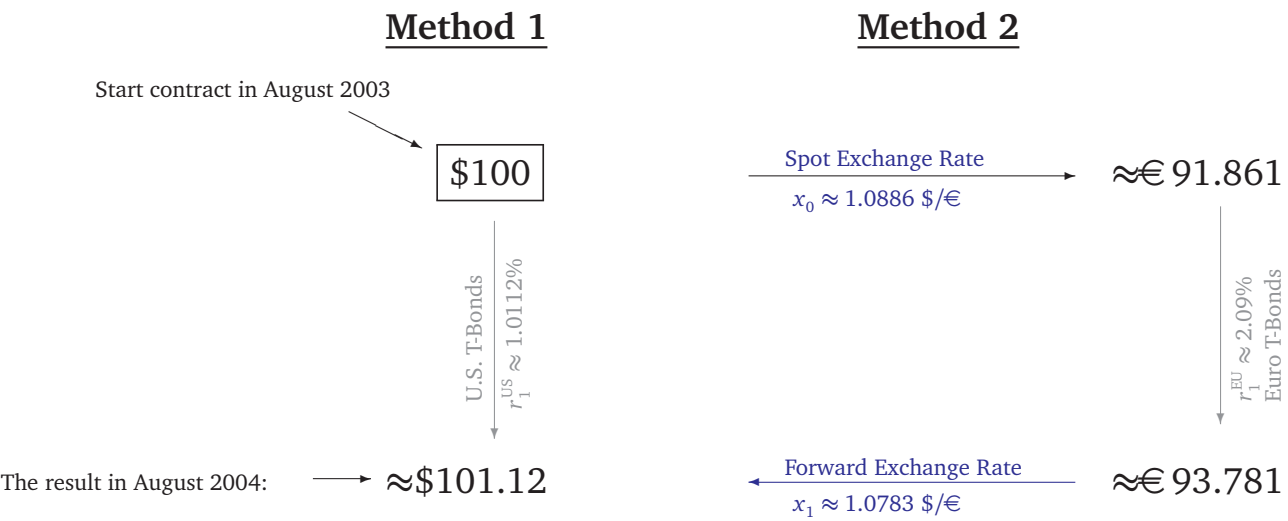
Figure 27.1 illustrates covered interest rate parity by showing two methods that lead to the same result. On August 22, 2003, the 1-year U.S. dollar Treasury interest rate was 1.12%. The 1-year European Central Bank interest rate was 2.09%. (Each currency has its own yield curve. You can find many such yield curves on financial websites, e.g., at http://www.bloomberg.com.) The left part of the figure shows that you could save $100 at the U.S. Treasury interest rate of 1.0112% to receive $101.12 in 1 year. The right part of the figure shows that you could instead exchange $100 into €91.861 at the spot rate, invest the euros at the Euro Treasury interest rate of 2.09% to receive €91.861 · 1.0209 ≈ €93.781 in 1 year, and lock in the 1-year-ahead forward exchange at the rate of 1.0783 $/€ to translate your future €93.781 back into 1.0783 $/€ · €93.781 ≈ $101.12.

x

What if the 1-year forward $/€ rate had been different? For example, what should you have done if the current forward rate had been 1.0886 $/€ (like the spot rate) instead of the actual 1.0783 $/€? You should have exchanged into euros today and locked in the exchange rate of future euros back into dollars in order to earn the interest rate in euros. Specifically, you could have exchanged your $100 into €91.861 and earned the 2.09% interest to end up with €93.781, with a

Figure 27.1: Covered Interest Rate Parity: Two Methods to Earn a 1.12% Dollar Interest Rate

—All numbers are known today, at time 0 (August 2003): The 1-year U.S. Treasury interest rate of 1.12%, the 1-year Euro Treasury interest rate of 2.09%, the current exchange rate of 1.0886 \$/€, and the 1-year forward exchange rate of 1.0783 \$/€ are known and contractible in August 2003. Note that we do not use—and thus do not need to know—the future spot exchange rate.



lock back into the reverse currency exchange for a net of €93.781 · 1.0886 \$/€ ≈ \$102.09. This is \$0.97 more than the \$101.12 that you would have received if you had invested in U.S. Treasuries. The U.S. Treasury rate would have been inferior—an inadmissible arbitrage opportunity that would have violated the law of one price.

anecdote

Currency arbitrage is nothing new. In the thirteenth century, Venetian bankers speculated in currencies on a grand scale. Twice a year, 20 to 30 ships sailed from Venice to the Middle East carrying silver and returning with gold. The gold/silver exchange rates were different in Europe than they were in Egypt. (The gold was exported from China to Egypt by looting Mongols.) By the fourteenth century, the Venetians had in effect replaced the Eastern gold standard with a silver standard and the Western silver standard with a gold standard. Their large currency reserves also allowed the Venetians to introduce cashless bank transfers among merchants' accounts, with credit lines and overdrafts. By the fifteenth century, Mongols, the Black Death, and

large-scale creditor defaults ended the dominance of Italian banks and set the stage for the reign of the German banking family of the Fuggers—the most dominant commercial company in history.

x

You can write covered interest rate parity as a formula. Call the \$/€ exchange rate today x_0. Call the forward exchange rate that you can lock in August 2003 for an exchange in August 2004 x_1. The arbitrage relationship is

$$\begin{array}{ccccccccc} \$100 & \cdot & (1+1.12\%) & \approx & [\$100/(1.0886\,\$/€)] & \cdot & (1+2.09\%) & \cdot & (1.0783\,\$/€) \\ I & \cdot & (1+r_1^{\text{US}}) & = & I \cdot 1/x_0 & \cdot & (1+r_1^{\text{EU}}) & \cdot & x_1 \end{array}$$

Simplify and rearrange this formula into the more standard way to write the interest rate parity equation, and you get Formula 27.1.

important

Covered interest rate parity is an arbitrage condition that implies that currency spot and forward exchange rates are linked to the country interest rates via

$$\frac{x_1}{x_0} = \frac{(1+r_1^{\text{US}})}{(1+r_1^{\text{EU}})} \qquad \left(= \frac{f_1}{s_0}\right) \tag{27.1}$$

The exchange rate x is defined in \$/€. x_1 is the forward exchange rate at time 0 for an exchange at the future time 1. In our example, 1.0783\$/€ /1.0886\$/€ ≈ 1.0112/1.0209. (The formula is easy to remember: Dollar and euro interest rates are in the same order as the exchange rate: dollar on top, euro on bottom. For extra clarity, the right side repeats the left side, but with f as the name for the forward rate and s as the name for the spot rate.)

x

Is the forward exchange rate the expected future spot exchange rate? The answer is "not necessarily." The question is analogous to whether forward interest X rates are expected future spot interest rates. Recall that you learned in Section **??** that there are two possible explanations for high forward interest rates: The expected future interest rate could be higher than today's interest rate, or investors may require risk compensation to be willing to hold longer-term bonds. In our currency context, the forward exchange rate could be different from the spot exchange rate for the same two reasons:

1. The future spot exchange rate could be expected to be different from today's spot rate.

2. One side of the futures contract must be compensated for being willing to carry risk.

It is only if you believe that there is no risk compensation that the exchange rate future today would be the best expectation of the future spot exchange rate. This is called **uncovered interest rate parity**. In this case, you can replace the forward rate in the covered interest parity with the expected future spot rate: The prevailing forward rate f_1 would be an unbiased predictor of the unknown future spot rate s_1: $f_1 = \mathrm{E}(s_1)$. There is no reason to believe that this is usually the case.

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question

On Friday, August 22, 2003, the Mexican peso forward currency rates were as follows:

	Cash Spot	1-Year Forward
\$/peso	0.09230	0.08660

In other words, 1 peso = \$0.0923. The 1-year U.S. Treasury note offered a yield of 1.12%. Explain what interest rate a 1-year Mexico Treasury investment in 1,000,000 pesos would earn.

answer

To compute the peso interest rate, use Formula 27.1:

$$\frac{0.08660\,\$/Peso}{0.09230\,\$/Peso} \approx \frac{(1+1.12\%)}{(1+r^{M}X_1)}$$
$$\frac{f}{S_0} = \frac{(1+r_1^{US})}{(1+r^{M}X_1)}$$

Therefore, the peso interest rate would be $1.0112/(0.08660/0.09230) - 1 \approx 7.78\%$. In English: Think about starting with 1 peso. Change it into \$0.0923 dollars at the spot rate. Earn the 1.12% U.S. dollar interest rate so that you have $\$0.0923 \cdot 1.0112 \approx \$0.0933$ after 1 year. Convert it back into pesos at the forward rate to get $\$0.0933/0.0866\,Peso/\$ \approx$ Peso1.0778. This is the 7.78% interest rate.

question

Does the forward rate necessarily give you the best forecast of the future expected exchange rate in x months? Can it tell you how it will differ from the current spot rate?

answer

The forward rate is not necessarily the expected exchange rate. There is also a risk compensation component in the forward rate, which drives a difference between the best expected future spot rate and the forward rate. Instead, the spot and forward rates are linked through arbitrage via the interest rate differential. So the forward rate tells you only about the interest rate differential. To the extent that there is a forecast of a future exchange rate, it should be reflected in today's exchange rate, too.

question
If the ¥/€ forward rate is at a **forward premium** relative to the spot rate (i.e., the forward rate is higher than the spot rate), is the nominal interest rate in Japanese ¥ or in European € higher?

answer
Let's work through an example in which the ¥/€ forward rate is at a forward premium. Think of a spot rate of 100 ¥/€ and a forward rate of 200 ¥/€. If the interest rate in euros is 0%, and the interest rate in yen is 100%, you would indeed be indifferent. You can invest €1 and have €1 next year, or you can invest ¥100 today, earn 100% interest, which comes to ¥200, and exchange it for €1. Thus, the interest rate in Japan is higher.

Purchasing Power Parity

x

Forward exchange rates are exactly determined by interest rates through an arbitrage condition. But there is a deeper question here: Why is the interest rate in
x euros higher than the interest rate in U.S. dollars in our example?

Economists are not sure, and here is why. The most important question is whether **purchasing power parity** (**PPP**) holds. The PPP theory of exchange rates posits that prices of identical goods should be the same in all countries, differing only in the costs of transport and duties. But does PPP hold? Does $108.86 buy the same amount of goods—say, apples—that €100 buy? If an apple costs $1.0886 in the United States and €1.00 in Europe, then PPP holds. What if it does not hold? What if, for example, an apple costs $1.00 in the United States and €1.00 in Europe? Then we should export cheaper U.S. apples to Europe, sell them for €1, and earn a profit of about $0.09/apple. Transport costs and import/export barriers (such as tariffs) are probably too high to permit an apple "arbitrage," but there are other more easily transportable commodities, ranging from diamonds to gold to gasoline. As economists, we expect prices for easily exportable and tradeable commodities to obey PPP. But other goods need not obey PPP: Land in France is not the same as land in Manhattan and it cannot be exported. Concrete is too costly to transport because shipping costs are too high. Raspberries spoil too easily to transport long distances. Maple syrup has little demand in Europe. A work hour by a Czech hair stylist is not the same as a work hour by an American hair stylist. And so on. Indeed, PPP does not even hold inside one country: Apartments and plumbers cost more in Manhattan than they do in New Jersey. Gas costs more in San Francisco than in San Antonio. The reasons why PPP does not hold inside
X a country are the same as the reasons why PPP does not hold across countries. But, if after taking transport costs into account, gas is still too expensive in San

Francisco relative to San Antonio, someone will likely start shipping it from San Antonio to San Francisco—and sooner rather than later. x

Still, let us assume for a moment that PPP does hold—that is, that goods in Europe and goods in the United States cost the same—and that PPP will also hold in the future. This assumption allows us to determine relative inflation rates. For example, consider an apple that costs \$1.0886 in the United States today and that costs €1 in Europe today. If the U.S. dollar inflation rate is 2%, then the apple will cost $\$1.0886 \cdot 1.02 \approx \$1.1104$ next year. We can lock in a forward exchange rate of 1.0783 \$/€, which means that next year's U.S. apple will be worth $\$1.1104/1.0783 \approx €1.0298$. Thus, a euro apple that costs €1 today will cost €1.0298 next year, which means that the euro inflation rate would have to be 2.98%. x

Another consequence of purchasing power parity is that real interest rates must be equal. (A real interest rate is just an inflation-adjusted nominal interest rate.) After all, you can think of money as a good like apples, although it loses value through inflation and gains value through interest earnings. Therefore, in our context, the PPP claim is that

$$\begin{aligned} \frac{1.0209}{1.0298} &\approx \frac{1.0112}{1.02} \\ \frac{(1 + r_1^{\text{EU}})}{(1 + \pi_1^{\text{EU}})} &= \frac{(1 + r_1^{\text{US}})}{(1 + \pi_1^{\text{US}})} \end{aligned} \tag{27.2}$$

where r is the nominal interest rate and π is the inflation rate. x

Clearly, purchasing power parity is a strong assumption. Real-world import-export "arbitrage" is likely to make PPP hold well for goods that trade in perfect markets and that are easy to move from one location to the other, and less well for those goods that do not. It is also more likely to hold in the long run than in the short run, because it takes time to set up import/export busineses. x

There is also a weaker form of the PPP formula (Formula 27.2), which replaces actual inflation rates with expected inflation rates. The **Fisher hypothesis** (or **Fisher effect**) states that expected real rates of return should be equal across countries. There is no arbitrage reason that forces this relationship to hold, either. X Aside from the basic question of which goods the inflation rate refers to, it could again be that investors on one of the two sides earn extra compensation for sharing the risk of currency movements.

anecdote

Irving Fisher, inventor of the Fisher hypothesis, easily ranks among the best economists ever. But he was also an eccentric, colorful (and flawed) human being. When Irving Fisher wrote his 1892 dissertation, he constructed a mechanical machine equipped

with pumps, wheels, levers, and pipes in order to illustrate his price theory. (You can google for images of his first and second prototypes on a number of websites.) Socially, he was an avid advocate of eugenics and health food diets. He made a fortune with his visible index card system—known today as the rolodex—and advocated the establishment of a 100% reserve requirement banking system. His fortune was lost and his reputation was severely marred by the 1929 Wall Street crash, when just days before the crash, he was reassuring investors that stock prices were not overinflated but rather had achieved a new, permanent plateau. Even financial geniuses can be humbled by the markets.

important

- If PPP holds, then goods should cost the same in different countries. In turn, this means that interest rate differentials should be driven by inflation rate differentials.
- The Fisher hypothesis states that expected real rates of return should be the same across countries.

x

In the real world, different goods follow PPP to varying degrees. For gold, for which there is no import duty between the European Union and the United States, PPP holds very well. For many other commodities, the answer may be a "maybe." It depends on how perfect the underlying real-goods market is. Moreover, few X noncommodity goods are exactly alike, and the reported inflation rate is itself based on an arbitrary bundle of goods, usually the Consumer Price Index (CPI). What about the empirical evidence? Do countries with higher "average" inflation rates experience depreciating currencies, as they should under PPP? The answer is "only very weakly" over horizons of 1-5 years. But in the long run, 5-20 years, there are many arbitrageurs (called "import/export firms") that are hard at work to help make PPP come true—or at least to limit deviations from PPP. The same evidence that suggests almost no PPP over shorter horizons suggests that PPP holds much better over 10- to 20-year horizons. Market forces are on the side of PPP!

anecdote

The price of the Big Mac has become such a popular measure of PPP among economists that it is published at least once a year (with updates) in The Economist. In July 2011, the Big Mac Index stood as follows:

Country	PPP of U.S.$	Relative Value Raw	/GDP	Country	PPP of U.S.$	Relative Value Raw	/GDP
United States	$4.07	0	0				
Argentina	$4.84	19	101	Norway	$8.31	104	46
Australia	$4.94	22	12	Pakistan	$2.38	–42	16
Brazil	$6.16	52	149	Philippines	$ 2.78	–32	33
Britain	$3.89	–4	9	Russia	$2.70	–34	10
Canada	$5.00	23	24	Saudi Arabia	$2.67	–34	–3
China[a]	$2.27	–44	3	Singapore	$3.65	–10	–6
Egypt	$2.36	–42	11	South Africa	$2.87	–29	24
Euro Area	$4.93	21	36	South Korea	$3.50	–14	21
Hong Kong[a]	$1.94	–52	–43	Sweden	$7.64	88	85
India	$1.89	–53	–8	Switzerland	$8.06	98	63
Japan	$4.08	0	5	Thailand	$2.35	–42	6
Mexico	$2.74	–33	13	Turkey	$3.77	–7	53

a China and Hong Kong have pegged their currencies to the U.S. dollar at exchange rates that are generally believed to be too low. This makes it cheap for them to export and expensive to import. Both countries are, however, slowly raising their exchange rates.

If you plan to retire on your U.S. Social Security check, Europe looks financially a lot less attractive than the Arab or Asian countries—at least, if you like to eat Big Macs. The "/GDP" index tries to adjust for the fact that local workers also often earn less. Thus, even though the Big Mac is cheaper in Pakistan, the average worker earns far less and a Big Mac would consume much more of his paycheck.

Of course, one Big Mac alone is not a representative consumption basket. On August 29, 1993—a time when management gurus predicted that the Japanese model was destined to rule the world—the New York Times reported the following violations from PPP:

Item	Manhattan	Tokyo
Doughnut	$0.75	$1.06
Rice	$0.89	$2.71
Kirin Beer	$1.50	$2.12
Big Mac	$2.99	$3.66
Häagen Daz	$2.99	$8.18
Movie Ticket	$7.50	$17.33
Sony Walkman, AM/FM Cassette	$39.99	$209.92
Round-Trip Economy Airfare, Tokyo–NYC	$1,360.45	$3,832.45
Apartment, per sq.ft. Purchase Price	$309.00	$715.67

How times have changed...

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question
According to the CIA World Factbook, in early 2007, China had an inflation rate of 1.5%, while the United States had an inflation rate of 3.7%. The exchange rate was 7.61 yuan per U.S. dollar. How would you have expected the exchange rate to change in 2007?

answer
Given the CIA World Factbook information, the yuan should have appreciated by $1.037/1.015 - 1 \approx 2.2\%$ in 2007. In real life, the yuan (¥) appreciated from 7.97 ¥/$ to 7.61 ¥/$, or 4.7%. One important reason is that China has a soft peg on its currency to the U.S. dollar, meaning that they actively manipulate it. Thus, the Chinese currency was significantly undervalued at the start of 2007. (This is also why the Factbook listed China's GDP at purchasing power parity as $7.043 trillion, but as $3.249 at the official exchange rate.) Another way to look at this problem is to work it this way: $1 in 1 year has a purchasing power of $1/1.037 ≈ $0.96432 today; 7.61 yuan in 1 year has a purchasing power of ¥7.61/1.015 ≈ ¥7.4975; so the future exchange rate differential in today's terms would be ¥7.4975/$0.96432 ≈ 7.7749¥/$. This is an increase in the expected currency exchange rate of $(7.7749¥/\$ - -7.61¥/\$)/(7.61¥/\$) \approx 2.2\%$.

question
What factors can prevent arbitrage from kicking in if PPP does not hold?

answer
PPP arbitrage is prevented primarily by transaction costs, transport costs, and import barriers—all problems related to imperfect markets. In addition, different tastes could also play a role.

question
What is the Fisher effect?

answer
The Fisher effect is the claim that real interest rates should be the same in different countries.

question
If PPP holds for "Small Macs," and the 1-year U.S. inflation rate is 1% per annum, and the Small Mac in Mexico costs the equivalent of $2.12 today, how much would you expect the Small Mac to cost next year in pesos? Again, assume a 1.12% U.S. Treasury rate, a 7.78% peso interest rate, and a spot rate that is 0.09230 peso/$.

answer
The peso inflation rate can be computed as $(1+1.12\%)/(1+1\%) \approx (1+7.78\%)/(1+\pi) \Longrightarrow \pi \approx 7.65\%$. At the current spot rate, the Small Mac, which costs \$2.12, goes for about 23.00 pesos. Thus, if PPP holds, we would expect the Small Mac to cost 24.76 pesos in 1 year.

question
How does interest rate parity differ from purchasing power parity?

answer
Interest rate parity is the relation between interest rates and forward rates. Arbitraging violations require only financial market transactions and are therefore very easy. This ensures that IRP holds quite well. Purchasing power parity is the relation between the prices of goods and currencies. Arbitraging violations require importing/exporting and are therefore very difficult. This means that PPP holds only in the very long run.

question
Is it possible that PPP holds for some goods but not others?

answer
Yes, PPP holds for some, but not all, goods. It almost always holds for gold but rarely holds for, say, cars. The former is easier to import/export than the latter.

27.B Investments in Foreign Financial Markets

x

Now that you understand currencies, our next subject is a necessary prelude to determining the corporate cost of capital in an international context. If you recall the logic of the corporate cost of capital, managers have to determine the opportunities that investors have elsewhere (in the financial markets) and then infer the cost of capital for their own corporate projects relative to these opportunities. So we must first discuss foreign investment opportunities. Although they are conceptually like investments in domestic financial securities, they do have some novel components—especially those related to market access and the local currency and exchange rate.

Local versus Foreign Returns and Home Bias

x

Recall that the CAPM suggests that investors hold the (value-weighted) market portfolio. This portfolio should consider all investable assets, domestic and foreign. The CAPM therefore states that investors should invest not just in the U.S. market

but also in all foreign markets. Of course, even if the CAPM does not hold, thinking about diversification across all possible dimensions—including international opportunities—is a good thing to do.

However, the empirical evidence suggests that investors tend to have a strong **home bias**—a tendency to prefer domestic securities. U.S. investors tend to overweight U.S. stocks; European investors tend to overweight European stocks; Japanese investors tend to overweight Japanese stocks; and so on. In fact, many investors hold nothing but domestic securities. This home bias holds up even after we adjust for differential transaction costs and the following currency complications.

Currencies matter because investment rates of return themselves depend on the currency in which they are earned. For example, Volkswagen AG started 2002 with a price of €52.30 and ended 2002 with a price of €34.50. Therefore, its local currency rate of return was $€34.50/€52.30 - 1 \approx -34\%$ (incorrectly ignoring dividends). But the euro started 2002 at 0.90 \$/€ and ended 2002 at 1.05 \$/€, a 16.7% appreciation of the euro against the dollar. To a U.S. investor, the Volkswagen shares therefore cost $€52.30 \cdot 0.90$ \$/€ = \$47.07 and returned $€34.50 \cdot 1.05$ \$/€ ≈ \$36.23 for a more favorable Volkswagen U.S. dollar rate of return of −23%. Most U.S. investors in Volkswagen are more concerned with the dollar rate of return; most German investors in Volkswagen are more concerned with their local currency rate of return.

Let's look at more examples of how local rates and dollar rates of return can differ. The Morgan Stanley Capital International (MSCI) indexes provide rates of return on country-based investing activities, as well as a "world index" of all stock markets in MSCI's database. The following are the historical rate-of-return statistics, from 1970 to 2005, in percent per month:

					Market Beta with Respect to the	
Index	**Currency**	**Type of Investor**	**Mean**	**Sdv**	**U.S. Market**	**World Market**
MSCI World Index	in Dollars	World-Savvy U.S. Investor	0.92	4.18	0.80	1.00
United States Index	in Dollars	Home-Biased U.S. Investor	0.95	4.46	1.00	0.92
German Index	in Dollars	German-Savvy U.S. Investor	**1.02**	6.19	0.64	0.93
German Index	in Euros	Home-Biased German Investor	**0.79**	5.70	0.65	0.78

Before we get to our real point, note that both the U.S. stock market and the world market experienced average price increases of about 0.95% per month (which comes to about 11% per year). But the MSCI world index had much lower volatility—due to extra diversification. A home-biased U.S. investor would have missed out on this free risk reduction.

How would a German investor and how would an American investor think about the reward and risk contribution of investing in the German stock market?

For a German investor, the average rate of return was 0.79% (around 9.5% per annum) in euros. Of course, the beta with respect to the German market was 1. But for a U.S. investor, because the dollar depreciated, the euro investment component was more profitable, thereby earning a higher 1.02% (around 12.2% per annum) in dollars. Furthermore, the risk contribution of Germany for our U.S. investor would have depended on whether our investor was home-biased or fully globally diversified (world savvy). If our U.S. investor had held the world portfolio, then investing a little more in Germany would have contributed to the overall portfolio risk with a market beta of 0.93. However, if our U.S. investor was home-biased and held primarily the U.S. stock market, then adding a little investment in Germany would have contributed with a market beta of 0.64—much better diversification benefits. The first dollar of investment in Germany really helped! x

This leaves us with an important conceptual question: As corporate executives of a U.S. corporation, what shall we assume about our investors when we judge our opportunity costs of capital? In line with empirical reality, we will assume that most of our investors are domestic and home-biased, and that they consume and therefore care about their investment returns in dollars. It is in this context that we will evaluate the effect of adding any foreign investments to our firm. Therefore, we are primarily interested in the expected rate of return in dollars and in the beta of our foreign investment with respect to the U.S. market portfolio—not with respect to the world market portfolio. (Of course, the simplest such investment could even be the purchase of a future on a foreign currency, although an investment in a foreign stock market would likely add more in diversification benefits.) But keep in mind that this home-bias scenario need not apply to every country and company—and that it may change in the future if stock market investors become more globally diversified.

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question

If a U.S. investor in the U.S. stock market experiences a negative rate of return, is it possible for a French investor with the same investment to experience a positive rate of return?

answer

Yes. For example, if the U.S. stock value drops from $100 to $75 per share but the U.S. dollar doubles in euros, then the French investor would experience a positive euro rate of return of 50%.

question

Why is it useful to look at the risk contribution of foreign stock markets with respect to the U.S. stock market index, rather than to the world market?

answer
The reason for looking at the risk contribution of a foreign stock market with respect to the U.S. stock market is that investors are home biased. Therefore, U.S. investors are primarily invested in the U.S. stock market, and they benefit if foreign investments help them diversify.

question
Should we consider the rate of return of the British stock market in terms of British pounds or in terms of U.S. dollars?

answer
If you are a U.S. investor who is mostly consuming in U.S. dollars, you are interested in the U.S. dollar rate of return. If you are a British investor, you are interested in the British pound rate of return. So, the kind of currency return that you are interested in depends on who you are.

Historical International Investment Performance

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From a U.S. investor's perspective, how did investment into the stock markets of different countries perform historically? Table 27.1 describes the performance of various MSCI stock market returns from 1970 to 2005 and from 1986 to 2005. It also shows the performance of two more global indexes: the equal-weighted index of the preceding 14 countries in the table, and the MSCI world index.

