

Topic 8: Risk and Project Selection

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In this set of notes, we're going to bring together *everything* that we've seen so far, so that we can *finally* develop a *realistic* approach to evaluating projects. We'll do that first by going over what we've seen so far, so we're all on the same page. We'll then remind ourselves explicitly of what the goal of project selection is. Finally, we'll show how we implement tools like CAPM to estimate our discount rate, and hence perform project valuation.

1 What have we done so far?

Here's a list of what I think we've covered so far:

- That money has *time value*.
 - Money now is better than money later.
 - Money later means a *lost opportunity*—hence we call it an *opportunity cost*.
 - The greater the opportunities that we miss out on, the greater the cost, as captured by the *discount rate*.
- That projects involving cash flows in multiple periods can be compared by looking at their *present value*.
 - Present value captures the idea that money has *time value*.
 - It also ensures that projects that deliver the *most* returns to shareholders are the projects selected.

- That there are two concerns when constructing present value:
 - Making *forecasts*.
 - * Hard to predict the future. Hard to know what governs the random fluctuations in payoffs/in general.
 - * We can use *rational expectations*.
 - Selecting the *discount rate*.
 - * Supposed to capture the opportunities lost had we invested in a *similar* project.
 - * We kind of deferred this to a later date...
- That risk and return should *always* be related.
 - If a project has high returns, that means it has high risks, and vice versa.
 - As such, if our project is risky, it should have higher returns.
- That diversification affects the risk-reward trade-off.
 - Well-diversified portfolios eliminate *idiosyncratic* risk.
 - CAPM then tells us that *only* market risk should matter for the return on an asset/project.

So, with that in mind, we just have one final step we need to take to wrap everything up: *take what we've learned about returns and apply it to our concept of Present Value to select our discount rate.*

2 CAPM and the discount rate

The goal of selecting our discount rate is to account for other *similar* opportunities that are foregone by investing in a given project. Up until now we have been hazy on how to do this. Let's clarify! We'll do this by first re-outlining the CAPM model. We'll then argue that CAPM allows us to estimate what the expected return of our firm *ought* to be. We'll then work through an example. Finally, we'll talk about some of the shortcomings of using CAPM in this way.

2.1 Brief review of CAPM

Recall that the CAPM model tells us that the expected returns of a stock or portfolio should *only* be a function of its co-movement with the market: if we know a stock's β , then we should know its expected returns.

$$(r_{i,t} - r_{rf,t}) = \beta_i(r_{m,t} - r_{rf,t})$$

Thus, our β is *the* measure of the risk-reward profile of our firm. Recall the argument behind this? I can *always* construct the market portfolio, and blend this with the risk-free asset, and such a portfolio will *necessarily* have the highest reward to risk ratio for any given level of risk. Given that this portfolio contains *no* idiosyncratic risk, *and* it is the benchmark against which all other stocks/portfolios are compared, *I am not rewarded for holding idiosyncratic risk.*

2.2 CAPM and Discount Rates

How is this relevant to our choice of discount rates? Recall that CAPM identifies what our expected return *ought to be*. As such, it captures the 'risk-reward' profile of the *opportunity* of investing in the stock. *As such*, it is the *perfect* measure to use for our discount rate!

Why? Because the CAPM gives us a formal method of identifying how much our firm moves with the market, and hence how much market risk our firm is subject to, and hence what the risk-reward profile of the *opportunity* of investing in our company involves.

Hence the procedure is as follows:

- Estimate your expected payoffs.
- Identify your firm β .
- Identify the *market premium*.
- Use the CAPM formula to back out the *expected return*.
- Use this expected return as the discount rate.

It is worth noting that the first two steps are easier said than done! How do we establish β ? Is using past data really the best way to estimate this parameter? How

much a firm responds to market shocks is surely a varying property of its behavior and environment! Similarly, how do we find the market premium? Is the premium today a good indicator? Or a historical average?

All of these questions are key sources of ambiguity in the life and times of a corporate finance enthusiast!!

2.3 An example

Suppose we are the CFO of Microsoft, and we're thinking about developing a new smartphone. Suppose that we project that the R&D involved in developing this new product will cost \$500mn. Should we succeed, the payoffs will be huge: suppose that if the smartphone takes off, we can expect to sell 10 million phones a year, and make a profit of \$100 on each phone. However, if we fail, we only sell 1 million phones a year. After 5 years, we will need to develop a new phone, after which the profits for this project dry up and we begin again.

2.3.1 Estimate expected payoffs

Suppose it is *more likely* that we fail. Let's say we put an 80% chance of failure, and a 20% chance of success. What is our *expected* profit? Let expected profit be given by $\pi_{i,t}$; then:

$$\begin{aligned}\pi_{i,t} &= PrSuccess \times \$1,000,000,000 + PrFailure \times \$100,000,000 \\ &= 0.2 \times \$1,000,000,000 + 0.8 \times \$100,000,000 \\ &= \$200,000,000 + \$80,000,000 \\ &= \$280,000,000\end{aligned}$$

So, this is the figure for expected payoff that we should use.

