The CAPM: Basic Theory and Inputs

(Welch, Chapter 10-A)

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Maintained Assumptions

Perfect Markets

1. No differences in opinion.
2. No taxes.
3. No transaction costs.
4. No big sellers/buyers—infinitely many clones that can buy or sell.

Again, **with risk and risk aversion**

- but this chapter leans much more heavily on many assumptions than the previous benchmarking chapter!

Same Question Again!

- **What is your investors' opportunity cost of capital?**
- If we lean heavily on more assumptions, can we do better than benchmarking?
  - and can we do better when we have no clear comparable alternative peers — like other condos in the condo valuation problem?

With Stronger Assumptions

- No measurement or model error.
- Investors dislike risk, they are smart, etc., and care about default, term, and equity risk.
- Investors care *only* about pfio risk and reward,
- ...and risk is just SD(R),
- ...and investors hold mostly the market pfio,
- ...and all type of risks are alike.
  - same for oil and real-estate as for U.S. Treasuries; same for inflation as for political uncertainty, etc.

What Is Assumed Away?

- Anything not in PCM (i.e., in ICM).
  - perfect vs. imperfect capital markets
- No unique labor or asset ownership.
  - all investors are perfectly alike
- No state-dependent preferences.
- No uncertainty about inputs.
- No (in aggregate important) careless or stupid investors.

Project-Beta Premium?

- Do projects that *add* more risk to investors' portfolios need to provide more reward?
- What is a good measure of risk *contribution* for our projects?

Project-Variance Premium?

- Do projects that have high variance, but whose risk can be diversified away in our portfolio, need to provide more reward?

The CAPM Formula

- The CAPM formula says that the expected RoR of every project is linearly related to this project's market-beta:

$$E(r_i) = \#_1 + \#_2 \cdot \beta_{i,M}$$

- $\#_1$ and $\#_2$ are two constants, the same for every project, i.e., not functions of project i.
  - Let's guess them.

Beta of Zero

- What asset has a market-beta of 0?
- What is its appropriate RoR?

$$E(r_i) = \#_1 + \#_2 \cdot \beta_{i,M}$$

Beta of One

- What asset has a market-beta of 1?
- What is its appropriate market RoR?

$$E(r_i) = \#_1 + \#_2 \cdot \beta_{i,M}$$

Intercept and Slope?

- What are $\#_1$ and $\#_2$?

The CAPM FormulaI

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

- **You must memorize the CAPM formula!**
- You must dream of this formula.
- You must be able to reproduce it on the spot and without thinking.
- Am I clear?

The CAPM Formula II

- $[E(r_M) - r_F]$ is the equity premium.
- Think of the CAPM as a line that relates any investment's beta (β_i) to its appropriate E(R_i).
- Any project that adds more risk to our (market) portfolio — because it has a higher market-beta — has to offer a higher reward (expected RoR).

The CAPM Ingredients

- The three most important numbers in finance also happen to be the CAPM inputs:
  - the risk-free RoR,
  - the equity premium,
  - and the risk-hedging aspects of projects.

CAPM Inputs Importance

- In what other contexts might you care about the three CAPM inputs?

If the CAPM Works

- All CAPM project valuation is relative to (***your*** estimate of) the equity premium.
- If the risk-free rate and equity premium pin down risk-reward relationships in the economy, then
- market-beta — and market-beta only — matters.
- and nothing else should — like book-value, size, momentum, etc.,

CAPM Inputs

- What CAPM inputs are the same for every project?
- What CAPM inputs are specific to your project?

Intercept and Slope Signs?

- What signs do the intercept (r_f) and the slope ($E(r_M) - r_F$) have?

Beta vs RoR

- Presume that r_F is 3% and $E(r_M)$ is 7%.
- What expected RoR must a project offer with a market beta of
  - 0.5?
  - 0.0?
  - 0.5?
  - 1.0?
  - 1.5?

Graph: Beta Exposition

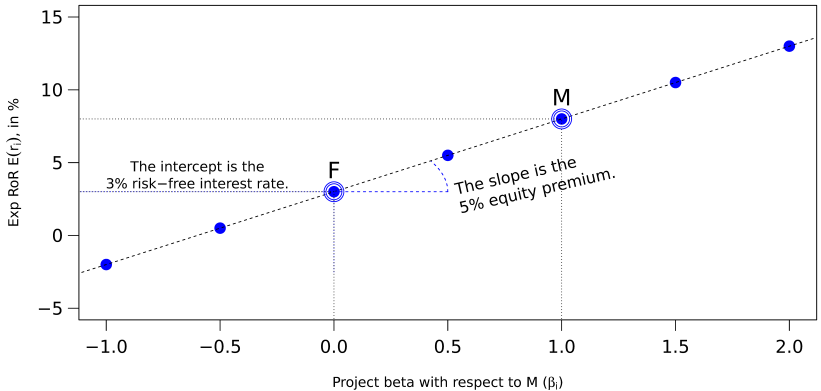

Figure 1: beta

Negative Expected Returns?