Reward: Even though 1970-2005 were terrific years for the U.S. stock market, it appears that foreign stock markets performed almost as well, if not better. (An important factor is, of course, that the dollar generally depreciated over these years.) Scandinavia and Hong Kong beat the U.S. market handily. Not all countries did, however—Canada, Singapore, and Japan beat the United States only over the full 36-year horizon, but not over the shorter 20-year horizon.

Risk contribution: All foreign stock markets had betas with respect to the U.S. stock market below 1. Austria and Japan were particularly helpful in diversifying U.S. market risk; Scandinavia, Hong Kong, and Singapore less so.

Over the full 36 years, the equal weighted index of the countries also performed better than the U.S. stock market, although with equal volatility. The MSCI world index was safer than the U.S. stock market, although it sacrificed a tiny 3 basis points per month performance. In the second half, both world indexes had lower risk, but only the equal-weighted portfolio outperformed the U.S. stock market.

Table 27.1: Monthly Reward, Risk, and U.S. Beta of Morgan Stanley Capital International Indexes (returns in dollars)

—The returns are monthly U.S. dollar returns from December 1969 or December 1986 through May 2005 on index-type broadly diversified stock market investments. The table shows, for example, that the U.S. financial market returned about $0.95\% \cdot 12 \approx 11.4\%$ annualized over the entire 36 years, and about 12.8% annualized over the 20-year span. (The average U.S. index percent price changes, i.e., the return without dividends, would have been around 3% lower.) The beta is the country rate of return with respect to the U.S. stock market—that is, the covariance of returns in the two stock markets, divided by the variance of the rate of return in the U.S. stock market, with both returns quoted in U.S. dollars.
Dollar returns are relevant if we are assuming that investors care about consuming and therefore performance in dollars. Betas with respect to the U.S. stock market are relevant if we are assuming that investors are home biased and from the United States. Data Source: Morgan Stanley Capital International (MSCI) indexes

		1970-2005			**1986-2005**		
Country	**Code**	**Mean**	**Sdv**	**Beta**	**Mean**	**Sdv**	**Beta**
Australia	aus	1.00	7.0	0.76	1.29	6.5	0.70
Austria	aut	1.08	6.0	0.24	1.23	6.8	0.33
Canada	can	0.96	5.5	0.89	0.96	5.2	0.88
France	fra	1.12	6.5	0.72	1.31	6.1	0.81
Germany	ger	1.02	6.2	0.64	1.16	6.7	0.83
Hong Kong	hkg	1.84	10.8	0.84	1.48	8.2	0.95
Italy	ita	0.86	7.4	0.48	1.26	7.3	0.59
Japan	jpn	1.07	6.5	0.44	0.74	7.0	0.50
Netherlands	net	1.21	5.3	0.73	1.27	5.1	0.77
Scandinavia	sca	1.29	5.9	0.73	1.51	6.4	0.91
Singapore	sng	1.27	8.5	0.91	0.96	7.8	0.95
Switzerland	swi	1.12	5.4	0.62	1.35	5.3	0.64
United Kingdom	uk	1.13	6.6	0.78	1.13	5.1	0.76
United States	us	0.95	4.5	1.00	1.07	4.5	1.00
Equal-Weighted	E	1.14	4.5	0.70	1.39	4.4	0.71
MSCI World	W	0.92	4.2	0.80	0.97	4.3	0.80

Risk contribution relative to the reward: Would investing in these countries' stock market portfolios have offered U.S. investors a high enough rate of return to make at least a small investment in international stock markets worthwhile? To answer this question, we use a U.S. CAPM formula. The market beta of each country's stock market with respect to a U.S. stock market index is the measure of how much reward our foreign stock market has to offer for its risk contribution/ diversification. To use a CAPM formula, we need an estimate for the appropriate risk-free rate in U.S. dollars. Reasonable choices would be about 0.4% per month (5% per annum) over the 36-year period, and 0.3% per month (4% per annum) over the 20-year period. Therefore, the ex-post CAPM in the United States was something like

$$\begin{aligned} \text{1970—2005:} \quad \mathrm{E}(r_i) &\approx 0.4\% + (0.95\% - 0.4\%) \cdot \beta_i \\ \text{1986—2005:} \quad \mathrm{E}(r_i) &\approx 0.3\% + (1.07\% - 0.3\%) \cdot \beta_i \end{aligned}$$

x Using these formulas, how did our specific countries perform for a U.S. investor? The majority outperformed! For example, according to our U.S. CAPM, Austria should have earned about $0.3\% + (1.07\% - 0.3\%) \cdot \beta_{aut} \approx 0.55\%$ per month from 1986 to 2005. Instead, it offered about twice this average return. Only Canada and Singapore did not outperform. Even Japan, which had the lowest average stock market returns, still outperformed because its U.S. beta was so low.

x

Moreover, although the sample suggests that international diversification has worked quite well and that the OECD country indexes in Table 27.1 had low betas with respect to the U.S. stock market, this empirical relationship seems to have changed in recent years. The OECD countries' stock indexes seem to be covarying more strongly with the U.S. stock market nowadays—perhaps a sign of increasing financial integration. Nevertheless, even if international diversification no longer works as well as it has historically, chances are that it is still not a bad financial

x choice.

Of course, we have ignored taxes and transaction costs. (Dividends from foreign stocks are taxed at a higher personal income tax rate under U.S. tax law than those from domestic stocks.) And you already know that you should always be cautious when it comes to historical data: The ex-post actual distribution may

X not be representative of the future. Much of the strong historical performance of foreign markets was due to the weakening of the dollar (a mean effect, which will not necessarily repeat). Fortunately, variances and covariances are generally more stable, so the international diversification benefits are likely to continue. Finally, it could also matter a little as to what specific stock market index and risk-free

rate you are using for each country, just as it could matter as to which exact sample period and foreign stock market indexes you use to look at the historical performances. x

In sum, the evidence suggests that investing in OECD countries' equity markets offered decent diversification benefits—but also that they have become less useful as more investors have taken advantage of them. And fortunately, widely available international mutual funds have made it very easy and cheap to partake in the diversification benefits. Nevertheless, many investors are not taking advantage of them. x

The jury is still out on the diversification benefits and expected rates of return from investments in "emerging markets" (developing countries). Many of these X emerging markets did not exist, or were not easy to access, for U.S. investors just 20 years ago and have only recently become available in a form that a typical U.S. retail investor can take advantage of (i.e., with ADRs or country-specific mutual funds).

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question
How did investment in foreign stock markets perform in our sample? What explains this performance?

answer
Foreign stock market investments outperformed U.S. stock market investments, primarily because the dollar depreciated during this period.

question
From the perspective of a U.S. investor, does an investment in foreign countries carry with it a beta above 1 or a beta below 1?

answer
The beta was below 1 for all foreign countries.

27.C Capital Budgeting with Foreign Cash Flows

x

We now turn to our main corporate finance question: What is the corporate cost of capital for our foreign projects? We always start by determining other appropriate market opportunities for our investors as our benchmark. Finance theorists would immediately point out that our investors should be investing globally. Their best trade-off would then be determined by the world market index. As corporate executives, we should therefore be thinking in terms of how our projects reduce the risk in the global market index. This should determine our project's cost of

capital. Unfortunately, this would most likely be bad advice. The reason is that even though it should be so, it is not so. Most investors suffer from a home bias. If we are a U.S. firm listed on the U.S. exchange, most of our investors are likely to be U.S. investors. And our investors are most likely holding portfolios that look much more like the Spd than they look like a global market index. Thus, thinking about how our (foreign) operations reduce the risk in our investors' U.S. portfolio holdings is probably still better than thinking about how our operations fit into investors' global market CAPM trade-off.

So let's now consider the practical problem of finding the cost of capital for a foreign subsidiary. For example, if you are the manager for a U.S. corporation—say, the National Football League (NFL)—and you care about helping your domestic investors earn expected rates of return above what they could earn in similar-risk investments domestically, should you set up a German football league (or syndicate U.S. television rights to Europe)? What should your capital budgeting rule be?

The General Perspective: Certain and Uncertain Cash Flows

As with any domestic project, the capital budgeting principle is easy; the implementation is tough. You "just" need to know the expected cash flows and discount rates to work out the net present value of your project. Your task is easy if your foreign cash flows are certain. For example, in August 2003, how would you value the television rights if they provided €100 (million) in August 2004 for sure?

1. You could execute a currency forward contract today to lock in an exchange rate of 1.0783 \$/€ for August 2004. This means that you would have €100 · 1.0783 \$/€ ≈ \$107.83 million for sure. You can discount this safe dollar cash flow with the U.S. 1-year Treasury rate of 1.12% per annum to obtain a project present value of \$107.83/1.0112 ≈ \$106.64 million.

2. You could discount the certain cash flow of €100 at the euro Treasury rate of 2.09% into €100/1.0209 ≈ €97.95 million today. Using the spot currency exchange rate, you emerge with €97.95 · 1.0886 \$/€ ≈ \$106.63 million. (The \$0.01 difference is rounding error.)

The two alternatives are equivalent under covered interest rate parity.

However, your task is more difficult if your cash flows are uncertain. For example, say your cash flows could be either €50 or €150. You cannot lock in the appropriate future exchange rate, because you do not know how much cash flow you need to lock for. You need to go back to basics. You need to determine two inputs: the expected cash flows of your project in dollars when the cash flows materialize, and the appropriate discount rate (based on dollar rates).

You already know that it is usually both more important, and more difficult, to estimate expected cash flows accurately. This is probably especially true for foreign projects, for which you may not have a long history and/or many easy comparable international projects. In addition, there is the uncertainty about future spot rates, the risk of political expropriation (e.g., having operations nationalized [stolen] by foreign governments), international tax issues, and so on. Yet all in all, there is little conceptual novelty to estimating expected foreign cash flows. The main difficulty is in the practice, just as it is for domestic projects. x

Estimating the appropriate discount rate for your project, however, does add one important novelty. You want to know the beta of your project's rate of return with respect to the U.S. stock market, again post–exchange rate (i.e., as a U.S. dollar rate of return). There is one sense in which this is the same (difficult) task of determining the beta of any new project: You need to have a good feel for how your dollar cash flow returns will covary with the U.S. stock market. The interesting novelty is that you can conceptually decompose this estimation into its components—a fact that makes your task a little easier. Our next subject is therefore figuring out how a U.S. firm's European operations covary with the U.S. stock market.

Valuing a Foreign Project with Uncertain Cash Flows

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First, you need some intuition of how correlations of exchange rates and local market projects matter. Let's make up a simple example. As a representative of the NFL, living in a U.S. CAPM world, you are considering investing in the creation of a German Football League (GFL). You want to determine the appropriate cost of capital for this project, taking into account currency movements. Moreover, the empirical evidence is that project returns are typically linked to their local stock markets more than to the U.S. stock market. (This is very common.) We shall assume the following macroeconomic scenario:

- The U.S. market can go up 16% or down 8% (expected rate of return: +4%).
- The spot rate is 1.0886 \$/€. The 1-year forward currency rate today is 1.0783 \$/€. In addition, we now assume that the actual exchange rate will be either 1.0000 \$/€ or 1.1566 \$/€ next year, averaging to 1.0783 \$/€. It is important that we assume that currency movements are independent of stock market movements.
- The German stock market index, the DAX, returns whatever the U.S. market returns (adjusted for forward/spot rate movements), plus or minus 10%. For example, if the U.S. market appreciates 16%, then the German market

is expected to appreciate by 7.1% or 27.1%. (I have not assumed that it will be exactly 7.0% or 27.0%, because of the expected currency rate change embedded in today's forward rate. The extra 0.1% is not an important factor here. Just trust me and don't worry about this one.)

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With two outcomes each, there are eight scenarios. We assume that they are equally likely. Figure 27.2 illustrates these scenarios. Actually, this is not a bad macroeconomic model: It has reasonably realistic annual rates of return, exchange rates, standard deviations, and correlations. When the U.S. stock market increases by 16%, the German stock market is expected to increase by $(27.1\% + 7.1\%)/2 = 17.1\%$ (in euro returns!). When the U.S. stock market decreases by 8%, the DAX is expected to change by $(2.9\% - 17.1\%)/2 = -7.1\%$. So the DAX moves about one to one with the Spd —although the DAX rates of return are in euros and the Spd rates of return are in dollars. (More recent historical data suggests that this relationship is empirically higher than the 0.65 that I reported in the table on Page 360, perhaps now closer to this 1.0 that we are using here.) And, also in line with our example, there is good empirical evidence that currency movements are empirically not correlated with stock market movements.

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Now consider our German project. Starting the German Football League costs €100 (million) today. We presume it has a German beta with respect to the German stock market, quoted in euros, of 1.5. The expected rate of return on this project is assumed to be

$$\begin{aligned} \mathrm{E}(r_p) &\approx 2.09\% + [\mathrm{E}(r_M{}^G) - 2.09\%] \cdot 1.5 \\ \mathrm{E}(r_p) &= r_F{}^G + [\mathrm{E}(r_M{}^G) - r_F{}^G] \cdot \beta^G_{p,M^G} \qquad \text{(all in euros)} \end{aligned}$$

The GFL follows a German CAPM with a German market beta of 1.5 and a euro risk-free rate of 2.09%. For example, if the DAX were to return 7.1% in euros, the GFL would be expected to return $2.09\% + (7.1\% - 2.09\%) \cdot 1.5 \approx 9.6\%$ in euros. This is not what you need to know, though: You are not representing a German corporation with German investors—you are representing a U.S. corporation with U.S. investors. What should be the project's appropriate cost of capital and value for you?

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Figure 27.2 works through the necessary calculations (and it's easier than it looks). The €100 project costs you $108.86 today. Just work through one of the branches (marked in yellow in the table): What happens if the U.S. stock market increases by +16%, if the exchange rate goes from 1.00886 today to 1.1566 next year, and if the DAX increases by 7.1%? Your project would then have a euro rate of return of $2.09\% + (7.1\% - 2.09\%) \cdot 1.5 \approx +9.6\%$. Having cost €100, your project would now be worth €109.62. At the 1.1566 \$/€ exchange rate, this

Figure 27.2: The German Project from the U.S. Corporation's Perspective

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Macroeconomics: There are eight equally likely scenarios, resulting from the combinations of the U.S. stock market going up or down, the German stock market going up or down, and the dollar/euro exchange rate going up or down. The U.S. market will be either –8% or +16%. The German market is the U.S. market plus or minus 10%, plus a little adjustment for the forward exchange rate (that you could lock in today); +16% in the U.S. will associate either with +27.1% or with +7.1% local currency return in Germany. The exchange rate of 1.0886 \$/€ will either move to 1.0000 \$/€ or to 1.1566 \$/€.

Our Project: Our German project, the GFL, costs €100 today, and has a German beta of 1.5. Specifically, it is expected to return $2.09\% + (r_M{}^G - 2.09\%) \cdot 1.5$. For example, if the German market appreciates by 27.1%, our German project will return $2.09\% + (27.1\% - 2.09\%) \cdot 1.5 \approx 39.6\%$.

The easiest way to understand this graph is to follow one scenario—say, the one in yellow, in which the U.S. stock market will increase by 16% (in dollars), the exchange rate will be 1.1566 €/\$, and the German stock market will increase by 7.1% (in euros). Our project costs €100 = \$108.86 today. With a beta of 1.5 and a German market rate of return of 7.1%, our project will have a euro-based rate of return of $2.09\% + (7.1\% - 2.09\%) \cdot 1.5 \approx 9.62\%$. Thus, it will be worth $€100.00 \times (1 + 9.62\%) \approx €109.62$.
At the 1.1566 \$/€ exchange rate, this is $€109.62 \cdot 1.1566 €/\$ \approx \$126.79$. Thus, your \$108.86 ended up with \$126.79, a $\$126.79/\$108.86 - 1 \approx 16.47\%$ rate of return in U.S. dollars.

Macroeconomics				Our Project			
	U.S. Mkt in \$	Xchg Rate in €/\$	Ger Mkt in €	Act. Ger Mkt in \$/€	Project r in €	Project P in \$	Project r in \$	
		1.0000	+27.1%	+39.6%	€139.62	\$139.62	+28.26%	
			+7.1%	+9.6%	€109.62	\$109.62	+0.70%	
	+16%							Mean Return: ≈ \$134.38 (+23.44%)
		1.1566	+27.1%	+39.6%	€139.62	\$161.48	+48.34%	
			+7.1%	+9.6%	€109.62	\$126.79	+16.47%	
Project Cost:			*€100.00 ≈ \$108.86*					
		1.000	+2.9%	+3.3%	€103.28	\$103.28	−5.13%	
			−17.1%	−26.7%	€73.28	\$73.28	−32.69%	
	−8%							Mean Return: ≈ \$95.19 (+12.56%)
		1.1566	+2.9%	+3.3%	€103.28	\$119.45	+9.73%	
			−17.1%	−26.7%	€73.28	\$84.75	−22.15%	
Mean:	+4%	1.0783	+4.99%	+6.45%	€106.45	\$114.78	5.44%	

would be $126.79, equivalent to a dollar rate of return of 16.47% on your $108.86 investment.

To determine the U.S. market beta, we need to find out what we can expect when the U.S. market goes up versus when the U.S. market goes down. The table tells us that your average return is $134.38 (or +23.44%) if the U.S. market increases by 16%, and $95.19 (or –12.56%) if the U.S. market decreases by 8%. If you draw a line between the points (X,Y)=(+16%,+23.44%) and (X,Y)=(-8%,-12.56%), you will find that the slope is

$$\beta_{P,\text{Spd}} = \frac{23.44\% - (-12.56\%)}{16\% - (-8\%)} = 1.5$$

This is our main point: If the German stock market moves about one to one with the U.S. stock market (both in local currency, and even in the presence of extra volatility in the German market), and if exchange rate movements are uncorrelated with stock market movements, then the German project beta with respect to the DAX (quoted in euros) is about the same as the project beta with respect to the Spd (quoted in dollars).

A conceptual question: Although we assumed that our GFL project follows the German CAPM, does it also follow the U.S. CAPM ? The U.S. CAPM would predict

$$\begin{aligned} \mathrm{E}(r_P) &= 1.12\% + (4\% - 1.12\%) \cdot 1.5 = 5.44\% \\ &= {r_F}^{\text{US}} + \left[\mathrm{E}({r_M}^{\text{US}}) - {r_F}^{\text{US}}\right] \cdot \beta_P^{\text{US}} \end{aligned}$$

Figure 27.2 shows that the expected rate of return on our project is [23.44%+(-12.56%)]/2 = 5.44%. It appears that we can indeed use our U.S. CAPM. Projects are fairly priced; the world is in good order. Hooray!

Recap of the Decomposition

What should you learn from this example? The answer is that you can mentally decompose the foreign project's beta with respect to the U.S. market (which determines its attractiveness to your U.S. investors) into three factors:

1. **Our foreign project's exposure in its own, foreign market:** For us, this is the German stock market beta of our foreign GFL project with respect to its own foreign stock market index (the DAX), with both rates of return quoted in euros.

   This local beta is a number that you must estimate. In many cases, you may have useful information from your U.S. experience. For example, gadget sales may have the same beta in the foreign country with respect to the

foreign stock market (in foreign currency units) as gadget sales have in the United States with respect to the U.S. stock market (in U.S. dollars). There may be comparables in the foreign market that are similar to your foreign subsidiary—for example, the Taiwanese stock market lists many computer manufacturers that could be similar to your computer manufacturing division. Of course, mechanics without intuition rarely works well. Other businesses may be different in other countries and you may have no good comparables. Use your intuition to fit your specific business needs.

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2. **The foreign market's exposure with respect to our U.S. market:** For us, this is how the U.S. stock market and the German DAX stock market move together, both still quoted in terms of euro rates of return.

   In general, if a foreign stock market index has a high beta with respect to the Spd, then each time the U.S. stock market moves, the foreign stock market moves even more—and with it, the foreign operations (through the project's local market beta). This would mean a higher U.S. beta for your project. Conversely, if the foreign stock market has no correlation with the U.S. stock market, then the foreign operation—which comoves with the foreign stock market—would show little or no correlation with the U.S. market.

   As was the case in our example, the beta of the German stock market with respect to the U.S. stock market is actually just a little below 1 nowadays. (However, the correlation between the German and the U.S. stock markets is only around 50%, so the two indexes can diverge quite substantially. This is because both indexes have their own idiosyncratic volatilities.) Many OECD countries have similar market betas with respect to the Spd.

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3. **The currency exchange rate's exposure with respect to our U.S. market:** This considers whether the euro exchange rate changes (and with it your dollar receipts) systematically when the U.S. stock market changes.

   For example, if financial asset markets and currency exchange rates tend to move together, you will need to adjust the beta upward. If every time the Spd moves up, the euro appreciates, and every time the Spd moves down, the euro depreciates, then any Spd fluctuations will be amplified in the value of the project through the currency channel.

   But as it turns out empirically, there is almost no correlation between currency movements and stock market rates of return. This is not to say that exchange rates are not a source of risk. They are—but primarily of idiosyncratic risk, which the CAPM considers irrelevant. It is only the systematic risk that matters to diversified U.S. investors. For many practical purposes, the

empirical evidence allows us to assume that currency fluctuations do not influence your U.S. beta and therefore can be benignly ignored. (Besides, you could lock in some of the variation in future exchange rates through forward contracts, and you could also hedge the currency risk, which is explained in the next section.)

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In our specific example, because the German stock market has a U.S. market beta of about 1, and because the euro/dollar exchange rate is almost uncorrelated with stock market performance, we have discovered that the German (euro) operation would have a similar beta with respect to the U.S. stock market as an equivalent American (dollar) operation would have with respect to the U.S. stock market.

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question

As a U.S. corporation, assuming your own investors are domestic, can you evaluate foreign projects in terms of their expected rate of return and market beta with respect to the U.S. market?

answer

Yes, you can evaluate foreign projects in terms of their expected rate of return and market beta with respect to the U.S. market. From your perspective, a foreign project is just like any other project. Risk is valued by your model of what expected rates of return should be, regardless of whether it comes from drug development or currency movement.

question

If foreign stocks follow their local CAPM, and U.S. stocks follow a U.S. CAPM, and U.S. and foreign stocks can be bought by both investors, is it likely that these foreign stocks obey a U.S. CAPM?

Deeper: There is also an international CAPM (also named **ICAPM**), a close relative of the intertemporal CAPM or APT (Page 77). (The international CAPM identifies the relevant factors for you.) In this model, investors care not only about the performance of the U.S. stock market but also about currency performance. For example, if investors already have half their wealth in the U.S. stock market and the other half in euro cash, then they may not like it if a corporation adds more euro exposure. The CAPM formula would then be modified to have one additional term,

$$\mathrm{E}(r_i) = r_F + [\mathrm{E}(r_M) - r_F] \cdot \beta_i + [\gamma] \cdot \beta_{i,X\text{in}€/\$}$$

where γ is some constant (like the equity premium), and $\beta_{i,X\text{in}€/\$}$ would measure the exposure of the project with respect to euro exchange rate movements. The γ could be either a positive or a negative constant, and functions just like the equity premium in the CAPM formula. The empirical evidence suggests that gamma is very small, so this extension of the CAPM is not too important—at least for OECD countries.

answer
Yes. If a project follows its local CAPM, it is also likely to follow a U.S. CAPM, as illustrated by our German example.

question
Into what components can you decompose the U.S. market beta of a foreign project?

answer
You can decompose the U.S. market beta of your foreign project into three parts: (1) The beta of the project's cash flows with respect to the foreign financial market, measured in foreign currency; (2) the beta of foreign exchange movements (usually 0); and (3) the beta of the foreign stock market with respect to the U.S. stock market (usually a little below 1).

question
Assume that the local stock market beta of a Japanese project is 1.5. Assume that the beta of the Japanese stock market with respect to the U.S. stock market is 0.5. Assume that the market beta of \$/¥ exchange rate movements is 0. What would you expect the U.S. market beta of this Japanese project to be?

answer
Think simple. If the U.S. stock market performs +20% better than expected, the beta of 0.5 means that the Japanese stock market performs +10% better than expected. If the Japanese stock market performs +10%, the local (Japanese) project performs $1.5 \cdot 10\% = +15\%$ better. Thus, for a +20% performance in the U.S. stock market, you expect the local Japanese project to perform +15% better. In other words, you are expecting a U.S. market beta for this Japanese project to be $0.5 \cdot 1.5 = 0.75$.

27.D Corporate Currency Hedging

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A corporation like the NFL thinking about building a German subsidiary is not the only type of firm worried about declines in the value of the euro. In fact, there are three types of firms that are concerned:

1. U.S. firms thinking about establishing a foreign subsidiary or selling products in foreign markets—like our NFL example.

2. U.S. exporters. For example, Boeing builds aircraft in the United States, so its costs are mostly in dollars. It sells aircraft in Europe, and these aircraft may be sold in euros. If the euro appreciates, it is good news when it is time to deliver. Instead of \$108 million per plane, Boeing might receive \$116

million per plane. But if the euro depreciates, it is bad news for Boeing. It might receive only $100 million per plane. In this case, it may not even be able to cover its costs any longer. (Note that currency volatility might not X necessarily be bad for Boeing from an ex-ante perspective. If it can expand its operations when the euro appreciates, then currency fluctuations would give it a valuable real option.)

3. European importers. For example, Danone of France (known as Dannon in the United States) buys organic yogurt from Stonyfield Farms in dollars and resells it in France in euros. If the euro depreciates, Danone's U.S. dollar inputs become more expensive.

x

In some cases, currency movements may influence both sides of the balance sheet and therefore not influence cash flow volatility—for instance, it could be that Danone can raise its selling prices in line with yogurt input costs, so it may not face any cash flow volatility—but this is fairly rare. Our question now is: What can firms that are worried about currency movements do to reduce their exposures?

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question
What kinds of firms are negatively affected by an appreciation of the Swiss franc?

answer
Firms whose costs are in Swiss francs and whose revenues are in other currencies are negatively affected by Swiss franc appreciation. For example, there could be a Swiss pharmaceutical firm like Novartis, which produces in Switzerland and sells worldwide. The equivalent would be a foreign importer of Swiss goods. Finally, the value of Swiss subsidiaries in foreign countries would decline from the perspective of a Swiss investor.

