

The CAPM: Application to Projects

(Welch, Chapter 10-B)

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Use Project or Overall Beta?

- ▶ You must use *own* project beta for *each* project.
 - ▶ Do not use *overall* company beta on every project.
 - ▶ Important in M&A. (See also Ch 13.)
- ▶ You must use own (asset-class) beta for each (asset-class) project and financing.

Linear Functions

- ▶ See previous chapter.
- ▶ For us, the following is important
 - ▶ Portfolios are linear combinations: $r_P = w_A \cdot r_A + w_B \cdot r_B$.
 - ▶ Firms consist of debt and equity $FM = DT + EQ$.
 - ▶ (They are linear combinations of non-linear contracts.)
 - ▶ Expectations are linear functions: $E(r_A) + E(r_B) = E(r_{A+B})$.
 - ▶ regardless of CAPM or not.

Market-Betas

- ▶ New: (Market) betas are linear function, too:

$$\beta_{A,M} + \beta_{B,M} = \beta_{A+B,M}$$

$$\beta_A + \beta_B = \beta_{A+B}$$

- ▶ Ergo

$$\beta_{FM} = \beta_{DT+EQ}$$

Asset-Beta

$$w_{EQ} + w_{DT} = 1$$

$$\beta_{FM} = w_{DT} \times \beta_{DT} + w_{EQ} \times \beta_{EQ}$$

Nerdnote: CAPM

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

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

$$\Leftrightarrow E(r_{FM}) = r_F + [E(r_M) - r_F] \cdot \beta_{FM,M} \cdot$$

What is The Debt Beta?

- ▶ For small debt levels, β_{DT} is close to 0.
 - ▶ or maybe 0.2?
 - ▶ Large well-capitalized, safe firms usually pay their debts, so there is not much variation or market covariation.
- ▶ In many such cases, firm debt is nearly risk-free and the market-beta is almost zero and the cost of capital is close to US Treasuries.

Corporate Debt Beta

If $\beta_{DT} = 0$ (risk-free), then

$$\beta_{FM} = \left(\frac{EQ}{DT + EQ} \right) \cdot \beta_{EQ}$$

$$\implies \beta_{EQ} = \beta_{FM} \cdot \left(\frac{DT + EQ}{EQ} \right) = \beta_{FM} \cdot \left(\frac{FM}{EQ} \right) = \beta_{FM} \cdot \left(\frac{FM}{FM - DT} \right)$$

Perfect Market CoC

- ▶ Holding the assets constant, as the firm alters its debt-equity mix, the beta and value of its overall *firm* assets does not change.
- ▶ **The equation therefore implies that the more debt a firm has, the higher is its equity beta.**

Is Issuing Debt Cheap?

- ▶ Some consultants (deliberately) overlook the linkage between a firm's debt-equity mix and its equity beta.
- ▶ They tell client firms it is cheaper to issue debt, because the debt $E(r_{DT})$ is lower than $E(r_{FM})$
 - ▶ It is true that $E(r_{DT})$ is lower than $E(r_{EQ})$,
 - ▶ but their conclusion is wrong.
 - ▶ Using debt raises the equity beta, thereby eliminating the presumed CoC savings.
 - ▶ ...but wait until we cover imperfect markets for a more nuanced view.

Debt Effect on Equity I

- ▶ Let's illustrate what we know about β_{EQ} (and r_{EQ} if the CAPM holds) numerically.
- ▶ **Example:** $\beta_{FM} = 2$, $FM = \$100$
- ▶ Assume assets remain constant: when you issue debt, you retire an equal amount of equity,
- ▶ $r_F = 0.05$, $E(r_M) - r_F = 0.10$.

Debt Effect on Equity II

- ▶ DT=\$0: $\beta_{EQ} = 2.0$, $E(r_{EQ}) = 25\%$.
- ▶ DT=\$10: $\beta_{EQ} = 2.2$, $E(r_{EQ}) = 27\%$.
- ▶ DT=\$50: $\beta_{EQ} = 4.0$, $E(r_{EQ}) = 45\%$.
- ▶ DT=\$90: $\beta_{EQ} = 20.0$, $E(r_{EQ}) = 205\%$.

If very levered, a small increase in debt can cause a very large increase in the equity cost of capital $E(r_{EQ})$!

Firm (Asset-) Beta vs Equity Beta

1. Use comparable publicly-traded firms' *equity* market-betas.
2. Adjust the leverage:

$$FM = w_{DT} \cdot DT + w_{EQ} \cdot EQ$$

$$\beta_{FM,M} = w_{DT} \cdot \beta_{DT,M} + w_{EQ} \cdot \beta_{EQ,M}$$

- ▶ For large publicly traded corporation with very low debt,
 $\beta_{FM,M} \approx w_{EQ} \cdot \beta_{EQ,M}$.

Actual I-Bank Interviewing Question

- ▶ You are a consultant to a gas exploration company.
- ▶ Gas is a very pro-cyclical commodity and has a very high beta. (Where would you get it?)
- ▶ You are exploring a field and you are certain that it has a capacity of x million cubic meters of gas.
- ▶ You have sold the production schedule in the forward market for \$20 million.

Drill, Baby, Drill

- ▶ It costs \$10 million to set up the drill, and 9 out of 10 times, this works the first time. 1 out of 10 times, you must try again, and this again has a 90% chance of success (and so on).
- ▶ In 3 minutes or less, face-to-face with the client: how would you advise the client to value this project? What is the rough value?

Actual I-Bank Question

- ▶ Briefly describe a recent merger and what you think about it.

See NPV Applications

- ▶ You can average costs of capital,
- ▶ but you cannot assume that the CoC of one project applies to another project, too.
- ▶ This is especially important in acquisitions and when dealing with vastly different projects.
- ▶ The CAPM remains consistent with all these insights,
 - ▶ because expected returns and betas are both linear.

Omitted Appendices

1. Certainty Equivalence: Used when price today is not fair, efficient market price.
2. Logic: How the CAPM Comes About.
 - ▶ Portfolio Separation: combining two MVE portfolios are MVE.
 - ▶ MVE portfolios obey SML-type (CAPM-type) relationships.
 - ▶ Entire CAPM: Market portfolio is efficient.

Nerd: More Beta Implications

- ▶ Beta also has implications for *conditional* expected RoRs, not just for *unconditional* expected RoRs, as used in the CAPM.
- ▶ Thus, beta also has implication for overall stock risk (because market risk flows into projects), not just for expected RoRs.