The CAPCM

(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.

With risk and specific risk aversion

- this chapter leans more heavily on its assumptions than the 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?

WithStronger Assumptions

No measurement or model error.

Investors dislike risk, they are smart, etc., care about default, term, and equity risk.

Investors care *only* about pfio risk and reward,

and risk is just SD,

and investors hold mostly the market pfio,

and all risk is alike.

- same for oil and real-estate as for Treasuries

What Is Assumed Away?

Anything not in PFM (i.e., in ICM).

No unique labor or asset ownership.

No state-dependent preferences.

No uncertainty about inputs.

Careless or Stupid Investors.

Project-Beta Premium?

Do projects that *add* more risk to investors' portfolio need to provide more reward?

What is our measure thereof?

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 CAPCM Formula

The CAPCM 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 i.

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 CAPCM Formulal

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

You must memorize the CAPCM formula!

You must dream of this formula.

You must be able to reproduce it on the spot and without thinking.

Am I clear?

The CAPCM Formula II

$[E(r_M) - r_F]$ *is the equity premium.*

- Think of the CAPCM as a line that relates an asset's beta to its appropriate E(R)
- Projects that add more risk to our (market) portfolio (high market-beta) have to offer higher reward (expected RoR).

The CAPCM Ingredients

The three most important numbers in finance are the inputs:

- the risk-free RoR,
- the equity premium,
- and the risk-hedging capability of the project.

CAPCM Inputs Importance

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

If the CAPCM Works

All CAPCM 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
- beta—and beta only—matters.
- nothing else, like book-value, size, momentum, etc., can matter.

CAPCM Inputs

What CAPCM inputs are the same for every project?

What CAPCM 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

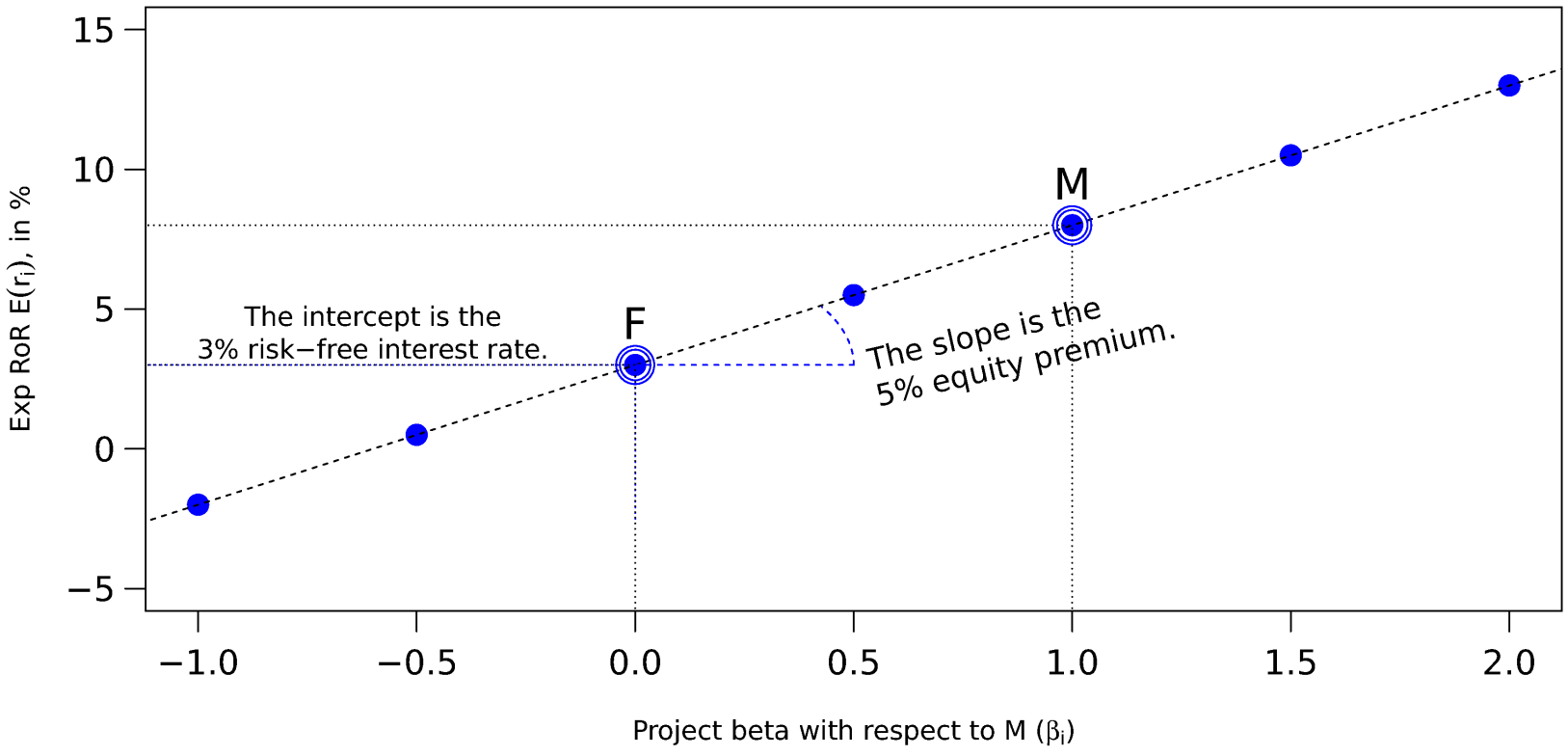

Figure 1: beta

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?