Hedging with Currency Forwards

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One answer to reducing currency risk is hedging of the euro receipts. A **hedge** is a simultaneous investment that moves in an opposite direction and thereby reduces risk. Here is our $108.86 investment example from Figure 27.2 again. Reorganize our eight scenarios (possible project outcomes).

wideonecolumn

Scenario	U.S. Mkt ↑ Ger Mkt ↑	U.S. Mkt ↑ Ger Mkt ↓	U.S. Mkt ↓ Ger Mkt ↑	U.S. Mkt ↓ Ger Mkt ↓	Average	
Euro depreciates to 1.0000 $/€:	$139.62	$109.62	$103.28	$73.28	$106.45	–2.22%
Euro appreciates to 1.1566 $/€:	$161.48	$126.79	$119.45	$84.75	$123.12	13.10%

The idea of a currency hedge is to sign a contract that will yield cash if the exchange rate moves against the real operations profits. We can use a forward contract to accomplish this. What would happen, for example, if Boeing engaged in a forward contract to deliver €100 in exchange for receipts of $107.83?

Scenario	Pay	Receive	€100 is Worth	"Profit" (Relative to Value)
Euro depreciates to 1.0000 $/€:	€100	$107.83	$100.00	+$7.83
Euro appreciates to 1.1566 $/€:	€100	$107.83	$115.66	-$7.83

If the euro depreciates to 1.0000 $/€, the contract will still deliver $107.83, even though the €100 would really be worth only $100.00—it would have earned $7.83. If the euro appreciates to 1.1566 $/€, the contract will oblige us to exchange €100 for $107.83, even though the €100 is really worth $115.66—it would have lost $7.83.

Now consider the project and forward contract together. You just need to add the $7.83 gain from the future to the project proceeds if the euro depreciates, and subtract it if the euro appreciates:

wideonecolumn

Scenario	U.S. Mkt ↑ Ger Mkt ↑	U.S. Mkt ↑ Ger Mkt ↓	U.S. Mkt ↓ Ger Mkt ↑	U.S. Mkt ↓ Ger Mkt ↓	Average	
Euro depreciates to 1.0000 $/€ (+$7.83):	$147.45	$117.45	$111.11	$81.11	$114.28	+4.9
Euro appreciates to 1.1566 $/€ (–$7.83):	$153.65	$118.96	$111.62	$76.92	$115.29	+5.9

The (currency-related) volatility of the GFL project plus the currency contract is lower than the (currency-related) volatility of the GFL alone, because the returns on the currency forward and those on the project move in opposite directions. In fact, the forward contract has almost neutralized the effect of exchange rate movements: Instead of the average rates of return of –2.22% and +13.10%, they are now +4.98% and +5.91%. (In Question 27.D, you will be asked to increase the scale of the currency contract to eliminate even this residual currency risk.) Of course, the currency contract has not eliminated other sources of uncertainty.

For example, if a fourth scenario comes about, the net revenues are either $81.11 or $76.92, both of which are significant losses relative to the $108.86 investment. x

This forward contract reduces cash flow volatility because our firm is paying for its corporate expenses in dollars and is receiving its corporate revenues in euros. The currency contract is like an insurance hedge because it gains if the euro goes down and loses if the euro goes up. Who would buy the other side of our currency forward contract? There are three natural candidates:

1. A European firm, like L'Oréal, building a plant in the United States is the exact opposite of the U.S.-based NFL starting up a German football league.

2. Airbus is the exact opposite of Boeing. It builds airplanes in Europe, so its costs are primarily in euros, and it sells many of its airplanes to U.S. airlines.

3. American importing firms that pay for inputs in euros and sell their products in dollars are just like L'Oréal or Airbus. If the euro appreciates, the input costs rise—a bad situation.

Thus, these types of firms naturally take the other side of the Boeing currency
x forward contract.

Most corporations with substantial foreign sales or operations use currency hedges of one kind or another. They usually just want to reduce their currency risks. Few companies want to fully eliminate it for a number of reasons:

- It is not easy for a corporation to determine how the value of a German operation changes if this operation has cash flows not only next year but for, say, 50 years. What exactly are the expected cash flows in 50 years that are to be hedged?

- Currency hedges can have detrimental accounting implications. Currency contracts have to be "marked to market" while the underlying hedged assets may not be. This can lead to interim problems (such as violations of bond covenants).

- There are many cases in which the full currency hedge would be multiples of the firm value—and it is neither easy nor especially advisable for a company worth $1 billion to have open currency forward hedges for, say, $10 billion.

Therefore, instead of exact hedging of each future cash flow in every year (for a complete NPV hedge), most corporations hedge only cash flows or some component of earnings occurring over the next few years.

question

The example used a €100 ↔ $107.83 currency contract to drop the risk from a range of about 15% to a risk of about 1%. Can you do better? What kind of currency forward contract would improve the hedge against exchange risk?

answer

Yes, you can improve on the hedge in the text. You need to hedge a little bit more to reduce the remaining $1.01 difference between $114.28 and $115.29 in the two states. Each €100 contract gives you a profit of $7.83 if the euro depreciates and a loss of $7.83 if the euro appreciates. To hedge the remaining $1.01, you need to earn $1.01/2=$0.505 more if the euro depreciates. The cost on the other side would be $1.01/2=$0.505 less return if the euro appreciates. Thus, you need to increase your contract by $0.505/$7.83 ≈ 6.45%. Your best hedge would be a forward contract on €106.45. Repeating the table in the text:

	Euro dep. to 1.0000 $/€:	Euro app. to 1.1566 $/€:
Pay	€106.45	€106.45
Receive	$114.785	$114.785
€106.45 is worth	$106.45	$123.12
"Profit" (rel to value)	+$8.335	-$8.335

Now add the gain and loss of $8.335 into the combined project table:

	Euro dep. to 1.0000 $/€:	Euro app. to 1.1566 $/€:
U.S. Mkt ↑, Ger Mkt ↑	$147.96	$153.15
U.S. Mkt ↑, Ger Mkt ↓	$117.96	$118.46
U.S. Mkt ↓, Ger Mkt ↑	$111.62	$111.12
U.S. Mkt ↓, Ger Mkt ↓	$81.62	$76.42
Average	$114.79 +5.45%	$114.79 +5.45%

anecdote

In late 1993, Metallgesellschaft (a very large, 100-year-old German company) experienced a major crisis: Owning a set of gas stations, Metallgesellschaft had agreed to purchase 2 billion barrels of oil at a price of $16 to $18 per barrel. The claimed intent was to "hedge" its input costs. Unfortunately, not only did the oil price move against the hedge (having fallen to $15 by the fall of 1993), but its gas stations had

also performed poorly, and it did not need as much oil any longer. In addition, it had made some hedging mistakes in matching the duration of its gas station assets and its hedging liabilities, and this triggered various bond covenants that pushed Metallgesellschaft into default. Not surprisingly, the market value of all shares in Metallgesellschaft fell from about 3.7 billion DM to 1.5 billion DM.

(Make sure not to miss a second sad anecdote about the pitfalls of corporate hedging on Page 435.)

Hedging with Real Operations

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Forward contracts are not the only method of currency hedging. For example, we know that a company that purchases inputs in its home currency and has sales in a foreign country can be hurt by a rise in its home currency against the foreign currency. If it sets up a foreign operation, which can then also purchase its inputs in the foreign market in foreign currency, then its currency exchange risk will be much lower—both costs and revenues will occur in the same currency. Further,
X such international operations often create a "real option," whereby companies can shift some production from the high-cost country to the low-cost country when exchange rates shift. (By the way, this can also create important tax implications that require armies of tax experts to understand.) Automakers, in particular, have invested heavily in such strategies: Most Toyota Camrys for the United States are produced in Georgetown, Kentucky. (Many are now reexported to Japan. Ironically, it is not inconceivable for the United States to become the top exporter of Japanese cars in the future if the dollar continues to depreciate.) BMW has manufacturing facilities in Georgia, Illinois, and California. Ford and General Motors have large European subsidiaries.

Hedging with Foreign Financing

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Yet another method of hedging for corporations is to match assets and liabilities: If a firm has an asset (such as a foreign operation) that has a net present value of €100, then it can create a liability that is also worth €100. The easiest way to do this is to raise the financing for the asset not in U.S. dollars (as we did in Figure 27.2) but in euros. If an operation has borrowed €100 and is worth €100, the currency risk on the assets itself almost disappears: Currency risk remains only
X in the earnings performance of the euro subsidiary. If you recall Table **??**, IBM was
x an example of a firm that extensively borrowed in foreign currencies.

If we raise this capital in the foreign host country itself, it may also mitigate **political risk**: If a revolution were to occur in Russia and our Russian operations were nationalized, chances are that we would not be liable to pay Russian investors

and lenders. This type of hedge is often accomplished with [pl]foreign bond, which have been around for at least 100 years. They are issued by corporations foreign to the host country in which they are issued and denominated in host country currency. They are named differently in different countries: **Yankee bonds** in the United States (i.e., issued by a non-U.S. corporation), [pl]samurai bond in Japan, [pl]matador bond in Spain, and [pl]bulldog bond in Great Britain. For example, when Ford Motors issues a Japanese-yen bond in Tokyo, it would be a samurai bond.

Eurobonds and the Issue-and-Swap Market

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[pl]Eurobond are bonds issued by corporations foreign to the host country in which they are issued, but in contrast to foreign bonds, they are denominated in the currency of a nonhost country. They are neither necessarily denominated in euros nor traded in Europe. For example, when Ford issues a dollar-denominated bond in Japan, it is a Eurobond, despite the name. (As you saw above, when Ford issues a yen-denominated bond in Japan, it would be called a foreign bond.) Therefore, depending on the currency that they are issued in, such bonds may or may not serve a hedging role. The name "Eurobond" is a historic term. The first important public Eurobond issue was an 1822 bearer bond, issued by Russia, denominated in British pounds, and payable at Rothschild Bank offices anywhere in the world. The first corporate Eurobond was issued by Petrofina in 1957. x

The Eurobond market accounts for a much larger share of borrowing than foreign bonds today, roughly by a factor of 5. It is also larger now than the U.S. bond market. The annual nominal issuing value had reached around $1 trillion by 2000, with outstanding debt of over $4 trillion. By 2006, issuing activity was $2 trillion. For U.S. companies issuing in Europe or Japan, the Eurobond market is often less a mechanism to hedge currency risk (many of their issues are denominated in U.S. dollars) than it is a mechanism to escape the regulation and supervision of the SEC. The institutional customs and features of Eurobonds are more flexible and somewhat different from those that apply to ordinary U.S. bonds. (The typical issue costs are about 25 to 50 basis points of the market price.) x

Another very large market for corporate financing is the **issue-and-swap market**, where a firm issues a bond and immediately swaps its payments with a counterparty. For example, a company like Disney may feel that its name recognition in the United States allows it a better borrowing rate in the United States than in Japan, even though it really wants to issue yen debt; while a company like Matsushita may feel that its Japanese name recognition allows it a better borrowing rate in Japan than in the United States—even though it really wants to issue dollar debt. An investment bank arranges for these firms to raise

capital in their host countries, where it is cheap for them, and then sets up a swap. In this swap, Matsushita pays Disney's debt service and Disney pays Matsushita's debt service. The complication is that, although the obligations are a fairly close match at the outset, over time, one loan may become more valuable than the other. To reduce the risk of default, a large AAA rated company (such as an insurance company) guarantees performance in exchange for an upfront payment. If Matsushita were to go bankrupt and could no longer pay for Disney's debt, Disney would then no longer pay for Matsushita's debt, either, and the difference would have to be picked up by the AAA guarantor.

---

question
What methods of foreign currency hedging can firms consider?

answer
Firms can do direct hedging with forwards or futures, hedging by moving the cost centers to the same currency location as the revenue centers, and hedging by financing revenues with debt in the same currency.

question
What kind of foreign bonds might U.S. companies issue? What are the alternatives?

answer
For a U.S. company, there are foreign bonds that are issued by corporations in the foreign host currency. Such bonds include bulldog bonds, matador bonds, samurai bonds, or yankee bonds. There are Eurobonds, which are basically a mechanism to escape SEC supervision. And there is a large issue-and-swap market, in which two firms exchange different types of obligations.

Should Firms Hedge?

x

Hedging can reduce the volatility of cash flows. But does this add shareholder

X value? Maybe, but it is probably not a first-order effect for two reasons. First, our shareholders should care little about the idiosyncratic currency risk our corporation faces because they are heavily diversified. As long as the foreign currency does not comove with the (U.S.) stock market, any extra currency risk should not change the U.S. market beta. For our investors' portfolios, currency fluctuations across many different companies—some net exporters, some net importers—should mostly wash out. Second, if our shareholders dislike the risk of losing money when the euro goes up or down, then they can themselves buy the proper currency forward

x hedges to neutralize any such risks.

Still, many corporations do hedge currency fluctuations. Why? There are a number of possible explanations. Most are exact analogs of the arguments in Chapter **??** as to why capital structure can influence firm value. Here are some examples:

- If adverse currency fluctuations could lead a firm to incur financial distress, the resulting costs to handle the financial distress are quite real. In this sense, hedging is really just like capital structure policy—the first-order effect should be that firms should be worth what the underlying operations are worth, which should not strongly depend on how the firm is financed. But if a firm is close to financial distress, too much debt can cost value.
- Managerial and corporate performance may be easier to evaluate if the firm can reduce the effects of unexpected currency fluctuations. This can reduce agency problems.
- Managers may just not like the uncertainty of currency fluctuations and may try to neutralize this risk even if it does not increase value. This could be a sign of an unmitigated agency conflict.

Sadly, some firms "hedge" because their traders believe they can outguess the financial markets and thereby increase their profits. This is often a sign of poor internal controls because the compensation of the employees who handle the hedging often implicitly or explicitly depends on the profitability of their hedges. Therefore, these employees often participate more in the upside than in the downside of their contracts. Thus, they may be quite willing to gamble with shareholders' money. The first lesson of good risk management should be to manage the risk of those managing the risk. Lack of such controls has led to a number of very high-profile corporate failures.

---

question
Why is it that corporate hedging is unlikely to create much shareholder value?

answer
Investors are widely diversified, so a little exposure to one or the other currency—as long as it remains idiosyncratic—does not matter to them. Besides, if investors care about currency risk, they can easily hedge for themselves.

question
How can foreign currency hedging create value?

answer
Currency hedging can add value only if it reduces market imperfections. For example, hedging can reduce financial distress costs.

27.E Who Are You Working For?

x

I have allowed our corporation to be multinational, but I have silently sneaked in one big assumption—that you are a U.S. corporation living in a U.S. CAPM world and working on behalf of U.S. shareholders who consume in U.S. dollars. This is a reasonable assumption if your shareholders (owners) are all Americans who are not otherwise internationally diversified, perhaps because they have a strong home bias that makes them hold a U.S. stock market portfolio exculsively. These investors naturally like projects that help them reduce the U.S. stock market risk—and in the end, they care only about consuming in U.S. dollars. This was
x the scenario that you worked out above.

But what if your investors are not Americans who are concerned only with their opportunities in the U.S. financial markets? What if your U.S. company shares are held by Chinese investors, and you are now considering an investment in a German plant? How should you think about the risk contribution of your
x investment projects now?

The answer is surprisingly clear. Ultimately, as a corporation, you exist for the benefit of your owners. Your goal is to earn a rate of return on the money handed to you that exceeds the opportunity cost of capital otherwise available to your investors. This is how your corporation adds value. If your owners are Chinese investors who otherwise have access only to the Chinese stock market (plus your firm's shares now) and who only consume in Chinese yuan, then your appropriate cost of capital would be determined by the Chinese stock market. You would have to compute the beta of the German plant opportunity with respect to the overall Chinese stock market, measuring the returns produced in euros after translation
x into yuan.

Now consider a more complex scenario to test your conceptual understanding: Your Chinese investors want to consume all their returns in British pounds, but they still remain restricted to investment in the Chinese stock market, plus your single firm. In this case, your opportunity cost of capital is still determined by the alternative investments (the Chinese stock market), but all calculations—including measurement of the expected rate of return in the Chinese stock market—should now be done in British pounds. After all, this is what your investors care about in
x the end.

Let me add another complexity: What if Chinese investors are not allowed to invest in American companies? Like investors in many countries, Chinese investors suffer from capital controls. And, even when there are no formal capital controls, investors in many countries fail to diversify themselves internationally. Even U.S. investors are often not diversified, although international diversification is no longer difficult: There are U.S.-traded funds that hold foreign stocks. If your U.S. investors have "forgotten" about foreign investment opportunities, the market is essentially segmented: Not all investors are taking advantage of the same markets. In this case, your U.S. corporation might still be able to add value by expanding domestic investors' opportunity sets through their foreign operations. x

That is, if your investors cannot or do not hold foreign investments, then foreign subsidiaries should help in expanding your U.S. investors' opportunities. After all, the foreign operation produces cash flows in foreign currency, which in an efficient stock market should always be appropriately valued in the firm's stock price. The total firm should just become the portfolio of a domestic operation and a foreign operation. Thus, even if the firm is only traded in the United States, the stock of the combined firm should covary with both the return in the U.S. financial market and the return in the foreign financial markets. Unfortunately, empirical evidence suggests that this is not as much the case as it should be—firms tend to covary too much with the index on the stock market on which they are trading and too little with the foreign stock market indexes where their underlying holdings are. This puzzle is linked to a number of related puzzles: Closed-end mutual funds that trade on the NYSE and that hold foreign country stocks tend to covary more with the Spd than with their foreign country's stock market; and real estate investment trusts (REITs) seem to covary more with the Spd than with the value of the underlying real estate. x

So, in the real world, as a corporate manager, you now understand that you must think of the opportunity costs of capital for your underlying corporate owners when you decide on projects. You need to learn who your investors are and what they care about. This is no longer simple. In the domestic CAPM, you could just assume that they cared about the portfolio with the highest expected rate of return, given minimal overall portfolio risk. Now you may have Chinese investors who care about the best Chinese yuan portfolio in the context of the Chinese financial markets but who ultimately want to consume in Canadian or U.S. dollars. Or you may have British investors who care about the best British pound portfolio in the context of the British financial markets but who ultimately want to consume some goods sold in/priced in euros and other goods priced in British pounds. Or you may have other investors who are represented by funds and are thus totally anonymous. In short, the possibilities are endless. What opportunity sets are your investors really facing, and how can your projects improve them? In what

currency should you determine the optimal alternative investments? What kind of CAPM world—with an international or a domestic market portfolio—do you live in? These are difficult questions. Most managers focus only on the project opportunities that they are providing to their domestic investors. Given investors' home biases, this could be a reasonable assumption, even if this is not perfectly correct. Fortunately, I am just an academic and therefore have escaped having to make such difficult decisions!

---

question

Assume you are a corporate manager in Germany. You are thinking of listing on the Brazilian stock exchange. If Brazilian investors are only allowed to invest in Brazil, and all Brazilian investors spend all their money to pay their children's tuition in the United States, then how should you think about investing in a Czech plant?

answer

The opportunity cost of your investors' capital are other opportunities in the Brazilian stock market, so you should use the Brazilian interest rates and Brazilian stock market index (as your CAPM market portfolio). Brazilians care about U.S. dollar returns, so you should work only in U.S. dollar returns (including Brazilian bonds and stocks, and your own Czech plant).

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wideonecolumn

Summary

widetwocolumns

This chapter covered the following major points:

- An exchange rate is the price of one unit of a country's currency in terms of units of another country's currency. The spot rate applies to an immediate exchange of money.
- Currency spot markets and futures markets are linked by covered interest rate parity (IRP), an arbitrage condition based on the law of one price.
- Uncovered IRP states that forward exchange rates are also expected exchange rates. This holds only if there is no risk compensation component in the pricing of the forward.

- In the real world, the prices of goods can vary across countries—a phenomenon known as deviation from purchasing power parity (PPP). To the extent that the market for a particular good is not perfect, PPP is not likely to hold.
- The Fisher hypothesis is a consequence of PPP. It posits that expected real rates of return are the same across countries. (It does not hold if there are risk premiums.)
- Investors can analyze their risk and reward from investing in foreign stock markets in a CAPM-like framework. Foreign stocks seem to add at least some diversification benefits.
- Market segmentation can make the portfolio problem conceptually more complex. One important cause of market segmentation is investor "home bias."
- Corporate managers should continue to think of capital budgeting in terms of their investors' opportunity cost of capital in an international framework.

  In the context of a U.S. CAPM, they can think of foreign projects as contributing both risk and reward. To measure the risk contribution—the project's U.S. market beta—managers can mentally decompose it into three components:

  1. The foreign project's beta with respect to its foreign market index (with rates of return quoted in the foreign currency)
  2. The beta of the foreign market with respect to the U.S. market (both measured in the foreign currency)
  3. The correlation of exchange rate movements with the U.S. market

  For many OECD countries, the foreign market beta in local currency is likely to be similar to the U.S. market beta in dollars because many international stock markets tend to move together one to one, and currencies do not tend to move with the equity markets.
- Corporate managers can hedge exchange risk through currency forward contracts, by creating foreign operations, or by matching foreign assets with foreign liabilities. This is a form of risk management, which can add value if the financial market that the firm is facing is not perfect.
- You can determine the currency and market that you should use to compute your cost of capital by thinking about who your investors are.

EOC MATTER

eocproblems

question

What is the most common form of quoting the exchange rate between the dollar and the British pound? What is the rate today? What would be the less common form of quoting this exchange rate?

answer

Go to the Financial Times website. They quote dollars per Euro, which was about 2.00 $/£ on March 25, 2008. The less common quote would have been 0.50 £/$.

question

On September 30, 2007, the following were the prices for the Euro FX Contract:

		Months				
	Cash	**3 Dec07**	**6 Mar08**	**9 Jun08**	**12 Sep08**	**18 Dec08**
€/$	TBD	1.4293	1.4303	1.4308	1.4311	1.4311

The 3-month U.S. Treasury offered a yield of 3.64% and the 6-month offered 3.91%. The price of USD to EUR was 0.7006€. The yield on the 3-month German federal security was 3.88%.

1. What was the spot rate?
2. If there are no market imperfections, was there an arbitrage opportunity here? If so, how would you have exploited it?
3. What is the most likely reason why you could not get rich?

answer

1. The spot rate suggested by IRP was 1.4325€/$ because this solves $1.4293/x \approx 1.0364/1.0388$.
2. The actual spot rate is 1.4273€/$U.S. ($\approx 1/0.7006$.) Therefore, if there are no market imperfections, you could earn an arbitrage profit by borrowing dollars at the 3-month Treasury rate of 3.64%, which translates to a quarterly rate of about 0.90%, converting them to euros, and investing at the 3.88% (0.95% per quarter) German government bond rate. Example (with $1,000 instead of the $100 in the text): Borrow $1,000 at 0.90%. Convert to 700.60 euros at the current exchange rate. At the end of 3 months, you would have $700.6 \cdot (1.0096) \approx$ 707.30 euros. Convert back to dollars at the (locked-in) exchange rate of 1.4293, and you will have $1,010.98. You will owe $\$1{,}000 \cdot (1.009) = \$1{,}009$, so this allows you to earn a $2 risk-free profit with no initial cash outlay required.
3. The most likely reason would be your inability to short dollars at the Federal rate.

question

If you believe that the euro will be higher in 6 months than it is today, would it be better to purchase the 6-month forward contract instead of the spot rate?

answer
No. The spot and the forward rate are linked with an arbitrage.

question
If the \$/€ forward rate is at a forward discount relative to the spot rate (that is, the forward rate is lower than the spot rate), is the nominal interest rate in Europe or in the United States higher?

answer
For example, think of a spot rate of 2 \$/€ and a forward rate of 1 \$/€. If the dollar interest rate is 0%, it must be that the euro interest rate is 100%. In the United States, your \$2 today will be \$2 tomorrow. Or, you can convert it into €1, invest it at 100%, come out with €2, which will be \$2 after conversion. Thus, the euro interest rate is higher.

question
Explain the difference between covered and uncovered interest rate parity.

answer
Covered IRP is an arbitrage relationship. Uncovered IRP is the economic hypothesis that the forward exchange rate is the best predictor of the future spot exchange rate.

question
In 2007, according to the CIA World Factbook, Zimbabwe had an inflation rate of 976% per annum—the world's undisputed inflation leader. Botswana, its neighbor to the east, had an inflation rate of 11.4%. If PPP holds, how would you expect their currency exchange rates to move over the next 12 months?

answer
You would have expected the Botswana currency to appreciate by a factor of $(1 + 9.76)/1.114 \approx 9.65$ per annum.

question
If everyone expects a currency exchange rate in 6 months to be higher than it is today (so that it will come back to PPP), would this be reflected in the differential between today's spot rate and the forward rate?

answer
No. The differential is entirely determined by the interest rate differential. To the extent that there is a forecast of a future exchange rate, it should be reflected in today's exchange rate, too.

question
What kind of characteristics of goods are most likely to obey PPP (and drive diverging economies back toward it)?

answer

They must be plentifully in demand and supply, have a large price difference in the two countries, and be easy to export/import. Things like precious metals or minerals.

question

Would you expect import and export firms to help make interest rate parity come true?

answer

Not really. Import/export firms really help make PPP come true, not IRP.

question

Look up where the Big Mac index stands today. Where is the United States relative to other countries? Which are the most expensive and which are the cheapest countries? How would this index suggest that the U.S. dollar should move relative to these currencies in the future if you believed in long-run PPP?

answer

The answer will depend upon when the student completes this question. However, as of 2008, the most expensive countries were those in Europe (e.g. Norway, Switzerland, and Denmark) and the cheapest countries were those in Asia (e.g. Hong Kong, Malaysia, and China). If you believed in long-run PPP, the Big Max Index suggests that the U.S. dollar should become weaker against the Asian currencies such as the Chinese yuan and stronger against the European currencies such as the Swiss franc.

question

The Australian firm CommSec has recently created the iPod Index. What are its conceptual advantages and disadvantages relative to the Big Mac Index? Search the Web to find where the two indexes stand relative to one another.

answer

Purchasing Power Parity states that the prices of goods that are virtually identical should be the same world-wide, with any differences due to the freight costs and import duties. Although both iPods and Big Macs are available world-wide, one advantage of using the iPod Index is that iPods are tradable across country borders, unlike hamburgers. Another advantage is that the iPod is, for the most part, manufactured in one country—namely, China—while Big Macs are produced in many different countries. Although the hamburgers are reportedly made the same way in all the countries, the prices of Big Macs will be affected by the local labor costs, ingredient costs, and local demand. The iPod Index is not subject to these distortions due to differences in rents, taxes,

labor costs and labor laws, and other non-tradables. On the other hand, the iPod Index is subject to distortions resulting from different pricing policies that Apple might employ in different parts of the world or in general. (Remember the iPhone fiasco.) And transit costs and import taxes can play a larger roll—although, depending on the importing country, these may be negligible relative to the retail price of an iPod. The standings of these two indexes relative to one another will depend upon when the student completes this question.

question

Construct a textbook price index. That is, take some of your school textbooks and see how their prices differ in five countries of your choice. Do textbooks obey PPP? Can you arbitrage the price differences?

answer

The textbooks will likely not obey PPP. However, you cannot easily arbitrage the difference, because foreign editions are usually deliberately different. In addition, the shipping costs are not inconsequential.

question

In your assessment, do real-goods markets or financial capital markets have more influence on exchange rates? Why?

answer

Probably financial rates. Capital is easiest to move and happen almost instantly.

question

Download the most recent 3 years of historical daily stock returns for various international stock market indexes from Yahoo!Finance. Compute the beta of these stock markets with respect to the S&P 500 market index. What do your market betas suggest about the diversification benefits of these markets?

answer

The answer will depend upon when the student completes this question and upon the various stock market indexes chosen. As noted in the text, global markets have recently covaried quite a bit more than they had in the past.

question

Redraw Figure 27.2, but do so assuming a 6-month period and a currency exchange rate that is in line with those from March 2008: The euro stood at $1.57, and the 6-month forward rate stood at $1.55. Work with an equal probability of an up-movement to $1.50 or a down-movement to $1.60.

answer

TO DO solution missing — to be created?

question
Assume that the local stock market beta of a British project is 3. Assume that the beta of the British stock market with respect to the U.S. stock market is 0.75. Assume that the market beta of $/£ exchange rate movements is 0. What would you expect the U.S. market beta of this British project to be?

answer
Think simple. If the U.S. stock market performs +20% better than expected, the beta of 0.75 means that the British stock market performs +15% better than expected. If the Japanese stock market performs +15% better, the local project performs at +45%. Thus, for a +20% performance in the stock market, you expect the project to perform $3 \cdot 15\% = +45\%$ better. In other words, you are expecting a U.S. market beta of $0.75 \cdot 3 = 2.25$.

question
Why do firms in the real world not hedge all foreign exchange risk? Is this necessarily a bad thing for their investors?

answer
Many of the cash flows are very long-term, and there can be short-term implications. There are accounting issues. And many of these hedges would simply be too large. Because investors can hedge themselves, this is not necessarily a bad thing.

question
Suppose you are a U.S. oil company thinking about investing in Russia. (The Kremlin has a track record of changing contracts after the fact.) How would you finance your Russian operations?

answer
If you were a U.S. oil company, it would make sense for you to borrow from the Russian state. If the Russian state expropriates your operations, at least you will not owe your creditors money.

question
Search the SEC's Edgar database for a 424(b)(5) filing by KfW on 2007/09/28. What kind of bond is this?

answer
It is a bond by a German company denominated in Yen and sold to U.S. investors (registered with the SEC).

question
Assume you are a corporate manager in the United Kingdom. You are thinking of listing on the NYSE. If British investors are primarily investing in the United States, and British investors mostly consume in Britain, then how should you think about investing in a new plant in China?

answer
Your cost of capital is determined by the U.S. stock market and U.S. interest rates, so you would use this information to compute the beta of the China plant project. Given home-country bias, you would work to maximize the returns in British pounds since the British investors require pounds to satisfy their consumption needs and wants at home.