- If the risk-free rate is positive, would you ever buy a stock with a negative expected return?

Zero-Beta vs Risk-Free Rate?

- Why is there no difference between a zero-beta risky project and the risk-free rate when it comes to expected RoRs?

CAPM for Corporate Bond Pricing

- A corp 0-bond promises $1,000 in 1 year.
- Its market-beta is 0.5.
- The equity premium is 4%.
- The risk-free rate is 3%.
- What is the appropriate bond *price* today?

Quoted vs Expected Returns

- **Never ever use the CAPM to infer *a quoted* price**
  - the quoted price contains more than the *expected* RoR, i.e., also the default and other premia.

CAPM: *Expected*, Not *Quoted*

- To get a quoted price, we need to know the default risk, so we can compute the expected cash flow in the numerator. We do not have this information, so we cannot solve this.
  - (Aside, this large a beta is also a big hint that there is a lot of default risk in play.)
- Put differently, the CAPM gives us an *expected* RoR, not a *promised* RoR.

Take Off the Blinders

- There are much better benchmark returns for corporate bonds than those from the CAPM — Treasuries and Moody Portfolios, for example.
  - Many economists believe markets are “segmented”
  - and stockmarket-beta is not a great measure of risk across markets.

Risk Premia and Credit Premia

- Does the CAPM take care of default risk?
- Does the use of the CAPM $E(r)$ in the NPV formula take care of default risk?

Systematic vs Idiosyncratic Risk

- Is idiosyncratic default (non-payment) risk “priced”, by the CAPM or otherwise?
- When does the CAPM give you a higher rate of return?

Price of Idiosyncratic Risk

- Credit (non-payment) risk is not typically "priced" by the CAPM. The CAPM gives an expected RoR.

- Of course, *more default = lower price*, but this is not through the E(r) (cost of capital) in the PV denominator, but the E(CF) in the numerator.

CAPM: Quoted or Expected CoC?

- **It does not provide *a quoted* RoR.**
- **It provides *an* expected RoR.**

- **For PV, you must take care of default (credit) risk in the E(CF) numerator.**

CoC Decomposition I

- The CAPM is our first model/formula that changes the expected RoR across different projects and does so in the context of a PCM.
- Projects with higher market-betas must offer higher expected RoRs.

$$\text{Expected RoR} = \text{Time Prem} + \text{Expected Risk Prem}$$

CoC Decomposition II

$$\text{Promised RoR} = \text{Time Prem} + \text{Default Prem} + \text{Risk Prem}$$

$$\text{Actual RoR} = \text{Time Prem} + \text{Default Realization} + \text{Risk Prem}$$

CAPM Inputs: Estimated or Known?

- Do you know the CAPM inputs?
- Can you estimate them?
  - We already did the risk-free rate and the equity premium in the previous chapter.
  - Recall that you want to use a time-equivalent risk-free RoR.
  - We still need to discuss market-beta estimation.

Market-Beta Estimation

- How do you find the correct forward-looking market beta for the project(s) of a publicly-traded firm?
- "Again," you want a forward-looking beta, but all you have is historical data.

Good **Equity** Betas?

- Run a market model time-series regression on $\approx$ 2 years of **daily** data to find the plain unshrunk OLS b^1.
  - (1 to 5 years is acceptable, too.)
- For a short-term (1 year) project, use

$$b = (1 - 0.3) \times b^1 + 0.3$$

- For a long-term (5 years +) project, use

$$b = (1 - 0.4) \times b^1 + 0.4$$

Shrinking Estimator Example

- If OLS $b^1 = 2$, then use 1.7 for 1-year project.
- If OLS $b^1 = 0$, then use 0.3 for 1-year project.
- This procedure is called *shrinking.*
- Shrunk market-betas predict future market-betas better than unshrunk historical market-betas.

If Input Data is Inadequate

- If you only have monthly data (yikes!!), use 0.5 instead of 0.3-0.4.
- If you have no own RoR data (super-yikes!!), use similarly sized firms.
- Never use monthly data if you have daily data.
- Never use industry data if you have own data.
- (Never use accounting returns. Today's returns must encompass value changes for all eternity.)