2.3.2 Identify the β

We can do this using the approach we've seen so far: use historical returns to estimate the following regression:

$$(r_{i,t} - r_{rf,t}) = \beta_i(r_{m,t} - r_{rf,t})$$

For Microsoft, this β_i comes out at 0.93.

2.3.3 Identify the market premium, implement CAPM

The market premium in the US has hovered around 5.3-5.7% from 2011 onwards. Let's take the midpoint, 5.5%. The current risk-free rate is around 2.8%. Let's implement these figures to find our *expected* payoff for Microsoft:

$$\begin{aligned}(r_{i,t} - r_{rf,t}) &= \beta_i(r_{m,t} - r_{rf,t}) \\(r_{i,t} - 0.028) &= 0.93 \times 0.055 \\ \therefore r_{i,t} &= 0.07915\end{aligned}$$

So, this is the value of the discount rate that we will use.

2.4 Run NPV using the discount rate

Recall the definition of NPV:

$$NPV = \mathbb{E}_0 \left[\sum_{t=0}^T \left(\frac{1}{1+r} \right)^t \pi_{i,t} \right]$$

In words, the NPV is the sum of the discounted expected future *profits* from the project (i.e. cash flows in minus cash flows out). Using our results from above:

$$\begin{aligned}NPV &= \mathbb{E}_0 \left[\sum_{t=0}^T \left(\frac{1}{1+r} \right)^t \pi_{i,t} \right] \\ &= \sum_{t=0}^T \left(\frac{1}{1.07915} \right)^t \mathbb{E}_0 [\pi_{i,t}] \\ &= - \left(\frac{1}{1.07915} \right)^0 \$500,000,000 + \left(\frac{1}{1.07915} \right)^1 \$280,000,000 + \\ &\quad \left(\frac{1}{1.07915} \right)^2 \$280,000,000 + \left(\frac{1}{1.07915} \right)^3 \$280,000,000 + \\ &\quad \left(\frac{1}{1.07915} \right)^4 \$280,000,000 + \left(\frac{1}{1.07915} \right)^5 \$280,000,000 \\ &= \$620,467,834.70\end{aligned}$$

Wow, big bucks!! Microsoft should do it straightaway! Right...?

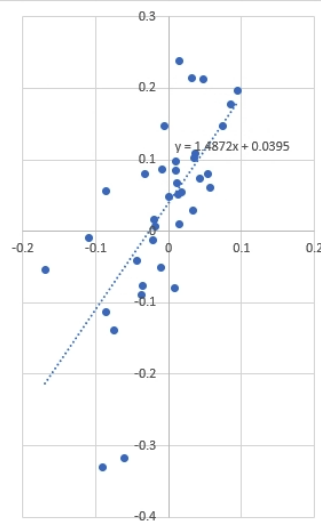
2.5 Pitfalls of CAPM

When we implement CAPM to identify the discount rate, we are implicitly making the claim that this new project has the same risk-reward profile of the *average* activities of our firm. We are using those *average* activities as a proxy for our new projects.

Does launching a new smartphone sound like an *average* activity for Microsoft? Probably not right! Microsoft has a very steady and reliable cash flow from its software business. This exercise is in many respects a *major* departure from Microsoft's usual business! As such, perhaps choosing the discount rate using the company's β , *as though it were an extension* of their usual business is perhaps not appropriate.

How do we get around this? One way is to identify what is called a 'pure play' stock. These are stocks that *only* deal in the market that we're setting up a project in. We then use the β of *these* stocks to form our discount rate.

In the smartphone world, there aren't really any pure plays. What we *could* do is use the β of Apple *around the time of the iPhone launch* as a proxy for a smartphone launch. If we go to the data, and look at Apple returns from 2007-10, compare them with those of the market, and estimate the β , then we find:



So Apple's β was around 1.49 during this period. Suppose we use this value instead: what do we find?

$$\begin{aligned}
(r_{i,t} - r_{rf,t}) &= \beta_i(r_{m,t} - r_{rf,t}) \\
(r_{i,t} - 0.028) &= 1.49 \times 0.055 \\
\therefore r_{i,t} &= 0.10995
\end{aligned}$$

So the NPV is:

$$\begin{aligned}
NPV &= - \left(\frac{1}{1.10995} \right)^0 \$500,000,000 + \left(\frac{1}{1.10995} \right)^1 \$280,000,000 + \\
&\quad \left(\frac{1}{1.10995} \right)^2 \$280,000,000 + \left(\frac{1}{1.10995} \right)^3 \$280,000,000 + \\
&\quad \left(\frac{1}{1.10995} \right)^4 \$280,000,000 + \left(\frac{1}{1.10995} \right)^5 \$280,000,000 \\
&= \$534,981,339.037
\end{aligned}$$

Okay, so still pretty good! Nonetheless, the figure is lower.