Prominent International Institutions

wideonecolumn

The International Monetary Fund (http://www.imf.org) is a United Nations nonprofit agency established in 1946 with 38 members and currently made up of 185 member nations (in 2008). Its prime purpose is to encourage the smooth functioning of money flows and to aid in the stability of currencies (e.g., by preventing runs on country currencies or by facilitating information disclosure). The IMF's operations consist of "surveillance, financial assistance, and technical assistance." (For example, in September 2002, it lent $30 billion to Brazil to dispel doubts that Brazil might default on its foreign debt.) Member countries' voting power is determined by their contributions to the IMF capital pool. The IMF's board of governors consists of finance ministers and central bank heads. Day-to-day operations are performed by a 24-person executive committee. Eight countries have permanent representations, while the remaining 16 rotate. The IMF headquarters is in Washington, D.C. In early 2008, the IMF had about $362 billion at its disposal, from which it could make temporary loans.

The World Bank (http://www.worldbank.org) is also a United Nations nonprofit agency (really five closely associated institutions). It was also established in 1946, and is made up of the same 185 member countries. (World Bank members must be members of the IMF.) The World Bank was set up to reduce poverty in developing nations. It both extends loans itself and attempts to coordinate third-party private and bilateral loans. The World Bank raises financing through World Bank bonds (it has an AAA rating) and passes the resulting low interest rates onto developing country client loans. The World Bank headquarters is in Washington, D.C. About 20% of the $23 billion raised by the World Bank in 2006 was used for outright grants (not loans) to poor countries.

The World Trade Organization (http://www.wto.org) was set up in 1995 to deal with the global rules of trade between nations, set out in the General Agreement on Tariffs and Trade (GATT). In 2007, the WTO had 150 member countries, accounting for over 97% of world trade. Its main function is to ensure that trade flows as smoothly, predictably, and freely as possible. It handles trade disputes, administers WTO trade agreements, offers a forum for trade negotiations, monitors national trade, and provides some technical assistance and training for developing countries. The WTO headquarters is in Geneva. Its 2007 budget was 182 million Swiss francs.

The Organization for Economic Cooperation and Development (http://www.oecd.org), founded in 1961, grew out of the Marshall Plan for reconstruction after World War II. In 2007, its 30 member countries produced about 2/3 of the world GDP. (Another 70 countries had informal links.) The OECD is a sort of think-tank agency and/or meeting place and/or information agency that seeks to aid economic cooperation among like-minded, democratic, well-developed, and mostly open economy countries. It is common to refer to the developed countries as OECD countries. The OECD headquarters is in Paris. Its 2008 budget was €343 million.

anecdote

The OECD nations are generally proponents of free trade. Most economists would agree that free trade generally helps all nations develop. Unfortunately, the OECD countries show little consistency. On one hand, for example, their farmers have enormous domestic voting power, which has made OECD countries erect high trade barriers against potentially competitive agricultural imports from Third World countries. On the other hand, they subsidize their farming industries and regularly get into mutual disputes as to which nation (among them) is "most unfair." Unfortunately, the Third World just does not have enough power to demand a level playing field. Naturally, the OECD nations will press and penalize Third World nations if they erect trade barriers against their goods. A particularly egregious example is the fact that the United States presses other nations not to tax American tobacco and cigarette companies.

But thinking of this as a self-interested conspiracy is too simplistic. For example, the United States and Europe have permitted Southeast Asian (especially Japanese and Chinese) imports aplenty, even when the playing field has not been level for U.S. industries (some of which thereby suffered huge job losses or destruction). In reality, trade policy is a rather incoherent and highly politicized area.

anecdote

Despite their seemingly uncontroversial missions and intents, all these international agencies have been widely criticized. The critics make strange bedfellows—there are, for example, both analytical economists and political activists with Molotov cocktails. This is not a light matter: The decisions of these financial organizations decide not only the fortunes of billions of people but the very lives of millions of people in the developing world. (Personally, I think it is fair to say that both the international organizations and their critics have good intentions, but the issues themselves are so complex that there is tremendous disagreement about what is right and what is wrong. There are no easy and obvious answers.)

On the lighter side, one of the more unusual political soap operas was instigated by World Bank chief economist Josef Stiglitz (former professor of economics at Stanford) in late 1999. It began when Stiglitz sharply

criticized the IMF and its former managing director, Stanley Fischer (former professor of economics at MIT). In turn, Larry Summers (professor of economics and a former president of Harvard), tried to influence the World Bank to quiet Stiglitz's view. The World Bank president refused—only to find Stiglitz starting to publicly criticize the World Bank, too. Eventually, Stiglitz resigned with a big splash in an attempt to bring more attention to his policy views.

Chapter 28

Options and Risk Management

intro

. . . and some other derivatives

This chapter provides a brief introduction to the most important aspects of the area of options. It covers options basics, arbitrage relationships, put-call parity, the Black-Scholes formula (and binomial option pricing), and corporate applications of option pricing ideas and methods—but all in a very condensed form. You may prefer to resort to a full book on options and derivatives if this chapter is too telegraphic for you.

Most of the concepts in the world of financial options rely on arbitrage, which is primarily a perfect-market concept. Fortunately, for large financial institutions, the market for options seems fairly close to perfect. For smaller investors, transaction costs and tax implications can play a role. In this case, the arbitrage relations discussed in this chapter hold only within the bounds defined by these market imperfections.

anecdote

Options have been in use since Aristotle's time. The earliest known such contract was, in fact, not a financial but a real option. It was recorded by Aristotle in the story of Thales the Milesian, an ancient Greek philosopher. Believing that the upcoming olive harvest would be especially bountiful, Thales entered into agreements with the owners of all the olive oil presses in the region. In exchange for a small deposit months ahead of the harvest, Thales obtained the right to lease the presses at market prices during the harvest. As it turned out, Thales was correct about the harvest, demand for oil presses boomed, and he made a great deal of money.

Many centuries later, in 1688, Joseph de la Vega described in Confusion de Confusiones how options were widely traded on the Amsterdam Stock Exchange. It is likely that he actively exploited put-call parity, an arbitrage relationship between options discussed in this chapter. In the United States, options have been traded over the counter since the nineteenth century. A dedicated options market, however, was organized only in 1973. In some other countries, option trading is banned because it is considered gambling.

28.A Options

x

Options are examples of [pl]derivative (also called [pl]contingent claim). A derivative is an investment whose value is itself determined by the value of some other underlying base asset. For example, a $100 side bet that a Van Gogh painting—the base asset—will sell for more than $5 million at auction is an example of a contingent claim, because the bet's payoffs are derived from the value of the Van Gogh painting (the underlying base asset). Similarly, a contract that states that you will make a cash payment to me that is equal to the square of the price per barrel of oil in 2010 is a contingent claim, because it depends on the price of an underlying base asset (oil).

x

As with any other voluntary contract, both parties presumably engage in a derivatives contract because doing so makes them better off ex-ante. For example, your car insurance is a contingent claim that depends on the value of your car (the base asset). Ex-ante, both the insurance company and you are better off contracting to this contingent claim than either would be without the insurance contract. This does not mean that both parties expect to come out even. On average, your insurance company should earn a positive rate of return for offering you such a contract, which means that you should earn a negative expected rate of return. Of course, ex-post, only one of you will come out better off. If you have a bad accident, the insurance was a good deal for you and a bad deal for the insurance company. If you do not have an accident, the reverse is the case.

Call and Put Options on Stock

x

Options are perhaps the most prominent type of contingent claim. And the most prominent option is simply the choice to walk away from an unprofitable position without retaining any obligation. A **call option** gives its holder the right to "call" (i.e., to buy) an underlying base security for a prespecified dollar amount—called the **strike price** or **exercise price**—usually for a specific period of time. A **put option** gives its holder the equivalent right to "put" (i.e., to sell) the security. Naturally, the values of these rights depend on the value of the base asset, which can fluctuate over time. Let's look at these options in more detail.

X

Call Options

x

Table 28.1 shows a number of options that were trading on May 31, 2002. For example, you could have purchased a July IBM stock call option with a strike price of $85, thereby giving you the right to purchase one share of IBM stock at the price of $85 anywhere between May 31 and July 20, 2002. Call options increase in

Table 28.1: Some IBM Option Prices on t = May 31, 2002

—The original source of these prices was OptionMetrics. The expiration date T, July 20, 2002, was 0.1333 years away. (IBM's closing price at 4:00 pm EST was 5 cents lower than what the website reported.) The prevailing interest rates were 1.77% over 1 month, and 1.95% over 6 months. For up-to-date option prices on IBM options, see, for example, http://finance.yahoo.com/q/op?s=IBM, or optionmetrics.com.

Underlying Base Asset S_t		**Expiration T**	**Strike Price K**	**Call Price C_t**	**Put Price P_t**
IBM	$80.50	July 20, 2002	$85	$1.900	$6.200
		Different Strike Prices			
IBM	$80.50	July 20, 2002	$75	$7.400	$1.725
IBM	$80.50	July 20, 2002	$80	$4.150	$3.400
IBM	$80.50	July 20, 2002	$90	$0.725	$10.100
		Different Expiration Dates			
IBM	$80.50	Oct. 19, 2002	$85	$4.550	$8.700
IBM	$80.50	Jan. 18, 2003	$85	$6.550	$10.200

value as the underlying stock appreciates and decrease in value as the underlying stock depreciates. If on July 20, 2002, the price of a share of IBM stock was below $85, your right would have been worthless: Shares would have been cheaper to purchase on the open market. (Indeed, exercising would have lost money: Purchasing shares that are worth, say, $70, for $85 would not be a brilliant idea.) Again, the beauty of owning a call option is that you can just walk away. However, if on July 20, 2002, the price of a share of IBM stock was above $85, then your call option (purchase right) would have been worth the difference between what IBM stock was trading for and your exercise price of $85. You should have exercised the right to purchase the share at $85 from the call writer. For example, if the price of IBM stock turned out to be $100, you would have enjoyed an immediate net payoff of $100-$85=$15. The relationship between the call value and the stock value at the instant when the call option expires

$$C_t(K = \$85, t = T) = \max(0, S_T - \$85)$$
$$C_T(K, T) = \max(0, S_T - K)$$

where C_T is our notation for the value of the call option on the final date T, given the (pre-agreed) strike price K. If the stock price at expiration, S_T, is above K, the option owner earns the difference between S_T and K. If S_T is below K, then the option owner will not exercise the option and earn zero. (The max function means "take whichever of its arguments is the bigger.") Note that, like other derivatives, an option is like a side bet between two outside observers of the stock price. Neither party necessarily needs to own any stock. Therefore, because the person owning the call is paid $\max(0, S_T - K)$ at the final date (relative to not owning the call), the person having sold the call must pay $\max(0, S_T - K)$ (relative to not having written the call).

Why would someone sell ("write") an option? The answer is "for the money up front." Table 28.1 shows that on May 31, 2002 (when IBM stock was trading for $80.50), an IBM call with a strike price of $85 and an expiration date of July 20, 2002, cost $1.90. As long as the upfront price is fair—and many option markets tend to be close to perfect—neither the purchaser nor the seller comes out for the worse. Indeed, as already noted, because both parties voluntarily engage in the contract, they should both be better off ex-ante. Of course, ex-post, the financial contract will force one side to pay the other, making one side financially worse off and the other side financially better off, relative to not having written the contract.

Call options are often used by shareholders to sell off some of the upside. For example, the following are common motivations for participants:

The buyer: Why would someone want to purchase a call option? It's just another way to speculate that IBM's stock price will go up—and it is very efficient in terms of its use of cash up front. In May 2002, the option to purchase IBM at $90 until July 20, 2002, cost only $0.725 per share, much less than the $80.50 that one IBM share cost at the time.

The seller: As a large IBM share owner, you may have decided that you wanted to keep the upside until $90 but did not care as much about the upside beyond $90 (or you believed that the IBM share price would not rise beyond $90 by July 20, 2002). In this case, you might have sold a $90 call option now. This would have given you an immediate payment of $0.725. You could have invested this anywhere (including into more IBM shares or Treasuries). The extra cash of $0.725 would have boosted your rate of return if the IBM stock price had remained below $90. But if IBM had ended up at $120, you would have participated only in the first $9.50 gain (from $80.50 to

$90). (Of course, you would also have kept the upfront option payment.) The remaining $30 of the IBM upside would have gone to your call option purchaser instead of to you. x

If you write an option on a stock that you are holding, it is called "writing a covered option." Effectively, this is like a hedged position, being long in the stock and short in the call. Thus, if properly arranged, its risk is modest. However, there are also some sellers that write options without owning the underlying stock. This is called naked option writing. (I kid you not.) Lacking the long leg of the hedge, this can be a very risky proposition. In our extreme $120 example, the option buyer would have had a rate of return on the option alone of ($30 − $0.725)/$0.725 ≈ 4,038%. Thus, the option seller would have lost 4,038%. (You can exceed –100% because your liability is not limited to your investment.) Writing naked out-of-the-money options is sometimes compared to picking up pennies in front of a steamroller—profitable most of the time, but with a huge risk.

Put Options

x

In some sense, a **put option** is the flip side of a call option. It gives the owner the right (but not the obligation) to "put" (i.e., sell) an underlying security for a specific period of time in exchange for a prespecified price. For example, again in May 2002, you could have purchased a put option for the right to sell one share of IBM stock at the price of $75 up until July 20, 2002. This option would have cost you $1.725, according to Table 28.1. Unlike a call option, a put option speculates that the underlying security will decline in value. If the price of a share of IBM stock had remained above $75 before July 20, 2002, the put right would have been worthless: Shares could be sold for more on the open market. However, if the price of a share of IBM stock was below $75 on the expiration date, the put right would have been worth the difference between $75 and IBM's stock price. For example, if the IBM share price had been $50, the put owner could have purchased one share of IBM at $50 on the open market and exercised the right to sell the share at $75 to the option writer for an immediate net payoff of $25. The relationship between the put value and the stock value at the final moment when the put option expires (i.e., in this case at the end of the day on July 20, 2002) is

$$\begin{aligned} P_t(K = \$75, t = T) &= \max(0, \$75 - S_T) \\ P_T(K, T) &= \max(0, K - S_T) \end{aligned}$$

x

Put options are often purchased as "insurance" by investors. For example, if you had owned a lot of IBM shares when they were trading at $80.50/share on

May 31, 2002, you may have been willing to live with a little bit of loss, but not a lot. In this case, you might have purchased put options with a strike price of $75. If IBM were to have ended up at $60 per share on July 20, 2002, the gain on your put option ($15/put) would have made up for some of the losses ($20.50/share) on your underlying IBM shares. Of course, buying this put option insurance would have cost you money—$1.725 per share to be exact.

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question

How is owning a call option the same as selling a put option? How is it different?

answer

Owning a call option is similar to selling a put option in that both are bullish bets. However, they have very different payoff patterns (tables). For example, the owner of a call option enjoys limited liability and thus can, at most, lose the money paid for the call. The seller of a put option can lose an unlimited amount.

More Institutional Stock Option Arrangements

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There are a variety of other option contract features. One common feature is based on the time at which exercise can occur. An **American option** allows the holder of the option to exercise the right any time up to, and including, the expiration date. The largest financial market for trading options on stocks is the **Chicago Board Options Exchange** (**CBOE**) and its options are usually of the American type. A less common form is called a **European option**. It allows the holder of the option to exercise the right only at the expiration date. The popular S&P index options are of the European type.

anecdote

The origin of the terms "European" and "American" is a historical coincidence, not a reflection of what kind of options are traded where. Although no one seems to remember the origins of these designations, one conjecture is that contracts called "primes" were traded in France. These could only be exercised at maturity—but they were not exactly what are now called European options. Instead, the option owner either exercised (and received S-K) or did not exercise and paid a "penalty" fee of D called a "dont" (not "don't"). There was no upfront cost. (The best strategy for the prime owner was to exercise if S - X > -D.) Because these contracts could only be exercised at maturity and because American options could be exercised at any time, the terminology may have stuck.

Incidentally, "Bermuda options," or "Atlantic options," can be exercised periodically before maturity but not at any other time. They are so named not because they are used in Bermuda, but because Bermuda (and of course the Atlantic Ocean) lies between Europe and America.

What happens to the value of a CBOE stock option when the underlying stock pays a dividend or executes a stock split? In a stock split, a company decides to change the meaning, but not the value, of its shares. For example, in a 2-for-1 split, an owner who held 1,000 shares at \$80.50/share would now own 2,000 shares at \$40.25 per share (at least in a perfect market). Splitting itself should not create shareholder value—it should not change the market capitalization of the underlying company.

Although such a split should make little difference to the owners of the shares (\$80,500 worth of shares, no matter what), it could be bad news for the owner of a call option. After all, a call with a strike price of \$75 would have been **in-the-money** (i.e., the underlying share price of \$80.50 was above the strike price) before the split. If the option were American, the call would be worth \$5.50 per share if exercised immediately. After the split, however, the call would be far **out-of-the-money** (i.e., the underlying share price of \$40.25 would be far below the strike price of \$75). Fortunately, the option contracts that are traded on most exchanges (e.g., the CBOE) automatically adjust for stock splits, so that the value of the option does not change when a stock split occurs: In this case, the option's effective strike price would automatically halve from \$75 to \$37.50 and the number of calls would automatically double from 1 to 2. (Completing the options terminology, not surprisingly, **at-the-money** means that the share price and the strike price are about equal.)

But common options are typically not adjusted for dividend payments: If the \$80.50 IBM share were to pay out \$40 in dividends, and unless dividends fall like manna from heaven, then the post-dividend share price would have to drop to around \$40.50. Therefore, the in-the-money call option would become an out-of-the-money call option. Consequently, if your call was American, you might decide to exercise your call with a \$75 strike price to net \$5.50 just before the dividend date.

important
When you purchase/value a typical financial stock option, the contract is written in a way that renders stock splits but not dividend payments irrelevant.

There are other important institutional details that you should know if you want to trade options. First, because the value of options can be very small (e.g., 72.5 cents for each IBM call option), they are usually traded in bundles of 100. This is called an **option contract**. Five option contracts on IBM are therefore 500 options (options on 500 shares), which in the example would cost $\$0.725 \cdot 500 = \$362.50$. Second, CBOE options typically expire on the Saturday following the third Friday of each month, which is where our 20th of July came from. Third, published

option prices can be mismatched to the underlying stock price. The CBOE closing price is at 4:00 pm CST (5:00 pm EST), which is 1 hour later than the closing price from the NYSE (4:00 pm EST). This sometimes leads to seeming arbitrages in printed quotes, which are not really there. Instead, what usually happens is that the underlying stock price has changed between 4:00 pm and 5:00 pm and the printed quotes do not reflect the change. (In addition, the closing price may be a recent bid or recent ask quote, rather than the price at which you could actually transact.)

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question
An option is far in-the-money and will expire tonight. How would you expect its value to change when the stock price changes?

answer
An option that is far in-the-money and expiring soon will change in value about one to one with the underlying stock price. After all, it will almost surely pay off.

question
In a perfect market, would a put option holder welcome an unexpected stock split? In a perfect market, would a put option owner welcome an unexpected dividend increase?

answer
A put option holder is indifferent to the stock split in a perfect market because the contract is such that the option would be adjusted. However, the unexpected dividend increase would be good news for a put holder. In a perfect market, there would be no value change to the dividend announcement, but the post-dividend price at expiration would be lower.

Option Payoffs at Expiration

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It is easiest to gain more intuition about an option by studying its payoff diagram (and payoff table). You have already seen these in the building and capital structure

X

contexts. They show the value of the option as a function of the underlying base asset at the final moment before expiration. Figure 28.1 shows the payoff tables and payoff diagrams for a call and a put option, each with a strike price of $90. The characteristic of any option's payoff is the kink at the strike price: For the call, the value is zero below the strike price, and a +45-degree line above the strike price. For the put, the value is zero above the strike price, and a –45-degree line below the strike price.

Figure 28.1: Payoff Table and Payoff Diagrams of Options with Strike Price K=$90 on the Expiration Date T

—Note: In Figure 28.3, we will graph the value of an option prior to expiration.

Stock$_T$	**Call**$_T$	**Put**$_T$	**Stock**$_T$	**Call**$_T$	**Put**$_T$
$0	$0	$90	$100	$10	$0
$25	$0	$65	$125	$35	$0
$50	$0	$40	$150	$60	$0
$75	$0	$15	$175	$85	$0

Figure optionspayoff-call with width 0.5*fullwidth Figure optionspayoff-put with width 0.5*fullwidth

Optional: More Complex Option Strategies

x

Payoff diagrams can also help you understand more complex option-based strategies, which are very popular on Wall Street. Such strategies may go long and/or short in different options at the same time. They can allow you to speculate on all sorts of future developments for the stock price—for example, that the stock price will be above $60 and below $70. In many (but not all) cases, it is not clear why someone would want to engage in such strategies, except for speculation. x

Two important classes of complex option strategies are [pl]spread, which consist of long and short options of the same type (calls or puts), and [pl]combination, which consist of options of different types.

A simple spread is a position that is long one option and short another option, on the same stock. The options here are of the same type (puts or calls) and have the same expiration date but different strike prices. For example, a simple spread may purchase one put with a strike price of $90 and sell one put with a strike price of $70. Figure 28.2 plots the payoff diagram for this position.

A complex spread contains multiple options, some short, others long. You will get to graph the payoff diagram of a so-called butterfly spread in Question 28.A.

A straddle may be the most popular combination. It combines one put and one call, both either long or short, often with the same strike price and with the same time to expiration. You will get to graph the payoff diagram in Question 28.E.

In sum,

Figure 28.2: Payoff Diagram of a Simple Spread

—This spread is long 1 put option with a strike price of $90 and short 1 put option with a strike price of $70.

Payoff Table

Stock$_T$	Long Put(K=$90)	Short Put(K=$70)	Net
$50	$40	–$20	$20
$60	$30	–$10	$20
$70	$20	$0	$20
$80	$10	$0	$10
$90	$0	$0	$0
$100	$0	$0	$0

Figure optionspayoff-spread-70-90 with width 0.5

Option Strategy	Version A	Version B
Simple Spread	Long Call, Short Call	Long Put, Short Put
Combination	Long Call, Short Put	Short Call, Long Put
Straddle	Long Call, Long Put	Short Call, Short Put

A rarer strategy is the **calendar spread**, which is a position that is long one option and short another option, on the same stock. The options are of the same type (puts or calls) and have the same strike prices but different expiration dates. Therefore, they do not lend themselves to easy graphing via payoff diagrams because payoff diagrams hold the expiration date constant.

anecdote

Publicly traded options extend beyond stocks. For example, there is an active market in pollution options, which give option owners the legal right to spew out emissions such as CO_2. Experts generally agree that despite some shortcomings, the system of permitting trading in pollution rights and derivatives has led to a cleaner environment. It is no longer in the interest of a polluter to maximize pollution: Shutting down an old plant and selling the right to pollute can be more profitable than operating the plant.

question

Write down the payoff table and draw the payoff diagram (both at expiration) of a portfolio consisting of 1 call option with a strike price K of $60 and 1 put option with a strike price K of $80.

answer

The long call option with a strike price of $60 pays off if the stock price ends above $60; the long put option with a strike price of $80 pays off if it ends up below $80:

Stock	Pfio	Stock	Pfio
$0	+$80	$70	+$20
$20	+$60	$75	+$20
$40	+$40	$80	+$20
$60	+$20	$90	+$30
$65	+$20	$100	+$40

Figure optionspayoff-spread-60-80 with width 0.4*fullwidth

question

Write down the payoff table and draw the payoff diagram (both at expiration) of a portfolio consisting of 1 call short with a strike price K of $60 and 1 put short with a strike price K of $80.

answer

The short call option with a strike price of $60 costs money if the stock ends up above $60; the short put option with a strike price of $80 costs money below $80:

Stock	Pfio	Stock	Pfio
$0	–$80	$70	–$20
$20	–$60	$75	–$20
$40	–$40	$80	–$20
$60	–$20	$90	–$30
$65	–$20	$100	–$40

Figure optionspayoff-spreadneg-60-80 with width 0.45*fullwidth

question

Graph the payoff diagram for the following butterfly spread:

- 1 long call option with a strike price of $50
- 2 short call options with strike prices of $55
- 1 long call option with a strike price of $60

answer
The butterfly spread (1 long call K=$50, 2 short calls K=$55, 1 long call K=$60):

Stock Now	1 Long Call K=$50	2 Short Calls K=$55	1 Long Call K=$60	Net Pfio
⋮				
$40	$0	$0	$0	$0
$50	$0	$0	$0	$0
$52	$2	$0	$0	$2
$53	$3	$0	$0	$3
$55	$5	$0	$0	$5
$57	$7	–$4	$0	$3
$58	$8	–$6	$0	$2
$60	$10	–$10	$0	$0
$65	$15	–$20	$5	$0
$70	$20	–$30	$10	$0
⋮				

The payoff diagram of this butterfly spread is
Figure optionspayoff-butterfly with width 0.45*fullwidth

28.B Static No-Arbitrage Relationships

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How easy is it to value an underlying stock? For example, to value the shares of IBM, you have to determine all future cash flows of IBM's underlying projects with their appropriate costs of capital. You already know that this is very difficult. I cannot even tell you with great confidence that the price of an IBM share should
x be within a range that is bounded by a factor of 3 (say, between $50 and $150).