CAPCM 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 CAPCM to infer a quoted price just from the expected RoR.

CAPCM: *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 CAPCM 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 CAPCM—Treasuries and Moody Portfolios, for example.

Risk Premia and Credit Premia

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

Systematic vs Idiosyncratic Risk

Is idiosyncratic default (non-payment) risk "priced", by the CAPCM or otherwise?

Price of Idiosyncratic Risk

Credit (non-payment) risk is not typically "priced" by the CAPCM. The CAPCM 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.

CAPCM: 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 CAPCM is our first model/formula that changes the expected RoR across different projects in 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

Promised RoR = Time Prem+Default Prem+Risk Prem

&

Actual RoR = Time Prem+Default Realization+Risk Pre

CAPCM Inputs: Estimated or Known?

Do you know the CAPCM 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 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 ≈ 2 years of **daily** data to find the 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 Esimator 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 betas predict future betas better than unshrunk historical 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.)

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. Covered in Ch 13.

You must use own (asset-class) beta for each (asset-class) project and financing.

Linear Functions

A linear functions means

$$a + b = c \longleftrightarrow f(a) + f(b) = f(c).$$

For us, expectations, market-betas, portfolios, and firms (debt + equity) are linear; but, e.g., variance is not.

- E(r) holds regardless of CAPCM or not.
- Beta also holds in the CAPCM.
  In ed5, the following will move in Chapter 9.

Firm vs Equity vs Debt

The profits generated by a firm's assets are distributed to its debt and equity holders.

You can think of a firm's assets as consisting of a portfolio of debt and equity.

- DT: dollar value of the firm's debt.
- EQ: dollar value of the firm's equity.
- FM: dollar value of the firm's total assets.
- omits non-financial liabilities.
- $FM \equiv DT + EQ$.

Firm is Debt Plus Equity

$$FM \equiv DT + EQ$$

&

$$w_{DT} = \frac{DT}{DT + EQ}\,,\; w_{EQ} = \frac{EQ}{DT + EQ}$$

&

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

Asset-Beta

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

&

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

($\beta(FM) = \beta(DT + EQ)$, so beta is a "linear operator.")

What is The Debt Beta?

For small debt levels, β_{DT} is close to 0.

- or maybe 0.2?
- Large firms usually pay their debts, so there is not much variation or market covariation.

In many cases, firm debt is nearly risk-free.

Corporate Debt Beta

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

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

&

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

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?

Bad consultants sometimes (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 $E(r)$ on debt is lower.

- It is true that $E(r)$ is lower,
- but their conclusion is wrong.
- Using debt raises the equity beta, thereby eliminating the presumed CoC savings.

Debt Effect on Equity I

Let's illustrate what we know about β_{EQ} (and r_{EQ} if the CAPCM holds) numerically.

Example: $\beta_{FM} = 2$, $FM = \$100$

- assume assets remain constant: when you issue debt, you retire equal 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 large increase in $E(r_{EQ})$!

Firm (Asset-) Beta vs Equity Beta

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

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

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

Continued

Often, $\beta_{FM,M} \approx w_{EQ} \cdot \beta_{EQ,M}$.

Intuition: If unlevered beta is 1 and market $r_m \pm 5\%$, then $\Delta FM = \pm\$5$.

DT:EQ $= \$0$: $\$100 \rightarrow \$95, \$105$ $\quad r_{EQ} \approx \pm 5\%$.

DT:EQ $= \$80$: $\$20 \rightarrow \$15, \$25$ $\quad r_{EQ} \approx \pm 25\%$.

Recall: Linear Averaging of E(R)

As with benchmarking and market-beta,

$$E(r_{\text{FM}}) = E(w_{\text{DT}} \cdot r_{\text{DT}} + w_{\text{EQ}} \cdot r_{\text{EQ}})$$
$$= w_{\text{DT}} \cdot E(r_{\text{DT}}) + w_{\text{EQ}} \cdot E(r_{\text{EQ}})$$

The fact that the expected cost of capital on debt plus equity is that of the firm is much more general than CAPCM.

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?

I-Bank Question

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

See NPV Applications

. . . for cost of capital averaging

- especially the acquisition, and
- the spice expedition.

Omitted Appendices

1. Certainty Equivalence: Used when price today is not fair, efficient market price.
2. Logic: How the CAPCM Comes About.

- Portfolio Separation: combining two MVE portfolios are MVE.
- MVE portfolios obey SML-type (CAPCM-type) relationships.
- Entire CAPCM: Market portfolio is efficient.

Nerd: More Beta Implications

- Beta also has implications for *conditional* expected RoR, not just *unconditional* expected RoR used in the CAPCM.
- Beta also has implication for overall stock risk (because market risk flows into projects), not just for expected RoR.