In contrast, it is possible to find very good pricing bounds for options. Intuitively, the law of one price works quite well for them. The reason is that you can design a clever position—consisting of the underlying stocks and bonds—that has virtually the same payoffs as a call (or a put) option. Thus, the price of the call option should be very similar to the price of the securities you need to create such a
X call-mimicking position. This is a no-arbitrage argument. The price of an option should be such that no arbitrage is possible.

Some Simple No-Arbitrage Requirements

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Let us derive the first pricing bound: A call option cannot be worth more than the underlying base asset. For example, if IBM trades for $80.50 per share, a call

option with a strike price of, say, \$50 cannot cost \$85 per option. If it did, you should purchase the share and sell the call. You would make \$85-\$80.50=\$4.50 now. In the future, if the stock price goes up and the call buyer exercises, you deliver the one share you have, still having pocketed the \$4.50 net gain. If the stock price goes down and the call buyer does not exercise, you still own the share plus the upfront fee. Therefore, lack of arbitrage dictates that the value of the call C_0 now must be (weakly) below the value of the stock S_0,

$$C_0 \leq S_0$$

This is an upper bound on what a call can be worth. It improves your knowledge of what a reasonable price for a call can be. It may be weak, but at least it exists—there is no comparable upper bound on the value of the underlying stock! x

There are many other option pricing relations that give you other bounds on what the option price can be. For notation, call C_0(K,t) the call option price now, K the strike price, (lowercase) t the time to option expiration, and P_0 the put option price now. Here are some more pricing bounds:

- Because the option owner only exercises it if it is in-the-money, an option must have a nonnegative value. Therefore,

$$C_0 \geq 0, \quad P_0 \geq 0$$

- It is better to own a call option with a lower exercise price. Therefore,

$$K_{High} \geq K_{Low} \iff C_0\big(K_{Low}\big) \geq C_0\big(K_{High}\big)$$

- It is better to own a put option with a higher exercise price. Therefore,

$$K_{High} \geq K_{Low} \iff P_0\big(K_{Low}\big) \leq P_0\big(K_{High}\big)$$

American options, which can immediately be exercised, enjoy further arbitrage bounds:

- The value of an American call now must be no less than what you can receive from exercising it immediately. Therefore,

$$C_0 \geq \max(0, S_0 - K)$$

- The value of an American put now must be no less than what you can receive from exercising it immediately. Therefore,

$$P_0 \geq \max(0, K - S_0)$$

- It is better to have an American call option that expires later. Therefore,

$$t_{\text{Longer}} \geq t_{\text{Shorter}} \iff C_0\left(t_{\text{Longer}}\right) \geq C_0\left(t_{\text{Shorter}}\right)$$

- It is better to have an American put option that expires later. Therefore,

$$t_{\text{Longer}} \geq t_{\text{Shorter}} \iff P_0\left(t_{\text{Longer}}\right) \geq P_0\left(t_{\text{Shorter}}\right)$$

These are commonly called [pl]no-arbitrage relationship, for obvious reasons.

Put-Call Parity

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There is one especially interesting and important no-arbitrage relationship, called **put-call parity**. It relates the price of a European call to the price of its equivalent European put, the underlying stock price, and the interest rate. Here is how it works. Assume the following:

- The interest rate is 10% per year.
- The current stock price S_0 is \$80.
- A 1-year European call option with a strike price of \$100 costs C_0(K=\$100)=\$30.
- A 1-year European put option with a strike price of \$100 costs $P_0\left(K = \$100\right) = \$50$.

Table 28.2: Sample Put-Call Parity Violation

—The net arbitrage profit is $(-\$30)+(+\$50)+(+\$80)+(-\$90.91)=\ (+\$9.09)$. Because $-C_0(K)+P_0(K)+S_0-\text{PV}_0(K)$ is not \$0, this is a put-call parity arbitrage violation.

Now			**At Final Expiration Time T**				
		Covering S_T Range:	**S_T<\$100**		**S_T=\$100**	**S_T>\$100**	
Execute	**Cash Flow**	**Price S_T is:**	**\$80**	**\$90**	**\$100**	**\$110**	**\$120**
Purchase 1 call	-\$30.00	You can exercise	\$0	\$0	\$0	+\$10	+\$20
strike price K=\$100	$-C_0(K)$		\$0	\$0	S_T-K	S_T-K	S_T-K
Sell 1 put	+\$50.00	Your buyer can exercise	-\$20	-\$10	\$0	\$0	\$0
strike price K=\$100	$+P_0(K)$		S_T-K	S_T-K	S_T-K	\$0	\$0
Sell 1 share:	+\$80.00	The short is closed	-\$80	-\$90	-\$100	-\$110	-\$120
(= short 1 share)	$+S_0$		$-S_T$	$-S_T$	$-S_T$	$-S_T$	$-S_T$
Save money, to pay	-\$90.91	You get your money back	+\$100	+\$100	+\$100	+\$100	+\$100
the PV(strike price)	$-\text{PV}_0(K)$		+\$K	+\$K	+\$K	+\$K	+\$K
Net =	+\$9.09	Net =	\$0	\$0	\$0	\$0	\$0
			\$0	\$0	\$0	\$0	\$0

Further, assume that there are no dividends (which is important). Because the options are European, you only need to consider what you pay now and what will happen at expiration T. (Nothing can happen in between.) If this were the situation, could you get rich? Try the position in Table 28.2. (You can check the sign, because any position that gives you a positive inflow now must give you a negative outflow tomorrow, or vice versa. Otherwise, you would have a security that always makes, or always loses, money.)

Table 28.2 shows that you could sell one put for \$50 and short one share (for proceeds of \$80 from the buyer). You would use the \$130 in cash to buy one call for \$30 and deposit \$90.91 in the bank. This leaves you with your free lunch of \$9.09. The table also shows that regardless of how the stock price turns out, you will not have to pay anything. This is an arbitrage. Naturally, you should not expect this to happen in the real world: One of the securities is obviously mispriced here. Given that the risk-free interest rate applies to all securities, and given that the stock price is what it is, you can think of put-call parity as relating the price of the call option to the price of the put option, and vice versa—and in

x this example, either the call is too cheap or the put is too expensive.

As usual, the algebraic formulas are just under the numerical calculations. The table shows that put-call parity means that the world is sane only if

$$-C_0(K) + P_0(K) + S_0 - \mathrm{PV}_0(K) = 0 \iff C_0(K) = P_0(K) + S_0 - \mathrm{PV}_0(K)$$

X Let's apply put-call parity to the option prices in Table 28.1. An IBM put with a strike price of \$85, expiring on July 20, 2002, costs \$6.200. The expiration was 34 out of 255 trading days away ($34/255 \approx 0.1333$ years), or, if you prefer, 50 out of 365 actual days ($50/365 \approx 0.137$ years)—this is rounding error that makes little difference. The prevailing interest rate was 1.77% per annum. Thus, the strike price of \$85 was worth $\$85/(1+1.77\%)^{0.133} \approx \$84.80$. Put-call parity implies that the call should cost

$$\begin{aligned} C_0(K) &\approx \$6.20 + \$80.50 - \$84.80 = \$1.90 \\ C_0(K) &= P_0(K) + S_0 - \mathrm{PV}_0(K) \end{aligned}$$

This was indeed the call price in the market, as you can see in Table 28.1.

important

Given an interest rate and the current stock price, the prices of a European call option and a European put option with identical expiration dates and strike prices are related by put-call parity,

$$C_0(K) = P_0(K) + S_0 - \mathrm{PV}_0(K) \tag{28.1}$$

The stock must not pay dividends before expiration.

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question

Write down the put-call parity formula, preferably without referring back to the text. What are the inputs?

answer

Put-call parity is the formula $C_0(K) = P_0(K) + S_0 - \mathrm{PV}_0(K)$. The price of a call option now, the price of the same put option (strike price and expiration time) now, the stock price now, and the present value now of the strike price are the inputs.

question

A 1-year call option with a strike price of \$80 costs \$20. A share costs \$70. The interest rate is 10% per year.

1. What should a 1-year put option with a strike price of \$80 trade for?

2. How could you earn money if the put option with a strike price of \$80 traded in the market for \$25 per share instead? Be explicit in what you would have to short (sell) and what you would have to long (buy).

answer

1. Put-call parity states that $C_0(K) = P_0(K) + S_0 - \text{PV}_0(K)$. Therefore, $P_0(K) = C_0(K) + \text{PV}_0(K) - S_0 = \$20 + \$80/1.10 - \$70 \approx \$22.73$.
2. The put option should cost \$22.73, but it indeed costs \$25.00. Therefore, it is too expensive, and you definitely need to short it. To cover yourself after shorting it, you now need to "manufacture" an artificial put option to neutralize your exposure. Put-call parity is $P_0(K) = C_0(K) + \text{PV}_0(K) - S_0 \approx \$22.73$. Loosely translated, a long put is a long call, a long present value of a strike price, and a short stock. Try purchasing one call (outflow now), saving the present value of the strike price (outflow), and shorting the stock (inflow now):

		S_T<**\$80**	
Execute	**Now**	**\$60**	**\$70**
+ 1 Call (K=\$80):	–\$20.00	\$0	\$0
- 1 Share:	+\$70.00	-\$60	-\$70
Save $\text{PV}_0(\$80)$:	–\$72.73	+\$80	+\$80
- 1 Put (K=\$80):	+\$25.00	–\$20	–\$10
Net	+\$2.27	\$0	\$0

	$S_T = \$80$	$S_T > \$80$	
Execute	**\$80**	**\$90**	**\$100**
+ 1 Call (K=\$80):	\$0	\$10	\$20
- 1 Share:	–\$80	–\$90	–\$100
Save $\text{PV}_0(\$80)$:	+\$80	+\$80	+\$80
- 1 Put (K=\$80):	\$0	\$0	\$0
Net	\$0	\$0	\$0

You would earn an immediate arbitrage profit of \$2.27.

The American Early Exercise Feature

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Although put-call parity applies only to European options, it has the interesting and clever implication that American call options should never be exercised early. (Again, keep in mind that the underlying stock must not pay dividends.) Here is

why: If an American call option is exercised immediately, it pays $C_0 = S_0 - K$. If the call is not exercised immediately, is the live option price more or less than this? Well, you know that the American option cannot be worth less than an equivalent European, because you can always hold onto the American option until expiration:

$$\text{American Call Value} \geq \text{European Call Value}$$

Put-call parity tells you that the European call price is

$$\text{European Call Value} = C_0 = P_0(K) + S_0 - \text{PV}_0(K)$$

$P_0(K)$ is a positive number and $\text{PV}_0(K)$ is less than K, which means that

$$\begin{aligned} \text{American Call Value} \geq \quad & \text{European Call Value} \\ = \; & P_0(K) + S_0 - \text{PV}_0(K) \\ \geq \; & S_0 - \text{PV}_0(K) \\ \geq \; & S_0 - K \end{aligned}$$

Therefore, the prevailing value of a live, unexercised American call is always at least equal to what you could get from its immediate exercise ($S_0 - K$). If you need money, sell the call in the market (at its arbitrage-determined value) and don't
X exercise it! By the way, you can also see from Table 28.1 that the American call price was higher than what you could have gotten from immediate exercise. For example, the July 20, 2002, call with a strike price of \$75 would have netted you
x only \$80.50-\$75=\$5.50 upon immediate exercise, but \$7.40 in the open market.

In sum, the value of the right to exercise early an American call option on a non-dividend-paying stock is zero. Therefore, an American call option—even though it can be exercised before expiration—is not worth more than the equivalent European call option:

$$\text{American Call Value} = \text{European Call Value}$$

important

Assuming that the underlying stock pays no dividends, put-call parity implies that the value of an American call option is higher alive than if it is immediately exercised. Therefore, the American right to exercise early is worthless, and the price of a European call option is the same as the price of an American call option.

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However, there are cases when early exercise can be valuable, and in this case, American options are worth more than European options. Consider extreme examples for two cases:

Calls on dividend-paying stocks: If the underlying stock pays a liquidating dividend, and the call is in-the-money, it definitely becomes worthwhile for the American call option holder to exercise the call just before the dividend is paid.

Put options: If you have a 100-year put option with a strike price of \$100 on a stock that trades for \$1 now, it is worthwhile to exercise the option, collect the \$99, and invest this money elsewhere to earn interest. Given that stocks appreciate on average, waiting 100 years to expiration reduces your payoff.

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question
Under what conditions can a European option be worth as much as the equivalent American option?

answer
A European option can be worth as much as the equivalent American option if there is no value to early exercise. This happens if the option is a call option on a stock that pays no dividends.

question
Compare the direct value of exercising an American put that is in-the-money (you get $K - S_0$) to the value of the put in the put-call parity formula $P_0(K) = C_0(K) + [\text{PV}_0(K) - S_0]$. Under what conditions is it better not to exercise the American put?

answer
To compare the value of a live put to a dead put, compute the net value of a live put ($C_0(K) + [\text{PV}_0(K) - S_0]$) minus that of a dead put $\{(K - S_0)\}$. It is $\{C_0(K) + [\text{PV}_0(K) - S_0]\} - \{(K - S_0)\}$. This can be simplified into $C_0(K) + [\text{PV}_0(K) - K]$. This expression is worth more if the call is worth more (the stock price is high relative to the strike price) and if the interest rate is low. It is under those circumstances that you should not exercise the American put because it is worth less dead than alive. (In the real world, many put options that are far out-of-the-money have already been purchased and exercised before the final date, so they are no longer available.)

28.C Valuing Options from Underlying Stock Prices

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Put-call parity gives you the value of a call option if you know the value of the equivalent put option (or vice versa). Unfortunately, if you don't know the value of either the put or the call, you cannot pin down the value of the other. To determine

the price of either, you need a formula that values one of them if all you have is
x the underlying stock price.

Valuing an option from just the underlying stock (and risk-free bonds) requires a new idea—dynamic arbitrage. It asks you to construct a mimicking portfolio consisting of the underlying stock and borrowed cash, so that the call option and your mimicking portfolio always change by the same amount over the next instant. In our example, IBM stock trades for $80.50. Now presume that it can either increase by 1 cent to $80.51 or decrease by 1 cent to $80.49. (This is why this method is called binomial pricing.) How much would the value of the IBM call with a strike price of $85 change? The answer turns out to be about 0.3371 cents. Thus, your mimicking portfolio would invest about $33.71\% \cdot \$80.50 \approx \$27.14$ into IBM stock. In addition, you would have to take into consideration that you may have to pay the strike price, which is essentially handled by borrowing the appropriate amount of cash. If you do this right, then the mimicking portfolio and the call option will respond to a 1-cent change over one instant in the price of underlying IBM stock in exactly the same way. The law of one price then means that the IBM call and the mimicking portfolio (consisting of IBM stock and borrowing) should cost the same amount. Unlike static arbitrage (where you can establish a position once and then wait until expiration), dynamic arbitrage does not allow you to sit back. After this first instant, you will have to change your stock and borrowings again. If IBM goes up, then you will have to establish a stock position different
x from the one where IBM goes down.

The details of the binomial pricing method are explained in more detail in the chapter appendix. The bad news is that it is very tedious—you have to work out all possible stock price paths until expiration. The good news is that it is a mechanical method—well suited to computer programming—and that it is very flexible. It can handle all kinds of options (even American puts and dividend-paying stocks). The best news is that there is one special-case version that gives you a quick formula for the price of a European call option on a stock without dividends. It is called the Black-Scholes formula (named after Fischer Black and Myron Scholes for their 1973 article). This formula, and the dynamic arbitrage concept on which it is based, rank among the most important advances of modern finance. Its inventors were justly honored with half an economics Nobel Prize in 1997. (The other half went to Robert Merton for his set of no-arbitrage static relationships that you already learned above.) Let me show you how to use this formula.

The Black-Scholes Formula

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Unlike the CAPM, which provides only modestly accurate appropriate expected rates of return, the Black-Scholes formula is usually very accurate in practice.

The reason why it works so well is that it is built around an arbitrage argument—although one that requires constant dynamic trading. It turns out that, as a potential arbitrageur, you can obtain the exact same payoffs that you receive from the call if you purchase the underlying stocks and bonds in just the right proportion and trade them infinitely often. (This is explained in detail in the chapter appendix.) In other words, if the call price does not equal the same price, then you could get rich in a perfect market. In an imperfect real world, the call price can diverge a little from the Black-Scholes price, but not much beyond transaction costs. In contrast, if the CAPM formula is not satisfied, you may find some great portfolio bets—but there are usually no arbitrage opportunities.

An Example Use of the Black-Scholes Formula

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Although the Black-Scholes formula may look awe-inspiring, it is not as daunting as it appears at first sight. Let's use it to determine the price of a sample call option:

Stock Price Now	S_0	\$80.50
Agreed-Upon Strike Price	K	\$85.00
Time Remaining to Maturity	t	0.1333 years
Interest Rate on Risk-Free Bonds	r_F	1.77% per year
Volatility (Standard Deviation) of the Underlying Stock	σ	30% per year

Your task is to determine the Black-Scholes call value:

$$C_0\big(S_0 = \$80.50, K = \$85, t = 0.1333, r_F = 1.77\%, \sigma = 30\%\big) = ?$$

This is a good opportunity to introduce the Black-Scholes formula:

important

The **Black-Scholes** formula gives the value of a call option on a stock not paying dividends:

$$C_0\big(S_0, K, t, r_F, \sigma\big) = S_0 \cdot \mathcal{N}\big(d_1\big) - \mathrm{PV}_0\big(K\big) \cdot \mathcal{N}\big(d_2\big)$$

where you compute

$$d_1 = \frac{\log_N\big[S_0/\mathrm{PV}_0\big(K\big)\big]}{\sigma \cdot \sqrt{t}} + {}^1\!/_2 \cdot \sigma \cdot \sqrt{t}$$

and

$$d_2 = d_1 - \sigma \cdot \sqrt{t}$$

The five inputs are as follows:

S_0	is the current stock price.
t	is the time left to maturity.
K	is the strike price.
$\text{PV}_0(K)$	is the present value of K that depends on r_F (the risk-free interest rate input, which is used only to compute $\text{PV}_0(K)$).
σ	is the standard deviation of the underlying stock's continuously compounded rate of return, and it is often casually called just "the stock volatility."

The σ is very similar to the standard deviation, Sdv (from Chapter **??**), of the stock's rate of return. But in contrast to an ordinary rate of return standard deviation, each rate of return must first be converted into its continuously compounded equivalent rate of return (from Section A.5.F on 28). You can do this by calculating the natural log of one plus the rate of return for each value. For example, if the two simple rates of return are +1% and –0.5%, you would compute the standard deviation from $\log_N(1+1\%) \approx 0.995\%$ and $\log_N(1-0.5\%) \approx -0.501\%$. The returns (and therefore Sdv and σ) are similar if rates of return are low.

Note that the three parameters t, r_F, and σ have to be quoted in the same time units. (Typically, they are quoted in annualized terms.) These are the two functions:

$\log_N(\cdot)$	is the natural log.
$\mathcal{N}(\cdot)$	is the **cumulative normal distribution** function. (Spreadsheets call this the "**normsdist()**" function.) You can also look up its values in a table in the book appendix on **??**.

This requires five steps:

1. Compute the present value of the strike price. For the approximately 7 weeks left, the interest rate would have been $(1+1.77\%)^{0.1333} - 1 \approx 0.2342\%$. Therefore, the $\text{PV}_0(\$85) \approx \$84.80$.

2. Compute the input d_1, which is needed later as the argument in the left cumulative normal distribution function:

$$\begin{aligned}
d_1 &= \frac{\log_N\left[S_0/\mathrm{PV}_0\left(K\right)\right]}{\sigma\cdot\sqrt{t}} + {}^1\!/_2\cdot\sigma\cdot\sqrt{t} \\
&= \frac{\log_N\left[\$80.50/\mathrm{PV}_0\left(\$85\right)\right]}{30\%\cdot\sqrt{0.1333}} + {}^1\!/_2\cdot 30\%\cdot\sqrt{0.1333} \\
&\approx \frac{\log_N\left(\$80.50/\$84.80\right)}{30\%\cdot 0.365} + {}^1\!/_2\cdot 30\%\cdot 0.365 \\
&\approx \frac{\log_N\left(0.949\right)}{10.95\%} + {}^1\!/_2\cdot 10.95\% \\
&\approx \frac{-0.052}{10.95\%} + 5.48\% \\
&\approx -47.52\% + 5.48\% \\
&\approx -42.04\%
\end{aligned}$$

(My calculations could be a little different from yours because I am carrying full precision.)

3. Compute d_2, the argument in the right cumulative normal distribution function:

$$\begin{aligned}
d_2 &= d_1 - \sigma\cdot\sqrt{t} \\
&\approx -42.04\% - 30\%\cdot\sqrt{0.1333} \\
&\approx -42.04\% - 10.95\% \\
&\approx -53.00\%
\end{aligned}$$

4. Look up the standard normal distribution for the d_1 and d_2 arguments in Table **??**, or use the spreadsheet **normsdist()** function: X

$$\mathcal{N}\left(-0.4204\right) \approx 0.3371, \mathcal{N}\left(-0.5300\right) \approx 0.2981$$

5. Compute the Black-Scholes value, $C_0\left(S_0 = \$80.50, K = \$85, t = 0.1333, r_F = 1.77\%, \sigma = 30\%\right)$:

$$
\begin{aligned}
& S_0 \cdot \mathcal{N}(d_1) && - && \mathrm{PV}_0(K) \cdot \mathcal{N}(d_2) \\
\approx\ & \$80.50 \cdot \mathcal{N}(-0.4204) && - && \$84.80 \cdot \mathcal{N}(-0.5300) \\
\approx\ & \$80.50 \cdot 0.3371 && - && \$84.80 \cdot 0.2981 \\
\approx\ & \$27.14 && - && \$25.28 \\
\approx\ & \$1.86
\end{aligned}
$$

Let me also note that if you want to hedge your option with stock, $\mathcal{N}(d_1)$ is the amount of stock that you need to purchase to be as exposed as the option to changes in the underlying stock. It is called the **hedge ratio**. In this example, you would have to purchase \$27.14 worth of stock.

In sum, a call option with a strike price of \$85 and 0.1333 years left to expiration on a stock with a current price of \$80.50 should cost about \$1.86, assuming that the underlying volatility is 30% per annum and the risk-free interest rate is 1.77% per annum. Trust me when I state that the empirical evidence suggests that 30% per annum was a reasonably good estimate of IBM's volatility in 2002. If you look at Table 28.1, you will see that the actual call option price of just such an option was \$1.90, not far off from the theoretical Black-Scholes value of \$1.86.

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question

What is the value of a call option with infinite time to maturity and a strike price of \$0? Use the parameters of the example: S_0=\$80.50, r_F=1.77%, and $\sigma = 50\%$.

answer

Think about what a call with infinite time to maturity and strike price of \$0 really is—it is simply the stock itself. The (Black-Scholes) answer is that this must be equivalent to owning the underlying stock itself. Therefore, $C_0 = S_0 = \$80.50$.

question

Price a call option with a stock price of \$80, a strike price of \$75, 3 months to maturity, a 5% risk-free rate of return, and a standard deviation of 20% on the underlying stock.

answer

The present value of \$75 is $PV(\$75) = \$75/(1.05^{1/4}) \approx \$74.09$. Thus,

$$d_1 \approx \frac{\log_N\big(\$80/\$74.09\big)}{20\% \cdot \sqrt{0.25}} + \frac{1}{2} \cdot 20\% \cdot \sqrt{0.25} \approx 0.817,$$

so $\mathcal{N}\big(0.817\big) \approx 0.793$. Next, compute $d_2 = 0.817 - 20\% \cdot \sqrt{0.25} \approx 0.717$ and $\mathcal{N}\big(0.717\big) \approx 0.763$. Therefore, $BS\big(S_0 = \$80, K = \$75, T = 1/4, r_F = 5\%, \sigma = 20\%\big) = \$80 \cdot 0.793 - \$74.09 \cdot 0.763 \approx \$6.89$.

The Black-Scholes Value for Other Options

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The Black-Scholes formula prices European call options for stocks that pay no dividends. How can you apply the Black-Scholes formula to other options? First, the good news:

American calls on stocks without dividends: Because you would never exercise such a call before expiration, the value of an American call is equal to the value of a European call. Therefore, the Black-Scholes formula prices such American call options just as well as European call options. X

European puts: If you know the value of the European call option, you can use put-call parity to determine the value of a European put option with the same strike price and maturity as the call option. In our example, X

$$\begin{aligned} P_0 &\approx \$1.86 - \$80.50 + \$84.80 = \$6.16 \\ P_0 &= C_0 - S_0 + \mathrm{PV}_0\big(K\big) \end{aligned}$$

This happens to be close to, but not exactly equal to, the real-world (though American) put price of $6.20 in Table 28.1.

Now the bad news: For other options, although there are sometimes ways to bend the Black-Scholes formula, you generally have to use the more complex binomial valuation technique explained in the chapter appendix to get an exact solution. This applies to American calls on dividend-paying stocks and to American puts.

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question

Price an IBM put option with a strike price of $100, using the parameters of the example in the text: t=0.1333,r_F=1.77%, $\sigma = 30\%$, S_0=$80.50.

1. What is the price if the option is European?

2. What is the price if the option is American? Would you continue holding onto it?

answer

To price the IBM put option:

1. First compute the European Black-Scholes call value: $BS\big(S = \$80.50, K = \$100, r_F = 1.77\%, t = 0.1333, \sigma = 30\%\big)$. The interest rate to maturity is $1.0177^{0.1333} \approx 1.00234$. Thus, the present value of the strike price is $PV(\$100) \approx \$100/1.00234 \approx \$99.767$. Next,

$$d_1 \approx \frac{\log_N\big(\$80.50/\$99.767\big)}{30\% \cdot \sqrt{0.1333}} + \frac{1}{2} \cdot 30\% \cdot \sqrt{0.1333} \approx -1.9589 + 0.05477 \approx -1.904$$

   and $\mathcal{N}\big(d_1\big) \approx 0.02845$. Then $d_2 \approx -2.0136 and \mathcal{N}\big(d_2\big) \approx 0.02202$. The call price is therefore about $BS\big(\$80.50, \$100, 0.1333, 1.77\%, 30\%\big) \approx \$80.50 \cdot 0.02845 - \$99.767 \cdot 0.02202 \approx \$2.289 - \$2.196 \approx \$0.0928$. Therefore, the European IBM put would be worth $\$0.0928 - \$80.50 + \$99.767 \approx \$19.36$. (Your answer may vary a little due to rounding.)
2. If you hold onto the put if it is American, you have an asset worth $19.36. If you exercise it, you receive an immediate $100-$80.50=$19.50. Therefore, you would be better off exercising immediately!

Synthetic Securities

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A different way to look at arbitrage relationships is to recognize that they define securities. That is, even if a put option were not available in the financial markets, it would be easy for you to manufacture one (assuming minimal transaction costs, of course). For example, return to the put-call parity relationship. It states that European options have the relationship

$$C_0\big(K\big) = P_0\big(K\big) + S_0 - \text{PV}_0\big(K\big) \iff P_0\big(K\big) = C_0\big(K\big) - S_0 + \text{PV}_0\big(K\big)$$

Instead of purchasing one put option, you can purchase one call option, short one stock, and invest the present value of the strike price in Treasuries. You would receive the same payoffs as if you had purchased the put option itself. Therefore,

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you have manufactured a synthetic put option for yourself.

Creating synthetic securities has become a big business for Wall Street. For example, a client company owning gas stations may wish to obtain an option to

purchase 10,000 barrels of crude oil in 10 years at a price of $50 per barrel. A Wall Street supplier of such call options models the price of oil and determines the appropriate value of a synthetic call option. The Wall Street supplier then sells the call option to the gas stations for a little more. But would the Wall Street firm now not be exposed to changes in the oil price? Yes—but it would in turn try to hedge this risk away. In this example, the Wall Street firm could undertake a (usually dynamic) hedge—the same idea that underlies the Black-Scholes formula. That is, it would first determine its hedge ratio, which is the amount by which the value of X
a synthetic 10-year call option with a strike price of $50 per barrel changes with the underlying oil price now. Say this value is 0.08. In this case, the Wall Street firm would purchase a forward contract for $10{,}000 \cdot 0.08 = 800$ barrels of oil. If X
the price of oil increases, then the Wall Street firm's own position in oil increases by the same amount as its obligation to the gas station company. This way, the Wall Street firm has low or no exposure to changes in the underlying oil price. And it has added value to its clients through its better ability to execute and monitor such dynamic hedges than the clients themselves.

28.D The Black-Scholes Inputs

Let us now look a bit more closely at the five ingredients of the Black-Scholes formula.

Obtaining the Black-Scholes Formula Inputs

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The first four inputs, S_0, K, t, and r_F, either are given by the option contract (the strike price K and time to expiration t) or can be easily found online (the current stock price S_0 and the risk-free interest rate r_F[required to compute $\text{PV}_0\big(K\big)$]). Only one input, σ, the standard deviation of the underlying stock returns, has to be guesstimated. There are two methods to do so.

1. The old-fashioned way uses, say, 3-5 years of historical stock returns and computes the standard deviation of daily rates of return:

$$\sigma_{\text{Daily}} = \sqrt{\frac{\text{Sum from Day 1 to N: } (r_t - \overline{r})^2}{N-1}}$$

   (To be perfectly accurate, the rates of return that you should be using here are continuously compounded, not simple rates of return.) Then, this number X
   is annualized by multiplying it by $\sqrt{255}$, because 255 is the approximate number of trading days. For example, if the daily standard deviation is 1%, the annual standard deviation would be $\sqrt{255} \cdot 1\% \approx 16.0\%$. (Annualization

is done by multiplying a standard deviation by the square root of the number of periods.)

X

2. If other call option prices are already known, it is possible to extract a volatility estimate using the Black-Scholes formula itself. For example, assume that the price of the stock is \$80.50 and the price of a July call with a strike price of \$80 is \$4.15.

$$C_0\big(S_0 = \$80.50, K = \$80, t = 34/255, r = 1.77\%, \sigma = ?\big) \approx \$4.15$$

What is the volatility of the underlying stock that is consistent with the \$4.15 price? The idea is to try different values of σ until the Black-Scholes formula exactly fits the known price of this option.

Start with a volatility guess of 0.20. After tedious calculations, you find that

$$C_0\big(S_0 = \$80.50, K = \$80, t \approx 0.1333, r = 1.77\%, \sigma = 0.20\big) \approx \$2.70$$

Option values increase with uncertainty, so this was too low a guess for σ. Try a higher value—say, 0.50:

$$C_0\big(S_0 = \$80.50, K = \$80, t \approx 0.1333, r = 1.77\%, \sigma = 0.50\big) \approx \$6.18$$

Too high. Try something in between. (Because \$4.15 is closer than \$2.70 than it is to \$6.18, try something a little bit closer to 0.20—say, 0.25.)

$$C_0\big(S_0 = \$80.50, K = \$80, t \approx 0.1333, r = 1.77\%, \sigma = 0.25\big) \approx \$3.27$$

Too low, but pretty close already. After a few more tries, you can determine that $\sigma \approx 0.325$ is the volatility that makes the Black-Scholes option pricing value equal to the actual call option price of \$4.15.

You can now work with this **implied volatility** estimate as if it were the best estimate of volatility, and use it to price other options with the Black-Scholes formula. Unlike the historical estimated volatility, the implied volatility is forward-looking! That is, it is the market guess of what volatility will be like in the future.

Obtaining an implied volatility is such a common procedure that many Web pages provide both the option price and the implied volatility. For instance, Table 28.3 shows OptionMetrics' reported implied volatilities. For the specific \$80 July call, OptionMetrics computed an implied volatility of 32.58%—just about the 32.5% that we computed ourselves.

Table 28.3: Adding Implied Volatilities to Table 28.1

—The source of both prices and implied volatilities was OptionMetrics on May 31, 2002. July 20 was 0.1333 years away. The prevailing interest rates were 1.77% over 1 month, and 1.95% over 6 months.

Underlying Base Asset		Expiration T	Strike Price K	Option Type	Option Price	Implied Volatility	Option Type	Option Price	Implied Volatility
IBM	$80.50	July 20, 2002	$85	Call	$1.900	30.38%	Put	$6.200	29.82%
		Different Strike Prices							
IBM	$80.50	July 20, 2002	$75	Call	$7.400	34.89%	Put	$1.725	34.51%
IBM	$80.50	July 20, 2002	$80	Call	$4.150	32.58%	Put	$3.400	31.67%
IBM	$80.50	July 20, 2002	$90	Call	$0.725	29.24%	Put	$10.100	29.18%
		Different Expiration Dates							
IBM	$80.50	Oct. 19, 2002	$85	Call	$4.550	31.32%	Put	$8.700	31.61%
IBM	$80.50	Jan. 18, 2003	$85	Call	$6.550	31.71%	Put	$10.200	31.40%

Sometimes, this implied volatility is even used interchangeably with the option price itself. That is, instead of reporting the Black-Scholes call price, traders might just report that the option is priced at a "32.5% vol." This makes it sometimes easier to compare different options. Table 28.3 shows that the $75 July call has a price of $7.40, while the $85 January put has a price of $10.20. How do you compare the two? Quoting them as volatilities–34.89% versus 31.40%—makes them easier to compare.

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The Black-Scholes formula is not the only option pricing formula, although it is by far the most common and also usually the easiest to use. It is pretty accurate. However, there are similar formulas based on the same dynamic trading concept that can price options just a little better. In particular, they can explain what would be an anomaly from the perspective of the Black-Scholes formula: The real-world prices of options that are far out-of-the-money—both calls and puts—are typically higher than what the Black-Scholes formula suggests. Put differently, according to the Black-Scholes formula, out-of-the-money options are priced as if their volatilities are higher than that of options that are at-the-money. If you draw the implied volatilities as a function of strike price, you get a so-called **volatility smile**—which is exactly what this empirical regularity is called by traders.

One explanation for the smile is that there is a rare probability of a large stock price shock that is ignored by the Black-Scholes model. This may indeed be why far-out-of-the-money options are more expensive in the real world than in the model. It is especially plausible for puts, which can serve as insurance against a stock market crash, but perhaps less plausible for calls. For hardcore option traders, this opens up another question: If there is no longer just one implied volatility for a stock but different ones depending on the strike price, then which of these should you use? To predict future volatility, the recommendation here is to use at-the-money options. Historically, they have tended to predict volatility better than out-of-the-money options.

Comparative Statics for the Black-Scholes Formula

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If you have solved all the exercises from the previous section (as you should have before proceeding!), you have already seen how the Black-Scholes call option value changes with its inputs. Specifically:

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Current stock price (S_0)—positive: A call option is worth more when the stock price now is higher. This was also a static no-arbitrage relationship, and the Black-Scholes formula obviously must obey it. Furthermore, not only do you know that the Black-Scholes formula increases with S, but you can even work out by how much. Look at the Black-Scholes formula:

$$C_0\big(S,K,t,r_F,\sigma\big) = S \cdot \mathcal{N}\big(d_1\big) - \mathrm{PV}_0\big(K\big) \cdot \mathcal{N}\big(d_2\big)$$

The stock price appears at this very high level, separate from the strike price K, and multiplied only by $\mathcal{N}\big(d_1\big)$. It turns out that $\mathcal{N}\big(d_1\big)$ is how the value of the call changes with respect to small value changes in the underlying stock price. For example, if $\mathcal{N}\big(d_1\big) \approx 0.3371$, then for a 10 cent increase in the value of the underlying stock, the value of the call option increases by 3.371 cents. Put differently, if your mimicking arbitrage position is long 33.71 shares and short 100 options, then your overall portfolio will not be affected one way or the other when the underlying stock price increases (or decreases) by 1 cent. You are said to be hedged against small changes in the stock price; that is, your portfolio is insured against such changes. For this reason, $\mathcal{N}\big(d_1\big)$ is also called the **hedge ratio**. Option traders also call it the **delta**. $\mathcal{N}\big(d_1\big)$ is the number of stocks that you need to purchase in order to mimic the behavior of your one option. For example, if right now the value of your call option increases by about \$0.0025 when the underlying stock price increases by \$0.01, then your hedge ratio is 0.25. If you own four of these call options, your total option position would change in value by the

same $\$0.0025 \cdot 4 = \$0.01$ amount that it would change if you owned one stock. (In addition, option traders often want to know how quickly the delta [the stock position] itself changes when the underlying stock price changes. This is called the **gamma** of the option. You can think of it as the delta of the delta.)

Strike price (K)—negative: A call option is worth more when the strike price is lower. Again, this was also a static arbitrage relationship.

Time left to maturity (t)—positive: A call option is worth more when there is more time to maturity. Again, this was also a static arbitrage relationship. (The change in the price of the option as time changes is commonly called **theta**.)

Interest rate to maturity (r_F)—positive: A call option is worth more when the interest rate is higher. This comparative static is not as intuitive as the three previous "comparative statics." My best attempt at explaining this intuition is that as the call option purchaser, you do not need to lay out the cash to cover the strike price immediately. You live on "borrowed" money. The higher the interest rate, the more value there is to you, the call owner, not to have to pay the strike price up front.

This is most obvious when the option is far in-the-money. For example, take a 1-year option with a strike price of \$40 on a stock with a price of \$100. Assume that the volatility is zero. If the interest rate is zero, the value of the call option is \$60: With no volatility, you know that the option will pay off \$60, and with an interest rate of zero, the value of the future payoff is the same as its present value. However, if the interest rate is 20%, then you can invest the \$40 in bonds for 1 year. Therefore, the value of the option is \$60 (at exercise), plus the \$8 in interest earned along the way—a total of \$68. (The change in the price of the option as the risk-free rate changes is commonly called **rho**.)

Volatility to maturity (σ)—positive: A call option is worth more when there is more volatility. When the underlying stock increases in volatility, the call option holder gets all the extra upside, but does not lose more from all the extra downside (due to limited liability). This increases the value of the option. If this comparative static is not obvious, then ask yourself whether you would rather own an option with a strike price of \$100 on a stock that will be worth either \$99 or \$101 at expiration, or on a stock that will be worth either \$50 or \$150 at expiration. Holding everything else constant,

an option on a more volatile asset is worth more. (The change in the price of the option as volatility changes is commonly called **vega**.)

x

There is one counterintuitive feature of the Black-Scholes formula: The expected rate of return on the underlying stock plays no role. This is because the other inputs, most of all the stock price (but also the interest rate and volatility), already incorporate the expected rate of return on the stock and therefore all the necessary information that you need to price an option. (Different purchasers can even disagree as to what the expected rate of return on the stock should be and still agree on the appropriate price on the option.)

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question
What is the delta of an option? Does it have another name, too?

answer
The delta of an option is the number of stocks that you need to purchase in order to mimic the option. Delta is also called the hedge ratio.

question
In words, how does the value of a call option change with the Black-Scholes inputs?

answer
The value of a call option increases with higher share prices, longer lengths to maturity, more volatility, and higher interest rates; it decreases with higher strike prices.

Value Prior to Expiration

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X

The Black-Scholes formula allows you to determine the price of a call option not only on the final expiration date, but also before the final expiration date. Figure 28.3 plots the Black-Scholes value of a call option with a strike price of \$90, an interest rate of 5%, and a standard deviation of 20% for three different times to expiration. The figure shows that the Black-Scholes value is always strictly above $\max(0, S_0 - K)$—otherwise, you could arbitrage by purchasing the call option and exercising it immediately. Moreover, you also already know that calls must be worth more when the underlying stock value is higher and when there is more time left to expiration. The figure nicely shows all of these features.

Figure 28.3: Black-Scholes values prior to, and at, expiration

—In this example, the time to expiration is either 1 day, 6 months, or 5 years. In all cases, the strike price is K=$90, the annual interest rate is 5%, and the annual standard deviation is 20%.
Figure blackscholes-time-base-wide with width 1*fullwidth

Option Riskiness

You can now ask another interesting question: What are the advantages and disadvantages of call options with different strike prices? The answer is that different options provide different risk profiles. For example, say the stock was trading at $100, 3 months prior to option expiration, the annual interest rate was 5%, and the annual standard deviation of the stock's underlying rates of return was 20%. According to Black-Scholes, a call option with a strike price of $50 would have cost $50.61. A call option with a strike price of $90 would have cost $11.65. And a call option with a strike price of $120 would have cost $0.20. All are fair prices. But consider what happens if the stock were to end up either very, very high or very, very low. If the stock price ends up at $70, the $50 option is the only one worth exercising, providing its holder with a $20 payoff. This is equivalent to a rate of return of $(\$20 - \$50.61)/\$50.61 \approx -60\%$. Figure 28.4 shows this calculation as well as a couple more. The call with the strike price of $50 is relatively safe compared to those with higher strike prices: It is in-the-money in both cases. The call with the strike price of $90 has roughly a 50-50 chance of losing everything—but it provides more "juice" for each dollar invested if it expires in-the-money. Finally, the call with the strike price of $120 is very likely to be a complete loss—but if the stock price were to exceed the strike price even by a little, the rate of return would quickly become astronomical. The rates of return on the four call options are graphed in Figure 28.4.

28.E Corporate Applications

Actually, the current chapter is not the first time you have encountered options. On the contrary.

Déjà Vu: Securities as Financial Options

The first time you worked with options was when you learned about uncertainty. In Section **??**, you computed the value of levered equity ownership under limited

Figure 28.4: Rates of Return on Call Option Investments

—In all cases, the current stock price is $100, the option is 3 months before expiration, the interest rate is 5%, and annual volatility is 20%.

Call Option Strike Price	**Price Now Payoff at T**	**Stock Will End at $70 Payoff at T**	**Return**	**Stock Will End at $130 Payoff at T**	**Return**
Call (Strike = $0)	$90.00	$70–$0	–22%	$130–$0	+44%
Call (Strike = $50)	$50.61	$70–$50	–60%	$130–$50	+58%
Call (Strike = $70)	$30.85	$70–$70	–100%	$130–$70	+94%
Call (Strike = $90)	$11.65	$0	–100%	$130–$90	+243%
Call (Strike = $100)	$4.60	$0	–100%	$130–$100	+552%
Call (Strike = $120)	$0.20	$0	–100%	$130–$120	+4,900%
Call (Strike = $130)	$0.02	$0	–100%	$130–$130	–100%

Figure blackscholes-return-fixed-wide with width 1*fullwidth

liability. Limited liability is, at its heart, an option—the option to walk away without owing anything else.

Let's put the example from Table **??** of levered equity in a building into option's lingo. If you owe a $25,000 mortgage, then your levered equity ownership is in effect a call option with a strike price of $25,000. If your building ends up being worth more than $25,000 (at loan expiration), it is in your interest to pay off the mortgage and keep the rest. If your building ends up being worth less than $25,000, you walk away and end up with $0. Alternatively, by put-call parity, you can think of equity with limited liability as being the same as a portfolio of equity without limited liability plus a put option with a strike price of $25,000, plus $25,000 in a loan. If the building ends up being worth only $20,000, you exercise the put. This means that you sell your $20,000 house and the put gives you the $25,000 - $20,000 = $5,000 profit. You use the $20,000 + $5,000 to pay off the $25,000 loan.

We expanded on the building example in Section **??**. Equity holders in corporations are also limited liability owners. They are in-the-money only after the corporate debt is paid off. Like a building owner, a stockholder has the option to walk away without having to make up further losses to creditors. Therefore, shareholders' levered equity is essentially an option on the value of the underlying base asset, which is the firm. You can even see the equivalence of a financial option and levered equity by comparing their payoff diagrams in Figures **??** and 28.1, respectively. Conversely, corporate debt is like a portfolio of risk-free bonds plus a put option sold to equity owners:

- If the firm is worth a lot, the shareholders pay the face value of the bonds. This is the horizontal line in the payoff diagram.
- If the firm is worth very little, the shareholders walk away from the firm: They exercise their right to sell the firm to the creditors for the face value of the corporate debt. Creditors lose an amount that increases with the difference between the face value of the debt and the actual value of the firm. This is the diagonal line in the payoff diagram.

x

The direct-options perspective on the cash flow rights of securities can be quite useful. First, you can gain qualitative insights. For example, you know that the value of an option increases with the volatility of the underlying base asset. Therefore, levered shareholders should prefer more risky projects to less risky projects. Second, you may even be able to obtain quantitative solutions for the X value of corporate securities using option pricing tools. If you can learn what process the firm's underlying value follows, you might even be able to use the Black-Scholes formula to derive an appropriate price for the firm's levered equity.

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question
Is it possible to have a security that is an option on an option?

answer
Not only is it possible to have a security that is an option on an option, but the fact is that almost all common financial options are such. This is because the stock on which they are written is itself an option on the underlying firm value. Thus, CBOE options are essentially options on options.

Déjà Vu: Real Projects as Options

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The second time you worked with options was when you learned how to work with "real options" in Section **??**. Recall that I explained that it is important to recognize X the real options features of your projects and to value them properly. A real option is really the value of your flexibility to respond to changing environments in the future. For example, if you have the ability to shut down production if the market price of your output product were to fall, then you have an option on a base asset that is the market price of your output product. Your option's strike price would be equal to the output price at which production becomes profitable. x

In Section **??**, we used a tree approach for valuing a number of these real options. It is almost the same approach as the binomial approach explained in

this chapter's appendix. The difference is that in the tree framework of the earlier chapter, you had to provide probabilities of up and down movements, and then use standard discounting over time. In the binomial framework in this chapter, you do not have to guess the discount rate. (The underlying base asset is a traded stock. Recall also that the Black-Scholes formula does not ask you for an expected rate of return as an input.) This is a nice advantage, but not a big one. The main difficulty is writing down the tree payoffs in the first place and working out what the optimal operating policy is (as a function of different state variables). Unfortunately, compared with the wealth of options embedded in real projects and their value dependence on many underlying factors, even complex financial options seem like child's play. It is rare that you can use the same financial option tools, like the Black-Scholes formula, to value a real option—more commonly, a tree approach using CAPM -type (or even risk-neutral) discounting makes your task simpler. Fortunately, the approach to valuing real options remains conceptually very similar, so once you understand one, the other is much easier.

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(This book also has a complete web chapter dedicated to real options valuation. Even this dedicated chapter can only scratch the surface. Other authors have written entire books on the subject.)

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question

You have received an offer to buy a lease for 1 week's worth of production (100 ounces) in a particular gold mine. This lease will occur in exactly 18 months. It is an old mine, so it costs \$400/ounce to extract gold. Gold is trading for \$365/ounce now but has a volatility of 40% per annum. The prevailing interest rate is 10% per year. What is the value of the gold mine?

answer

Let's price the lease in 18 months. Assume that you must decide to produce at the start of this week. If you see that the price of gold is above \$400, then you extract gold. Otherwise, you do not. You can now value the gold mine as if it were 100 Black-Scholes call options, each with current price \$365, strike price of \$400, interest rate of 10%, volatility of 40% per annum, and 18 months to expiration. You can calculate this. The present value of the strike price is $PV(K) = \$400/1.1^{1.5} \approx \$346.71$. $\log_N\left[S/\mathrm{PV}\left(\left(\right)K\right)\right] \approx \log_N\left(\$365/\$346.71\right) \approx 0.0514$. The Black-Scholes value of such a call is about $BS\left(S = \$365, K = \$400, t = 1.5, r = 0.1, \sigma = 0.4\right) \approx \$79.51$. Thus, 100 calls should be worth \$7,951.

question

Now assume that you own this mine. If the mine is inexhaustible, but can only extract 100 ounces per week, and the production cost increases by 20% per year (starting at \$400 next week, your first production period), how would you value this mine? (Do not solve this algebraically. Just think about the concepts.)

answer
The value of the mine would be the sum of many such options. The production cost per ounce increases by about 20%/52 ≈ 0.35% per week. It would increase the strike price from \$400 to \$401.40, then to \$402.81, and so on.

$$\begin{aligned}\text{Value} = BS\big(S = \$365, K = \$400, t = 1, r = 10\%, \sigma = 40\%\big(\ \big)\big)\\ + BS\big(S = \$365, K = \$401.40, t = 2, r = 10\%, \sigma = 40\%\big)\\ + BS\big(S = \$365, K = \$402.81, t = 3, r = 10\%, \sigma = 40\%\big) + \cdots\end{aligned}$$

Déjà Vu: Risk Management

x

The third time you worked with derivatives (though not with options) was in Chapter 27, which showed you how a firm can hedge its exchange rate exposure. X For example, consider an American corporation that has just sold its product to a German corporation for payment in euros in 6 months but that must pay its suppliers for its own inputs in U.S. dollars. It can lock in the current dollar value of its future euro receipts by selling some euro futures. This is a form of **risk management**, the deliberate manipulation of the risk exposure that the corporation faces. (For most companies, risk management means lowering risk exposure.) Risk management is worth covering in more generality. For example, a firm may also purchase liability insurance to protect it against occasional random mishaps. Or it may want to hedge its credit risk or oil risk exposures. Options and other derivatives are natural tools that can help to manage corporate risk, which is why we cover risk management in this chapter.

Why Hedge?

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In a perfect market, there is no value to risk management. You learned in Section **??** X that if investors can freely do or undo a transaction, it cannot add value. If the firm sells euros for dollars at the appropriate price, investors can easily undo this by taking the offsetting position (buying euros). Investors' return would again be based only on the value of the unhedged firm. Equivalently, if the firm were not to hedge the currency, investors could hedge for themselves. They could sell euros, and their return would come from the unhedged firm plus the value of the hedge. This argument is really the same as the Modigliani-Miller indifference proposition in the context of capital structure. Indeed, hedging risk is often the equivalent of X

a capital structure activity—the company can often share its risk either by selling
x equity or by hedging.

It is only in an imperfect market that risk management matters. In this case, you have to think about all the capital structure issues raised in Chapters **??** and **??**:

- Can risk management change the taxes paid by the corporation or its investors?
- Can it reduce deadweight financial distress costs?
- Can it worsen or alleviate conflicts between bondholders and stockholders?
- Can it induce the manager to work harder and make better decisions, or work less and make worse decisions?

And so on. The considerations in favor of risk management are usually the same as those in favor of having more equity and less debt. For example, an airline company could avoid the financial distress that rising fuel prices could cause if it were to purchase fuel futures. If the fuel price were to rise, its flight operations would turn unprofitable, but its fuel hedge would make money. Such a fuel hedge could add value if it avoids the collapse of an otherwise valuable underlying business. But it could also subtract value if it prevents the managers (the agents of the owners) from shutting down the airline and selling its assets if this were the value-maximizing action.

How to Hedge

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The basic idea of risk management through hedging is simple: The firm reduces a source of risk that it otherwise faces. The firm has a number of risk-management tools at its disposal:

- It can buy a policy from an insurance company that may specialize in, and thus understand and manage, the risk better. This works especially well if the risks are idiosyncratic—for example, the risk of a firm being sued or the risk of a firm's building collapsing. Insurance policies may work—but often less well—for more systematic risks, such as industry risks, commodity price risks, exchange rate risks, or interest rate risks. (In the credit crisis of 2008, investors that had purchased insurance against the credit risk in bonds suddenly learned that their main risk was not that just the underlying issuer would go out of business. Rather, it was also that many low-credit bonds could default at the same time and the insurer itself could go out of business. In other words, these investors mistook a true systematic risk

for idiosyncratic risk and thus used the wrong tool [insurance policies] as protection.)

- It can execute or not execute certain projects. For example, it can take fewer projects or reduce its risk by preferentially taking more projects that have a lower correlation with its existing operations. This is the diversification intuition we used for the CAPM, except that the firm uses it here to reduce its own firm risk and not its investors' portfolio risks.

- It can buy or sell contracts in the financial markets. For example, it can buy or sell options (or futures or stocks) to shift the risk to another party. This is especially popular if the risk is systematic and economy-wide. (In some cases, both contract parties may experience a decline in risk. For example, an oil producer may want to sell the oil futures that an oil consumer would want to buy. In other cases, there may be firms that specialize in absorbing risks. [This is one of the roles of funds, especially hedge funds.] The risk management of such firms is to increase their corporate risk, although preferably in a very deliberate fashion.)

x

Because this is a chapter on options, we shall focus primarily on buying and selling contracts in the financial markets. The three most common risks that companies hedge are the prices of input or output goods (especially commodities), currency exchange prices, and interest rates. Hedging them is conceptually the same, so we can cover all of them together:

1. In the real world, the firm decides what it wants to hedge (e.g., its costs, sales, or income) and then determines its exposure to this risk.

   Some firms know their exposures from the operations of their actual businesses. For example, in 2005, Southwest Airlines spent about $1.3 billion on jet fuel, about 20% of its operating expenses. Thus, it knew that a 5% rise in fuel prices would increase its operating expenses by $65 million.

   Other businesses have to estimate their risks. For example, even a domestic U.S. firm may find that its U.S. customers tend to buy less of its product when the yen becomes cheaper. In this case, it must first determine its exposures. This is often done through a historical regression in which the firm's sales are explained by the underlying base asset (here, the exchange rate). For example, our firm may have run a regression of monthly sales on the exchange rate to find

$$\text{Sales (in Millions)} = \$10 - \$0.05 \cdot (¥/\$) + \text{Noise} \qquad (28.2)$$

This suggests that if the current exchange rate is 100 ¥/$, expected sales should be around $\$10 - \$0.05 \cdot (100) = \$5$ million. More importantly, it suggests that if the exchange rate increases to 101 ¥/$ (that is, the yen becomes cheaper because you get more yen per dollar), sales would be expected to decline to $4.95 million. Thus, this firm has a sales exposure of $50,000 for each 1-yen change in value. This is exactly what the 0.05 regression coefficient gives you—it is your hedge ratio, the same as the delta in the Black-Scholes formula.

2. The firm decides how much of its risk it wants to hedge. Reducing risk has not only an upside but also a downside. For example, if an airline buys jet fuel today, it is a great hedge against future fuel price increases, but it will hurt its profitability if the fuel price decreases. An airline may also suffer other maladies and may not need as much fuel as it originally anticipated. And there is a cost to executing fuel hedges. Then there are strategic considerations—if the airline is very different from its competitors, it may go out of business in the most likely scenario, but it could really pounce and gobble up its competitors if the less likely scenario occurs. Thus, hedging can create a real option!

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Firms do not need to disclose all their hedges. Indeed, hedging operations are often so complex and multifaceted that it may not even be possible to disclose them fully within the confines of a typical financial statement. Although we do not have full knowledge of how firms are hedging, we do have some data from certain industries. Research by Carter, Rogers, and Simkins shows that about two-thirds of U.S. airlines engaged in active hedging programs from 1992 to 2003. But during that time no airline hedged even 1 full year of jet fuel consumption. They typically hedged only about 15% of their annual fuel purchases. The two most active hedgers were Southwest and JetBlue, which hedged 43% of their annual fuel purchases. (By 2005, Southwest had significantly scaled up its fuel hedging operations—and to its good fortune. In 2005, it yielded a positive $892 million inflow vis-à-vis its $1.3 billion fuel cost.) Of course, even if an airline hedges its entire fuel budget for 1 year, if fuel prices rise, it would likely affect not only the next year but many years thereafter. This means that its lifetime operating costs would still remain quite exposed to fuel price risk. In this long-run sense, most

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corporate hedging programs seem conservative.

This is only a small taste of risk management. In the real world, there are many other complications. For example, firms need to consider what exactly they

should hedge—operating costs may not be the right target. After all, it could be that firms can charge customers higher prices when their input costs are higher. Higher input costs may not be detrimental—in fact, some financially strong firms may even benefit from otherwise adverse economic price developments if their competitors are forced out of business. Another hedging consideration is more technical: What firms want to hedge may not be linearly related to the underlying commodity, as it was in Formula 28.2. This can often be dealt with through dynamic trading (the same concept underlying the Black-Scholes formula). Yet another common problem is that the commodity available for hedging may not be the exact commodity that the firm wants to hedge. (It may only have short-term crude oil futures to trade, while it would really want to buy long-term jet fuel.) This can create all sorts of mismatching trouble. In any case, the firm may have to make some interim payments on its hedges and so has to worry about having enough liquidity before its own investments mature. This can also have certain accounting reporting obligations, which could in turn trigger certain bond covenants.

anecdote

Derivatives can be powerful hedging tools. But they can also be powerful speculation tools.

- In 1994, Barings was a venerable 223-year-old London investment bank. It had financed the Napoleonic Wars and the Louisiana Purchase. However, Barings was not equipped to handle its own 28-year-old trader Nick Leeson in its Singapore branch office. Leeson lost $1.3 billion—the entire equity assets of Barings—in a series of bets using options on forwards on the Nikkei index. (Like any other derivatives, these Nikkei options can be used either for hedging or for speculation.) One lesson from Leeson is that becoming notorious is not a bad way to earn large fees on the after-dinner speaking circuit. (He did however have to pay a 4 year sentence in a Singapore prison.)
- In 2008, Societe Generale disclosed that a 31-year-old rogue trader, Jerome Karviel, had lost $7 billion. If the gambles had paid off over the years, he would have probably been paid double-digit-million-dollar bonuses. Instead, having lost, he got 3 years in jail. (He is currently appealing this sentence. Still, even 50% times $100 million outweighs 50% times 3 years in jail in my book.) Unlike Barings, Societe Generale was large enough to survive this loss.
- In 2011, UBS disclosed that its own 31-year-old rogue trader, Kewku Adoboli, had lost $2.3 billion. UBS's press release stated that "The positions taken were within the normal business flow of a large global equity trading house as part of a properly hedged portfolio. However, the true magnitude of the risk exposure was distorted because the positions had been offset in our systems with fictitious, forward-settling, cash ETF positions, allegedly executed by the trader. These fictitious trades concealed the fact that the index futures trades violated UBS's risk limits." (Reader: the lesson is not to avoid 31-year old traders.)

Rogue "hedging" operations are common. For every rogue trader with losses large enough to require public disclosure (with public embarrassment for management), there are probably ten rogue traders whose losses are just in the hundred million dollar range—small enough not to have to be disclosed. The corporate lesson from these episodes is that inadequate oversight of financial traders—who would have earned large bonuses on their trading profits if their gambles had won—can easily make the risk of a firm worse, not better. Firms need good risk management for their risk management.

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question

Assume that oil is trading for $50 per barrel today. The oil price can go down by 33% or up by 50% per year. That is, it can sell for either $33.33 or $75.

1. You own a refinery. It is worth more if the oil price is higher. Intuitively, what kind of oil transaction would reduce your risk?
2. Your refinery can produce profits of $1.5 million if oil trades for $33.33, and profits of $3 million if it trades for $75. If you write a contract to sell 30,000 barrels of oil for $50/barrel next year, how would your risk exposure change?
3. If you want to be fully hedged, how many barrels of oil should you be selling?

answer

Given this process on the price of oil:

1. Selling oil would reduce your risk.
2. If you have agreed to sell 30,000 barrels of oil for $50/barrel, you would receive $1.5 million. If the oil price were to be $33.33/barrel, you can buy 30,000 barrels for $1 million. This would give you a net profit of $0.5 million. If the oil price were to be $75/barrel, you can buy the barrels for $2.25 million. This would give you a net loss of $0.75 million. Putting this together with your refinery, your payoffs would now be $1.5+$0.5=$2 million if oil goes down, and $3-$0.75=$2.25 million if oil goes up. Your risk is much lower now.
3. If you contract on 36,000 barrels of oil, your net is $2.1 million in either case:
   - If oil drops to $33.33, the gain on your hedge is ($50−$33.33)·36,000 = $600,120. Thus, your payoffs would be $1.5 + $0.6 ≈ $2.1 million.
   - If oil rises to $75.00, the loss on your hedge is ($75 − $50) · 36,000 = $900,000. Thus, your payoffs would be $3 − $0.9 ≈ $2.1 million.

The 36,000 (x=36) was obtained by solving $1,500+($50−$33.33)·$x$ = $3,000 − ($75 − $50) · x.

question
Is it possible for a small firm to hedge the risk of overall stock market (S&P 500) movements? That is, could a firm with a market beta of 1.5 change its market beta to 0? If so, have you seen its hedge ratio (delta) before?

answer
A firm could easily hedge its S&P 500 risk by shorting the stock market. This is cheaply done by trading S&P 500 futures or forwards. If the firm is worth $100 million and has a beta of 1.5, shorting $150 million in this future should do the trick. The hedge ratio is really the market beta itself!

Employee Stock Options

x

Many firms have managerial and [pl]employee stock option plan (**ESOP**) in order to better motivate their workforce. The main idea is that options are more sensitive to changes in the underlying value of the firm than stock, so employees will be especially motivated to work hard if they own options. There are many unusual details to these employee options:

- They tend to be very long term (often as long as 10 years).
- They often vest only after several years (meaning that if the employee leaves the firm before that time, he loses the option).
- They are actually misnamed. If exercise triggers the creation of new underlying shares by the firm, then the proper name for such a claim would be a **warrant**, not an option. This is the case here: Almost all employee stock options are dilutive. X
- Because of tax rules, most of these options must have a strike price equal to the current underlying stock price.
- Most importantly, they cannot be sold or bought, and because employees are often not allowed to short the firm's stock or own put options on it, these options cannot be easily hedged by employees. This should not be surprising—after all, the very reason the firm gives its employees these options is to leave them exposed to the fortunes of the firm.

The last feature means that employee stock options are very different from other financial options. There is no hedge that forces their value. On the contrary—they are worth less to employees than they would be to third parties. To say it again:

The firm gives its employees a security that costs more than what employees value it for. In the extreme, if employees are extremely risk averse, they may not place any value ex-ante on these options. Moreover, employees should exercise their options as soon as they can in order to diversify their wealth away from being too linked to this one company. From the perspective of the company, early exercise reduces the options' effective costs when compared with a hypothetical issue of freely trading warrants to external investors. But early exercise also robs the firm of the options' incentive effects sooner—which was, after all, the whole point of granting these options. Our tools, like the Black-Scholes formula or put-call parity, are definitely not applicable in this context.

x

Executive options are not small potatoes. For example, in April 2002, Business Week reported that Larry Ellison, CEO of Oracle, had pocketed $706 million from the exercise of long-held stock options—more than the GDP of Grenada! "Fortunately," Oracle stock was off 57% that year, or Ellison's options would have been worth $2 billion more. That same year, Dennis Kozlowski, CEO of Tyco, hit number 3 on the executive payoff list. However, he wound up in jail, partly for criminally looting $600 million from Tyco. (Maybe he should have received more options!)

anecdote

Executive options seemed particularly attractive to firms prior to 2006, because U.S. GAAP did not require firms to expense these options. Thus, these options did not have a negative influence on firms' financial statements upon granting—they were almost invisible as far as the firms' financials were concerned. (Of course, this was highly misleading. Even if not exercised, options can have tremendous value at issue time. They are not free to the corporation.) The adoption of this option-expensing rule by FASB in 2004 provoked strong complaints by many firms, especially high-tech firms. Even the U.S. Senate did some grandstanding with a motion to strike down this rule.

However, this storm of indignation died down in the wake of another scandal. Articles by David Yermack (from New York University) and others showed that many of these executive options were (illegally) backdated. That is, many corporate boards claimed to have granted options to their executives a number of days earlier when/if the stock price was lower in order to artificially increase the option value.

wideonecolumn

Summary

widetwocolumns

This chapter covered the following major points:

- Call options give the right (but not the obligation) to purchase underlying securities at a predetermined strike price for a given period of time. Put options give the right (but not the obligation) to sell underlying securities at a predetermined strike price for a given period of time. American call options give this right all the way up to the final expiration; European call options give this right only at the final expiration.
- Option payoffs at expiration and complex option strategies are best understood by graphing their payoff diagrams.
- A number of static no-arbitrage relationships limit the range of prices that an option can have.
- The most important no-arbitrage relationship is put-call parity, which relates the price of a call to the price of a put, the price of the underlying stock, and the interest rate.
- Put-call parity implies that American call options are never exercised early, and therefore that American calls are worth the same as European options. (This assumes no dividends.)
- The Black-Scholes formula relates the price of a call to five input parameters. The Black-Scholes value increases with the stock price, decreases with the strike price, increases with the time left to maturity, increases with the volatility, and increases with the risk-free interest rate.
- Options techniques and insights have found applications in the valuation of corporate securities, in capital budgeting of projects that allow for future flexibility (real options), and in risk management. They are less easy to apply in the context of employee and executive stock option plans.

EOC MATTER

eocproblems

question
Is writing a call the same as buying a put, provided both have the same strike price and same expiration date? That is, do they give the same payoffs in future states of the world?

answer
No. For one thing, your losses are limited to your original investment when buying a put. If you write a call, you have unlimited liability.

question
An option is far out-of-the-money and will expire tonight. How would you expect its value to change when the stock price changes?

answer
An option that is far out-the-money and expiring soon will not change in value with the underlying stock price. After all, it will almost surely expire valueless.

question
Would a call option writer welcome an unexpected stock split? Would a call option writer welcome an unexpected dividend increase? (Assume a perfect market in both scenarios.)

answer
The call option writer is indifferent to the stock split. However, the unexpected dividend increase would be good for the call option writer.

question
Write down the payoff table and draw the payoff diagram (both at expiration) of a portfolio consisting of one short call with a strike price K = \$60 and one long put with a strike price K= \$80.

answer
The short call option with a strike price of \$60 costs money if the stock ends up above \$60, the long put option with a strike price of \$80 pays off below \$80:

Stock_T	Pfio_T	Stock_T	Pfio_T
\$0	+\$80	\$70	\$0
\$20	+\$60	\$75	–\$10
\$40	+\$40	\$80	–\$20
\$60	+\$20	\$90	–\$30
\$65	+\$10	\$100	–\$40

figure lacking

question

Graph the payoff diagram for the following straddle: one long call option with a strike price of \$50 and one long put option with a strike price of \$60.

answer

figure was here figure lacking

question

How could you earn money in the put-call parity example in Section 28.B if the 1-year put option traded in the market for \$25 per share, the stock price were \$80, the equivalent 1-year call cost \$30, and the interest rate were 10% per year?

answer

The put option should cost $\$30 + \$80/1.10 - \$70 \approx \$32.73$, but the put indeed cost \$25.00. Therefore, it is too cheap by \$7.73, and you definitely need to buy it. You should sell one call (inflow now), borrow the present value of the strike price (inflow now), and buy the stock (outflow now):

		Stock Price at Expiration T will be				
Execute	**Now**	**\$60**	**\$70**	**\$80**	**\$90**	**\$100**
Sell 1 call (K=\$80):	\$30	\$0	\$0	\$0	-\$10	-\$20
Buy 1 Share:	-\$70	\$60	\$70	\$80	\$90	\$100
Borrow PV (\$80):	\$72.73	-\$80	-\$80	-\$80	-\$80	-\$80
Buy 1 put (K=\$80):	-\$25	\$20	\$10	\$0	\$0	\$0
Net	\$7.72	\$0	\$0	\$0	\$0	\$0

question

A 1-year put option with a strike price of \$80 costs \$25. A share costs \$70. The interest rate is 8% per year. What should a 1-year call option with a strike price of \$80 trade for?

answer

Put-call parity states that

$$C_0 = P_0(K) + S_0 - \text{PV}_0(K) = \$25 + \$80/1.08 - \$70 \approx \$29.07$$

question

List and describe the simple no-arbitrage relationships, preferably both in words and in algebra.

answer

The formal definitions are on Page 407 reference: Page 988.

In words: Options cannot have negative values (i.e., prices);

American options cannot earn arbitrage profits if they are purchased and exercised immediately; calls with lower strike prices must be more expensive than calls with higher strike prices (the reverse holds for puts); and longer-term American options must be worth more than shorter-term American options.

question

How would you cook up a numerical example in which you would want to exercise an American put before expiration? Is your American put in-the-money or out-of-the-money?

answer

To cook up an example in which you want to exercise the American put before expiration, just pick an American put option that is far in the money.

question

What is the value of a call option with a strike price of \$0 and 6 months to expiration? Use the parameters of the example: S_0=\$80.50, r_F=1.77%, and $\sigma = 50\%$.

answer

The (Black-Scholes) answer is that this is also still equivalent to owning the underlying stock itself. Therefore, $C_0 = S_0 =$ \$80.50.

question

Write a computer spreadsheet that computes the Black-Scholes value on row 4 as a function of its five inputs (in the first two rows). This will teach you more about the Black-Scholes formula than all the pages in this book. Recall that the normal distribution function is **normsdist**.

answer

Here is a sample spreadsheet to compute Black-Scholes values:

	A	B	C	D	E
1	'S	'K	't	'r	's
2	80	90	0.25	0.05	0.20
3					
4	'PV(K)	88.90887=	B2/(1+D2) ^C2		
5	'S*sqrt(T)	0.1=	E2*sqrt(C2)		
6	'd1	–1.00585=	ln(A2/B4)/B5+0.5*B5		
7	'd2	–1.10585=	B6-B5		
8	'Black-Scholes	0.630532 =	A2*NORMSDIST(B6)	-B4*NORMSDIST(B7)	

question

Use your spreadsheet from Question 28.E to price a call option with a stock price of \$80, a strike price of \$75, 3 months to maturity, a 5%

risk-free rate of return, and a standard deviation of return of 20% on the underlying stock. Check it against the solution in Question 28.C.

answer
$BS \approx \$6.89$. (Hint: $\mathcal{N}(0.817) \approx 0.793$, $\mathcal{N}(0.717) \approx 0.763$.)

question
Price the earlier call option but with a higher strike price. That is, price a call with a stock price of \$80, a strike price of \$80, 3 months to maturity, a 5% risk-free rate of return, and a standard deviation of return of 20% on the underlying stock.

answer
$BS(\$80,\$80,3/12,5\%,20\%) \approx \$3.68$. (Hint: $\mathcal{N}(0.172) \approx 0.568$, $\mathcal{N}(0.072) \approx 0.529$.)

question
Price the earlier call option with a higher interest rate. That is, price a call with a stock price of \$80, a strike price of \$75, 3 months to maturity, a 10% risk-free rate of return, and a standard deviation of return of 20% on the underlying stock.

answer
$BS(\$80,\$75,3/12,5\%,20\%) \approx \$7.56$. (Hint: $\mathcal{N}(0.934) \approx 0.825$, $\mathcal{N}(0.834) \approx 0.798$.)

question
Price the earlier call option with a higher volatility. That is, price a call with a stock price of \$80, a strike price of \$75, 3 months to maturity, a 5% risk-free rate of return, and a standard deviation of return of 30% on the underlying stock.

answer
$BS(\$80,\$75,3/12,1.05,0.3) \approx \$8.15$. (Hint: $\mathcal{N}(0.587) \approx 0.721$. $\mathcal{N}(0.437) \approx 0.669$.)

question
Price a European put option with a stock price of \$80, a strike price of \$75, 3 months to maturity, a 5% risk-free rate of return, and a standard deviation of return of 20% on the underlying stock.

answer
Use put-call parity. The put price is $P \approx \$6.89 - \$80 + \$74.09 = \$0.98$.

question
Price a European straddle: one call and one put option on a stock with a price of \$80, both with strike prices of \$75, a 5% risk-free rate of return, and a standard deviation of return of 20% on the underlying stock.

1. What is the price of the position if there are 3 months to maturity?

2. What is the price if nothing changed and there is only 1 month left to maturity?
3. What is the price at expiration?

answer

For this European straddle with one call and one put option, $S_0 = \$80$, K=\$75 for both, r_F= 5%, and $\sigma = 20\%$, the price of the straddle with its two options is

1. \$6.89+\$0.89=\$7.87 if there are 3 months left.
2. \$5.56+\$0.26 = \$5.82 if there is 1 month left.
3. At expiration time, you can compute the value either with the Black-Scholes formula, or through insight. The answer is \$5, because the put option will be worth \$0 and the call will be worth \$5.

question

(Advanced) There are numerous calculators on the Web that will calculate an implied volatility for you. Fortunately, it is not difficult to write one yourself in a computer spreadsheet, using the built-in equation solver. Write a computer spreadsheet program that uses this equation solver to back out a volatility estimate, given a call price and the five Black-Scholes inputs. Use it to confirm the implied volatilities in Table 28.3. Then use your spreadsheet and data from a financial website to compute the implied volatility of IBM now. Be clear about what inputs you are using.

answer

Do it! An example appears in http://www.hoadley.net/options/optiongraphs.aspx. Of course, IBM's volatility is an estimate, which may differ across different estimates and will depend upon when the student completes this question.

question

Are the deltas of options with different strike prices different?

answer

Yes, the delta of options with different strike prices is different. You can confirm this by working out the value of two different options.

question

Using the computer spreadsheet you created in Question 28.E, graph the Black-Scholes value as a function of the current stock value for options with two different interest rates: 5% and 20%. That is, repeat Figure 28.4 for a 3-month option with strike price K=\$90, 3 months to expiration, and a 20% volatility.

answer

Figure: Figure blackscholes-intst-base with width 0.5*full-width Parameters: Strike price K=\$90. Time to Expiration t=0.25 years.

Volatility: 20% per annum.
Interpretation: The figure shows that the call option is more valuable when the interest rate is higher.

question
Using the computer spreadsheet you created in Question 28.E, graph the Black-Scholes value as a function of the current stock value for options with three different volatilities: 20%, 80%, and 160%. That is, repeat Figure 28.4 for a 3-month option with strike price K=$90, 3 months to expiration, and a 5% interest rate.

answer
ȷfigure is out of page Figure: ART: options blackscholes-vol-base
Parameters: Strike price K=$90. Time to Expiration t=0.25 years. Interest Rate: 5% per annum.
Interpretation: The figure shows that the call option is more valuable when the volatility is higher. However, for very high stock prices, i.e., when the option is already far in-the-money, the advantage of volatility is relatively smaller.

question
In words, how does the value of a call option change with the Black-Scholes inputs?

answer
This is a repeat of a Solve Now! question—and intentionally so. The Black-Scholes formula increases with the share price, length to maturity, volatility, and interest rate; and decreases with the strike price.

question
Should employees and firms value employee stock options using the Black-Scholes formula?

answer
Firms should not value employee stock options using the Black-Scholes formula. Employees are undiversified and are therefore more eager to execute these options. From the firm's perspective, this reduces the value of granted options. However, the value of the firm itself should increase when these options are granted—after all, this is why they were supposedly granted in the first place.

eocproblems

question
Price an American call option with a strike price of $53 over the last two instants before expiration.

answer
to do

question
Price a European put option with a strike price of $53 over the last two instants before expiration. How does its value differ from an American Put option? (Hint: for the American put, consider at each node whether you would want to exercise the put or continue to hold it.)

answer
to do

28.F Chapter Appendix: The Ideas behind the Black-Scholes Formula

In the previous sections, you learned how to use the Black-Scholes formula. However, it descended on you out of the ether. If you are wondering where the formula actually comes from, then this section is for you.

Modeling the Stock Price Process as a Binomial Tree

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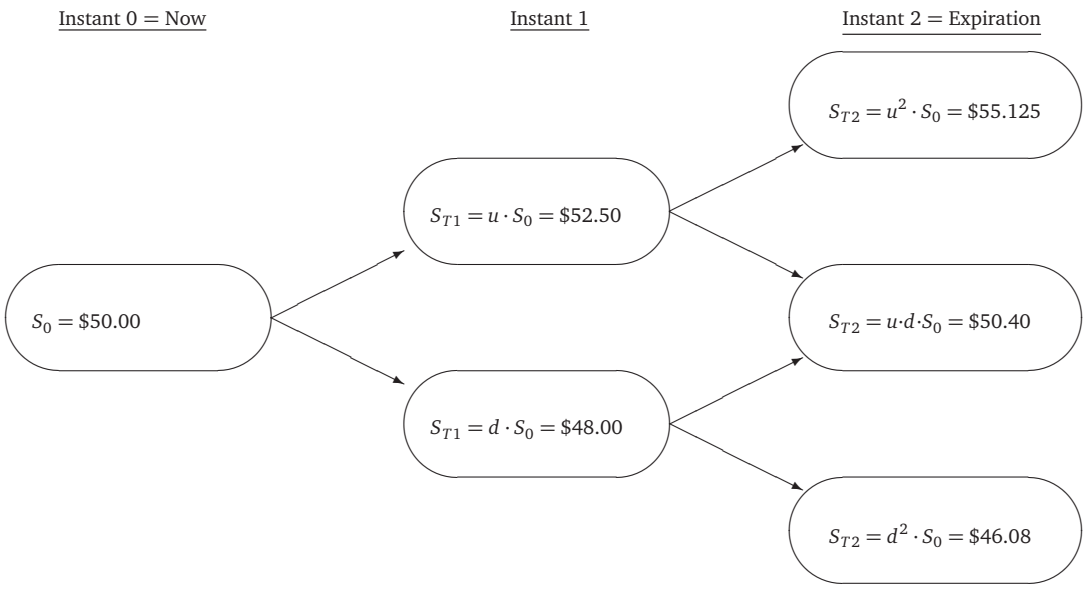
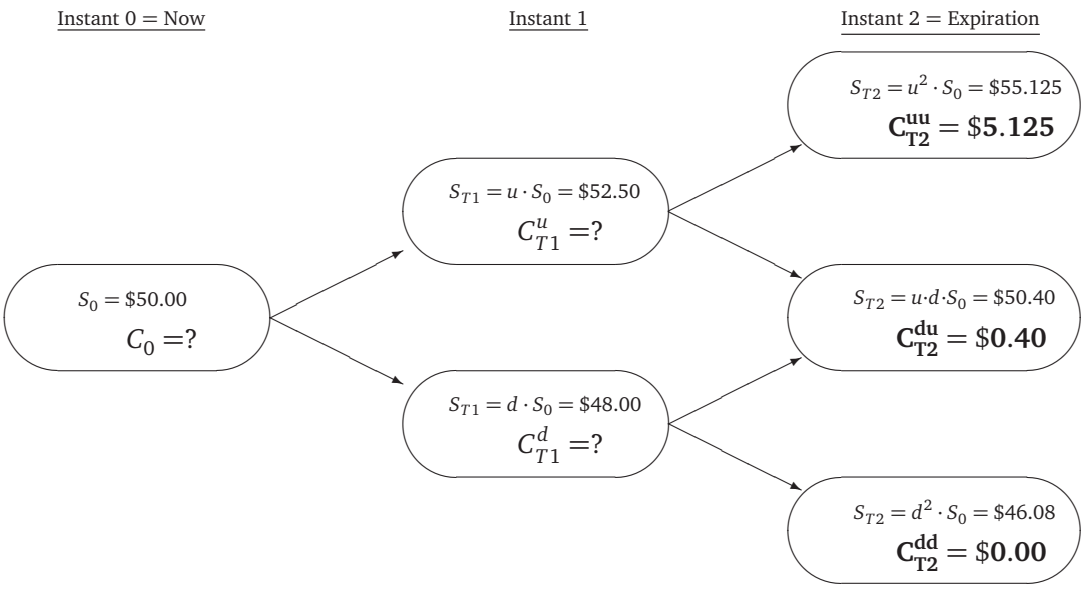
The basic building element for the Black-Scholes formula is the assumption that over one instant, the stock price can only move up or down. (This is called a **binomial process**.) So you must first understand how to work in such a world. Over two instants, the stock price can move up twice, move up once and move down once, or move down twice. Use the letter u to describe the stock price multiplier when an up move occurs, and d to describe the stock price multiplier when a down move occurs. You can represent the stock price process with a binomial tree—where one branch represents a price-up movement and the other a price-down movement. For example, if d= 0.96 (which means that on a down move, the stock price declines by 4%) and u= 1.05 (the stock price increases by 5%), the stock price is as follows:



Note that at instant 2, the middle outcome occurs on two possible paths, while the two extreme outcomes occur only on one path each; $u \cdot d \cdot S_0$ can come about if there is one u followed by one d, or if there is one d followed by one u. This is already a statistical distribution that shares with a bell-shaped (normal) distribution the feature that middle outcomes are more likely than extreme outcomes. (With many more binomial tree levels, you indeed end up with a continuous distribution that looks a lot like a bell-shaped curve.)

The Option Hedge

If you know that your stock follows this binomial process, and you know u and d, can you price a call option with a strike price of \$50? On inspection of the tree, realize that the call option pays \$0 if the stock price moves down twice, \$0.40 if the stock price moves up once and down once (or vice versa), and \$5.125 if the stock price moves up twice.



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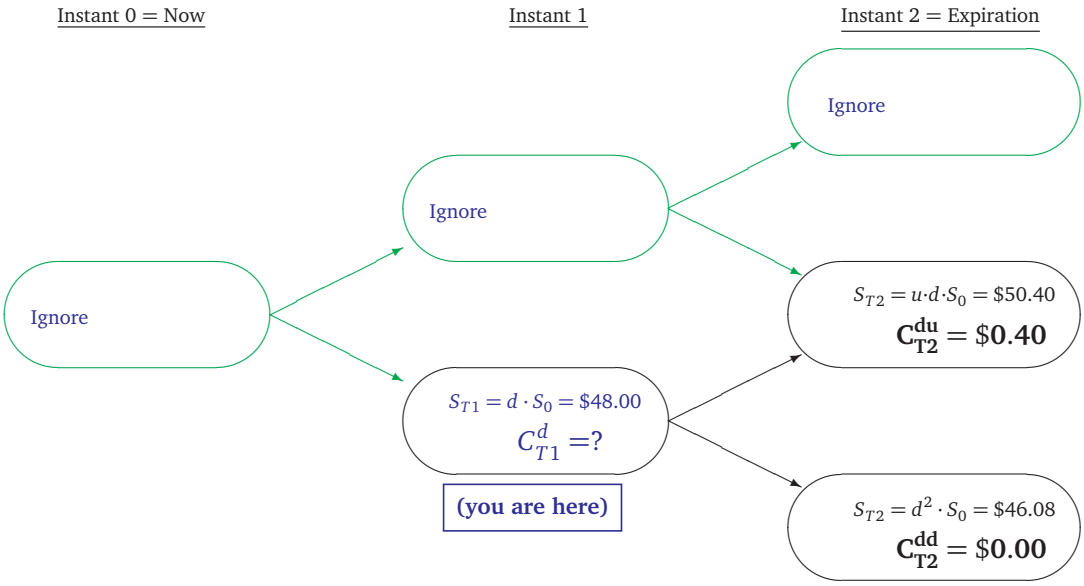
Your ultimate goal is to determine the call price at the outset, C_0. First place yourself into the position where the stock price has moved down once already, that is, where the stock price stands at \$48.00.



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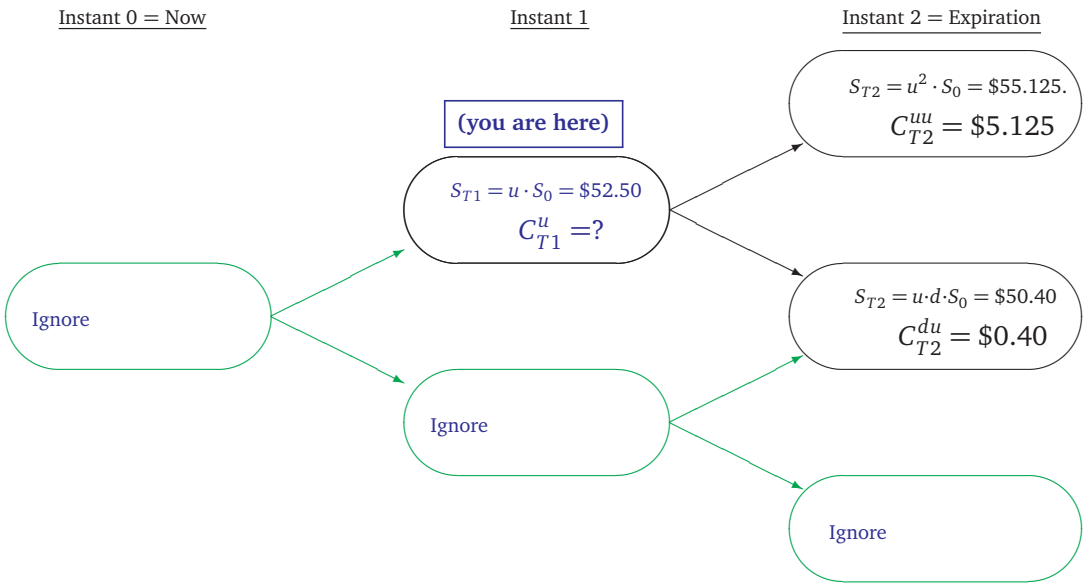
Your immediate goal is to buy stocks and risk-free bonds so that you receive \$0 if the stock moves down and \$0.40 if the stock moves up. Assume you purchase δ stocks and b bonds. Bonds increase at a risk-free rate of 1+0.1% each instant. If you own δ stock and the stock price goes up, you will own $\delta \cdot u \cdot S_0$ stock. If you own δ stock and the stock price goes down, you will own $\delta \cdot d \cdot S_0 stock$. Can you purchase a particular δ amount of stock and a particular b amount of bonds to earn exactly the same as your call option? Solve for b and δ so that

$$\begin{aligned} \delta \cdot 0.96 \cdot \$48 + b \cdot (1.001) &= \$0.00 \\ \delta \cdot 1.05 \cdot \$48 + b \cdot (1.001) &= \$0.40 \\ \delta \cdot d \cdot S_0 + b \cdot (1+r) &= C_d \\ \delta \cdot u \cdot S_0 + b \cdot (1+r) &= C_u \end{aligned}$$

The solution is

$$\delta = \frac{\$0.40 - \$0.00}{1.05 \cdot \$48 - 0.96 \cdot \$48} \approx 0.0926 \quad \text{and} \quad b \approx -\$4.262$$

If you purchase a portfolio of 0.0926 shares (which costs $0.0926 \cdot \$48 \approx \$4.444$) and borrow \$4.262 (for a net outlay of \$0.182 now), then in the next period, this portfolio will pay off \$0 in the downstate and \$0.40 in the upstate. Because this is exactly the same as the payoff on the call option, the C_1^d call option should also be worth \$0.182. This is the law of one price (absence of arbitrage) in action.



x

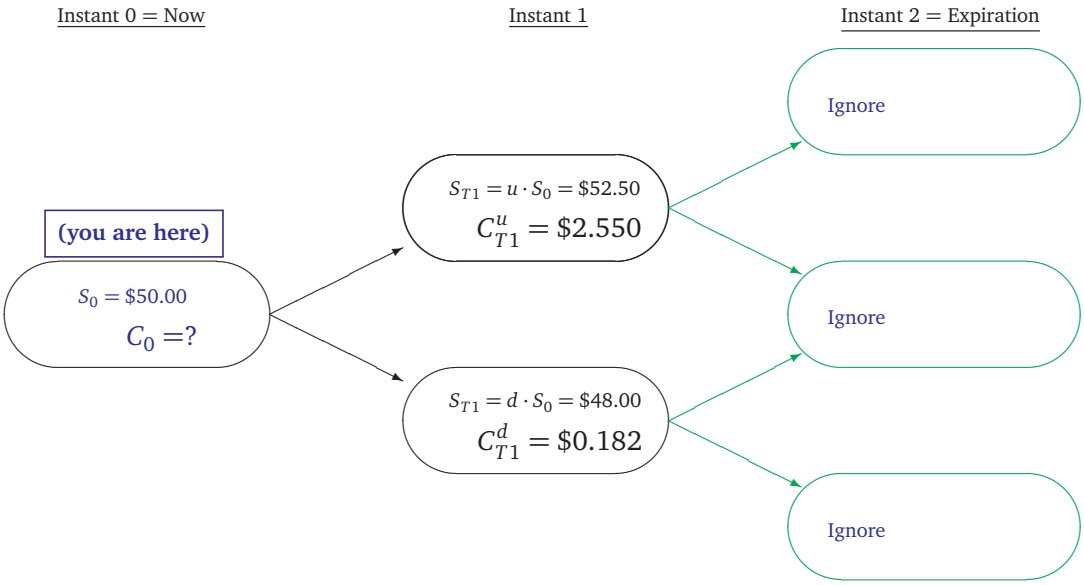
Now repeat the same exercise where the stock price stands at \$52.50 and next instant you can end up with either \$0.40 in the downstate or \$5.125 in the upstate. In this case, solve

$$\begin{aligned} \delta \cdot 0.96 \cdot \$52.50 + b \cdot (1.001) &= \$0.400 \\ \delta \cdot 1.05 \cdot \$52.50 + b \cdot (1.001) &= \$5.125 \\ \delta \cdot d \cdot S_0 + b \cdot (1+r) &= C_d \\ \delta \cdot u \cdot S_0 + b \cdot (1+r) &= C_u \end{aligned}$$

And the solutions are

$$\delta = \frac{\$5.125 - \$0.40}{1.05 \cdot \$52.50 - 0.96 \cdot \$52.50} = 1.00 \quad \text{and} \quad b \approx -\$49.95$$

If you purchase 1.00 shares (at a price of \$52.50) and borrow \$49.95 (for a net portfolio cost of \$2.550), you will receive \$5.125 if the stock price goes up and \$0.40 if the stock price goes down. Therefore, after the stock price has gone up once to stand at \$52.50, the C_1^u call option has to be valued at \$2.550, too.



x

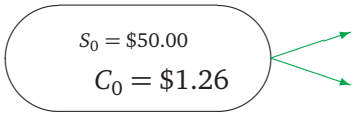
To determine the value of the call C_0 at the outset, find the price of a security that will be worth \$0.182 if the stock moves from \$50 to \$48, and worth \$2.55 if the stock moves from \$50 to \$52.50:

$$\begin{aligned}
\delta \cdot 0.96 \cdot \$50.00 + b \cdot (1.001) &= \$0.182 \\
\delta \cdot 1.05 \cdot \$50.00 + b \cdot (1.001) &= \$2.550 \\
\delta \cdot d \cdot S_0 + b \cdot (1+r) &= C_d \\
\delta \cdot u \cdot S_0 + b \cdot (1+r) &= C_u
\end{aligned}$$

The solution is

$$\delta = \frac{\$2.550 - \$0.182}{1.05 \cdot \$50 - 0.96 \cdot \$50} \approx 0.5262 \quad \text{and} \quad b \approx -\$25.05$$

You have to purchase 0.5262 shares (cost now: \$26.31), and borrow \$25.05 dollars. Your portfolio's total net outlay is $\$26.31 - \$25.05 \approx \$1.26$. Therefore, it follows that, by arbitrage, the price of the call option C_0 must be about \$1.26 now.



Matching a Stock Price Distribution to a Binomial Tree and Infinite-Level Pricing

In real life, the stock price can move many more times than just twice. You need a tree with many more levels, so you need to generalize this binomial process to more levels. For example, if there are 10 instants, what would be the worst possible outcome? Ten instant down movements mean that the stock price would be

$$\text{Worst-Case Scenario:} \quad d^{10} \cdot S_0 = 0.96^{10} \cdot \$50 \approx \$33.24$$

The second-worst outcome would be one instant of up movement, and nine instants of down movement.

$$\text{Second-Worst-Case Scenario:} \quad d^9 \cdot u^1 \cdot S_0 = 0.96^9 \cdot 1.05^1 \cdot \$50 \approx \$36.36$$

Although the worst scenario can only occur if there are exactly 10 down movements, there are 10 different ways to fall into the second-worst scenario, ranging from duuuuuuuuu, uduuuuuuuu, ..., to uuuuuuuuud. This should bring back bad memories of "combinations" from your SAT test: These are the 10 possible combinations, better written as

$$\begin{pmatrix} 10 \\ 1 \end{pmatrix} = \frac{10!}{1! \cdot 9!} = 10$$

$$\begin{pmatrix} N \\ i \end{pmatrix} = \frac{N!}{N! \cdot (N-i)!}$$

Therefore, with N levels in the tree, the stock price will be $u^i \cdot d^{N-i} \cdot S_0$ in $\begin{pmatrix} N \\ i \end{pmatrix}$ paths. The probability of exactly 1 in 10 up movements, if the probability of each up movement is 40%, would be

$$Prob(1\,u's, 9\,d's) = \begin{pmatrix} 10 \\ 1 \end{pmatrix} \cdot 0.4^1 \cdot (1-0.4)^{10} - 1 \approx 4\%$$

$$Prob((i)\,u's, (N-i)\,d's) = \begin{pmatrix} N \\ i \end{pmatrix} \cdot p^i \cdot (1-p)^{N-i}$$

x

Still, is it enough to work with such an unrealistic binomial tree process, given that the stock price from now to expiration is more likely to have a continuous bell-shaped distribution? Put differently, how realistic is this binomial stock price process? Figure 28.5 plots a distribution of prices at the end of the tree if there are up to 500 nodes, if up and downs are equally likely, and if u=1.02 and $d = 1/u \approx 0.98$. This binomial process looks as if it can generate a pretty reasonable

x distribution of possible future stock price outcomes.

If you assume that the stock prices can only move up or down each instant and that there are an infinite number of instants, then the underlying stock price distribution follows a **log-normal distribution**, with $0 as the lowest possible outcome. The rate of return follows a log-normal distribution with –100% as the lowest possible outcome. (The log-normal name comes from the fact that if a variable P follows a log-normal distribution, then log(P) follows a normal distribution.)

A practical question is how to select u, d, and q (where q is the true probability of an up movement) in a simulated tree to match an empirically observed stock price distribution. Assume you have a historical rate of return series to provide you with a reasonable mean and a reasonable variance for the expected rate of return. Call dt a really tiny time interval, call m the mean that you want to match, and s the standard deviation. Then select u and d as follows:

Figure 28.5: Stock Price Processes Simulated via Binomial Processes

—The probability of an up movement at each tree node is 50-50. The value multiplier is u=1.02 if an up movement occurs, d=1/1.02 if a down movement occurs. The stock price is $100. The graphs differ in the number of levels in the tree: 2, 5, 50, and 500.

2 Levels	5 Levels
Figure distributions2 with width 0.5*fullwidth	Figure distributions5 with width 0.5*fullwidth
50 Levels	500 Levels
Figure distributions50 with width 0.5*fullwidth	Figure distributions500 with width 0.5*fullwidth

$$u = m \cdot dt + s \cdot \sqrt{dt} \quad \text{and} \quad d = m \cdot dt - s \cdot \sqrt{dt}$$

In the limit, these choices create a log-normal distribution, which is completely characterized by its mean and variance, with mean m and standard deviation s.

Binomial Pricing and the Black-Scholes Formula

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In sum, the process to price options is as follows:

1. Determine the real-world stock price distribution to expiration—most importantly, the stock volatility.
2. Compute the u and d that you need in order to build your tree with a great many levels to expiration—the more the better—to match the real-world stock price distribution.
3. After you have written down your tree, write down the payoff of your option as a function of the underlying stock on the final nodes.
4. Work your way backward through the binomial tree.
5. At the origin node, you can read off the amount of stock (delta) that you need to purchase in order to mimic your option. You can buy the underlying stock and borrow some funds so as to mimic exactly how your option can change in value over the next instant, and your net cost determines the value of the option.

Computers can do this extremely quickly. You can also use this technique to price options that you could not otherwise price. For example, to price an American put

option, work your way backward through the tree, asking yourself at each node whether exercising your put option would yield greater profits than keeping it. If it would, assume you would exercise at this node, and use this higher value while working backward thereafter.

To find the Black-Scholes formula, there are no more novel concepts or intuition. You only need a lot of (tedious) algebraic manipulation and simplification. You let the number of levels in the tree go to infinity—of course, adjusting u and d in a way that continues to match the real-world stock volatility from now to expiration. After this messy algebra, the Black-Scholes formula pops right out. The amount of stock you need to purchase for your mimicking portfolio, which is δ in our binomial notation, becomes $\mathcal{N}\left(d_1\right)$ in this limit. Done.

eocproblems

question
Price an American call option with a strike price of $53 over the last two instants before expiration.

answer

question
Price a European put option with a strike price of $53 over the last two instants before expiration. How does its value differ from an American Put option? (Hint: for the American put, consider at each node whether you would want to exercise the put or continue to hold it.)

answer

Chapter 29

A Short Glossary of Some Bonds and Rates

This appendix briefly describes a plethora of different interest rates and bonds that you may encounter. More complete finance glossaries can be found at http://www.investopedia.com and The New York Times Dictionary of Money and Investing (also available online)—or simply by looking up the top hits in Google or Bing (which is how I find definitions for terms I do not know).

In the real world, there are many different interest rates. Every borrower and every lender may pay a slightly different interest rate, depending on the bond's default risk, risk premium, liquidity, maturity, identity, convenience, and so on. It is impossible to describe every common bond or rate. Section C of the Wall Street Journal has a wealth of information on many common and important interest bearing instruments. In addition, futures on interest rates (similar to forward rates) are listed in the B section.

Here are short descriptions of some of the fixed-income instruments and interest rates that are in common use.

Agency bonds: Issued by quasi-governmental companies, such as FannieMae, FreddieMac, the Federal Farm Credit Bank, and SallieMae (all described below). These agencies were originally set up by the U.S. government to facilitate loans for a particular purpose, then bundle the loans and sell them to the financial markets. These companies are huge. Sometimes they are thought to be implicitly backed by the U.S. government, though no explicit guarantees may exist.

APR (annual percentage rate): A measure of interest due on a mortgage loan that accounts for upfront costs and payments. Unfortunately, there are no

clear rules about how to compute APR, so the APR computation can vary across companies.

ARM (adjustable rate mortgage): A mortgage with an interest rate that is usually reset once per year according to a then-prevailing interest rate, prespecified by a formula but subject to some upper limit (called a cap), repayable by the borrower.

Bankers acceptances: Loans by banks to importers, used to pay the exporting firm. Backed by the issuing bank if the importer defaults. Usual maturities are |30| to |180| days.

Certificate of deposit (CD): An instrument issued by banks to retail customers willing to commit funds for longer than a day, but still over a short-term or medium-term period. Unlike ordinary savings accounts, CDs are not insured by the government if the bank fails.

Callable bonds: Bonds that the issuer can call back at a prespecified price. Often a feature of convertible bonds.

CMO (collateralized mortgage obligation): A security backed by a pool of real estate mortgages, with specified claims to interest and principal payments. For example, there are **interest only (IO)** bonds and **principal only (PO)** bonds, which entitle bondholders either only to the interest or the principal income that the pool of mortgages receives.

Collateralized trust bonds: Often issued by corporations, these bonds pledge as collateral the securities owned by a subsidiary.

Commercial paper: Short term bonds issued by corporations to the public markets. Often backed by bank guarantees. Because commercial paper is short term and often backed by assets, it is usually very low risk.

Consumer credit rates: The Wall Street Journal lists typical **credit card rates** and **car loan rates**.

Convertible bonds: Bonds that the holder can convert into common equity. Often issued with a call feature.

Debenture: Unsecured general obligation bond.

Discount rate: The interest rate that the Federal Reserve charges banks for short-term loans of reserves.

Equipment obligations: Unlike debentures, these corporate bonds usually pledge specific equipment as collateral.

Eurobond: Bonds issued by the U.S. government outside the domain of the Securities and Exchange Commission (e.g., in Europe) and purchased by foreign investors. Eurobonds need not be denominated in dollars.

Federal funds rate: Banks must hold financial reserves at the Federal Reserve Bank. If they have more reserves than they legally need, they can lend them to other banks. The rate at which they lend to one another overnight is the federal funds rate. It is this interest rate that is primarily under the control of the board of governors of the Federal Reserve.

FannieMae: Originally the Federal National Mortgage Association (**FNMA**), a corporation set up by the government to help facilitate mortgage lending. It holds mortgages as assets. FannieMae and FreddieMac together hold most of the U.S. mortgages, although they sell off claims against these mortgage bundles into the financial markets. The FNMA bonds are themselves collateralized (backed) by the mortgages, but, despite common perception before the 2008 crisis, not by the U.S. government. Still, it would be difficult to imagine that the United States would let FannieMae default. FannieMae may simply be too big to fail. To be eligible, an FNMA mortgage cannot exceed a certain limit. In 2008, this was |$417,000| for a single-family first mortgage loan.

Federal Farm Credit Banks Funding Corporation: Similar to FreddieMac and FannieMae, but focused on farm lending.

FreddieMac: Originally the Federal Home Loan Mortgage Corporation (**FHLMC**), an agency similar to FannieMae.

GIC (guaranteed investment contract): Usually issued by insurance companies and purchased by retirement plans. The interest rate is guaranteed, but the principal is not.

G.O. bond (general obligation bond): A bond whose repayment is not guaranteed by a specific revenue stream. See also revenue bond.

GinnieMae: The Government National Mortgage Association (**GNMA**) backs loans made by other federal departments (e.g., the Department of Veterans Affairs). GinnieMae securities are the only mortgage bonds guaranteed by the U.S. government and thus cannot default.

High-yield bonds: Sometimes also called **non-investment-grade bonds** or just **junk bonds**, high-yield bonds are bonds (usually of corporations) that have credit ratings of BB and lower.

Home equity loan rate: The rate for loans secured by a home. Usually second mortgages, that is, mortgages taken after another mortgage is already in place.

Investment-grade bonds: Bonds that have a credit rating of BBB or better. This is a common (and important) classification for corporate bonds.

Jumbo mortgage: A mortgage that exceeds the FNMA limit on standard mortgage sizes.

LIBOR (London interbank offer rate): The typical rate at which large London banks lend dollars to one another. Nowadays primarily a benchmark published by the Wall Street Journal.

Money market: Cash sitting in a brokerage account and not invested in other assets.

Mortgage bonds: Bonds secured by a particular real-estate property. In case of default, the creditor can foreclose the secured property. If still not satisfied, the remainder of the creditor's claim becomes a general obligation.

Municipal bond: Bonds issued by a municipality. Often tax-exempt.

N-year mortgage rate: The interest rate paid on a fixed-rate loan by the borrower, secured by a house, with standard coupon payments. The published number usually is for standardized mortgages issued through FNMA.

Prime rate: Historically, the prime rate was an average interest rate that banks usually offered their best customers for short-term loans. These days, it is primarily a rate published by the Wall Street Journal. The WSJ does not clearly explain its computation, but just states vaguely that it is "the base rate on corporate loans posted by at least |75%| of the nation's |30| largest banks." The prime rate is used less and less nowadays. It is being replaced by LIBOR, at least in most commercial usage.

Repo rate: A repo is a repurchase agreement, in which a seller of a bond agrees to repurchase the bond, usually within |30| to |90| days, but also sometimes overnight. (Repos for more than |30| days are called term repos.) This allows the bondholder to obtain actual cash to make additional purchases while still being fully exposed to, and thus speculating on, the bond.

Revenue bonds: Bonds secured by a specific revenue stream. See also G.O. bond.

SallieMae: Originally **Student Loan Marketing Association** (SLMA). Like FannieMae, an agency (corporation) set up by the U.S. government. It facilitates student loans.

Savings bonds: Issued by the U.S. Treasury, savings bonds can only be purchased from, or sold to, agents authorized by the Treasury Department. They must be registered in the name of the holder. **Series E bonds** are zero-bonds; **series H bonds** are semiannual coupon payers and often have a variable interest feature. In contrast to savings bonds, other bonds are typically **bearer bonds**, which do not record the name of the owner and are therefore easy to resell (or steal).

Tax-exempt bonds: Typically bonds issued by municipalities. Their interest is usually exempt from some or all income taxes. The designation **G.O. bond** means **general obligation bond**, that is, a bond that was not issued to finance a particular obligation. In contrast, a **revenue bond** is a bond backed by specific municipal revenues—but it may or may not be tax-exempt.

Treasury security: The subject of Section **??**, Treasuries are all bonds issued by the U.S. government's Treasury department to finance the national debt. They come in the form of short-term bills, medium-term notes, and long-term bonds.

Treasury STRIPS: An acronym for Separate Trading of Registered Interest and Principal of Securities. Financial institutions can convert each coupon payment and principal payment of ordinary Treasury coupon bonds into individual zero-bonds. The Treasury website has a detailed explanation.

Yankee bonds: U.S. dollar–denominated and SEC-registered bonds by foreign issuers.

x

Note: Mortgage (and many other) bonds can be paid off by the borrower before maturity. Prepayment is common, especially if interest rates are dropping.

Chapter 30

TODO

CHECKLIST:

- Look for equation spacing with fractions.
- Check figures for size and colors.
- check all marginpars for placement
- check all chapter and section title lengths for fit
- check all X references
- check all the keywords
- Ask RA to do a full detailed read.
- Add a table of contents