Topic I: Introduction

This course is about: **Corporate Finance**

We ask two questions:

1. What projects should a corporation undertake? (investment)
2. How should a corporation obtain the $ it needs to undertake them? (financing)

That there are general principals that tell us how to make these decisions is one of the most remarkable facts in economics.

We start by examining investment decisions for a firm – say, Boeing Corp:

- Boeing has to decide what kinds of planes to design and build. Does it new equipment? More employees?
- Where will it get money? Typically from financial markets. But then it faces a decision. Should it issue bonds (which require fixed payments – interest), or stock?

⇒ These are the kind of decisions the firm needs to make. If these are made correctly, value will be created. If these are made incorrectly, value will, typically, be destroyed.

So, we want to know what we can do to make these decisions correctly. With this in mind, let's consider the outline:

1. Net present value (NPV) rule: what is it and why it works
2. Specifics of calculating present value
3. Using present value to value bonds (fixed income).
4. Using present value to value equities. This is a precursor to valuing the corporation.
5. The relation between NPV rule, and a competing measure, the internal rate of return.
6. Putting NPV into practice: depreciation, inflation, decision to replace
7. We take a break from CFO thinking and start to think like investors in financial markets. First: what are definitions of risk and return?
8. Then: given the universe of stocks, bonds and mutual funds, how do you think about forming a portfolio?

   Even for CFOs who don't manage their own money, this exercise is very important. Why? Because it is necessary to understand how investors in markets make decisions, in order to use the markets as a source of financing

9. This will lead to a way to adapt NPV analysis for situations involving risk
10. Market efficiency also should be interesting to CFOs and investors in financial markets, and it has been a hotly debated area in recent years. The question market efficiency deals with is how quickly markets incorporate information. Can when make money by trading on publicly available information?
11. The next topics use this material on risk as background to look specifically at the question of debt versus equity. Can value be improved with this choice? Sometimes. In this section, we consider the investment decisions as fixed
12. Finally, we integrate the financing with the investing decision. This is where tools such as adjusted present value and weighted average cost of capital come into play
13. Options is a special topic at the end. Many kinds of financial decisions can be thought of in terms of pricing an option. Here, our aim is to present foundational material that will prepare you for finance electives.

(a) Present Value Concepts

Before defining the NPV rule, we need several present value concepts:

Future Value

Assume you deposit \$1000 in a bank account that pays 10% interest:

- The value of the deposit in 1 year:

$$\begin{aligned} \text{FV} &= \text{Principal} + \text{Interest} \\ &= \$1000 + \$1000(0.10) \\ &= \$1100. \end{aligned}$$

- In general, suppose r is the interest rate:

$$\begin{aligned} &= \$1000 + \$1000r \\ &= \$1000(1+r). \end{aligned}$$

⇒ The future value of your investment at the interest rate r is \$1000$(1+r)$

Definition *The future value of C_0 at interest rate r in 1 year is:*

$$\text{FV} = C_0(1+r).$$

Note: We are moving the cash flow forwards in time.

Present value

Suppose you need \$1000 in one year. What do you need to put aside today? Note that \$1000 is now the future value:

$$\$1000 = \text{PV} \times (1 + r)$$

Rearranging:

$$\text{PV} = \frac{\$1000}{1 + r}$$

when $r = 10\%$, PV = \$1000/(1.10) = \$909.09. \$909.09 is the *present value* of \$1000, at 10%. Note that we are bringing the \$1000 backward in time.

Definition *Suppose you will have a cash flow of C_1 in one year. The present value of C_1 at interest rate r is:*

$$\text{PV} = \frac{C_1}{1 + r}.$$

Note that we reduced the \$1000 to bring it back to the present. This is why present value is sometimes called *present discounted value.*

$$\text{Discount factor} = \frac{1}{1 + r} < 1.$$

This says that the PV of \$1000 < \$1000. Why? You earn $r > 0$ in a bank account.

An aside: Why do you earn $r > 0$ in a bank account? Suppose a bank said, "we will take \$1000 and give you \$920 next year." The interest rate is then

$$\$920/\$1000 - 1 = -0.08.$$

or -8%. You'd say: "I'd rather put my money in a mattress." In this class, we will assume the rate you can get in a bank is > 0. Keep in mind that this relies on money being storable.

Note: a consequence is that \$1000 is worth less to you one year from now than today if you have access to a bank account. \$1000 one year from now is worth \$909.09 today. This difference represents the *time value of money.*

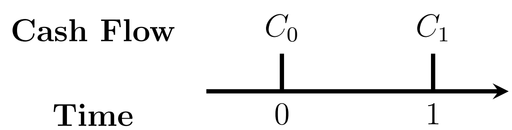
So now we've learned about present value. What's net present value?

Net Present Value

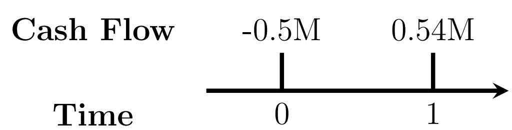
Definition *Consider an investment that pays a cash flow of C_1 in 1 year and costs $-C_0$ today. Interest rate is r. The NPV of the investment is:*

$$\text{NPV} = C_0 + \frac{C_1}{1+r}.$$

$\Rightarrow$ Basically, NPV is just present value. The “net” emphasizes that we have a negative cash flow at time zero. It is helpful to put these on a diagram:



Example You are a software developer. You see an opportunity to develop a software for a specific client. The investment has a cost (required investment) of \$0.5M and will pay you \$0.54M in one year. Interest rate is 5%. Payments are as follows:



Note: $C_0 = -0.5M$. That’s your cash flow (*outflow*) at time 0. $C_1 = 0.54M$. It is an *inflow*.

$$\begin{aligned} \text{NPV} &= -0.5 + \frac{0.54}{1.05} \\ &= -0.5 + 0.5143 \\ &= \$0.0143M \end{aligned}$$

We are now ready to define the NPV rule.

(b) NPV Rule

Definition *NPV rule: Accept projects with* NPV > 0 *and reject projects* NPV < 0.

Result. *Following the NPV rule maximizes the value of the corporation.*

To prove this result, let's consider a very simple corporation, consisting of a single person (Suzy), who has access to \$1M and can borrow and lend from a bank at 20%. Suzy allocates wealth between youth and old age. Assuming this bank represents Suzy's only opportunity, what should she do?

1. She can go on a trip around the world, and then live in poverty in old age
2. She can go on a smaller trip, have a moderate lifestyle in her youth (spending 0.5M) and still have $0.5(1.2) = 0.6M$ for her old age. (Note: FV of 0.5M is 0.6M)
3. She can put it all in the bank and go for an even better trip around the world in old age (\$1.2M)

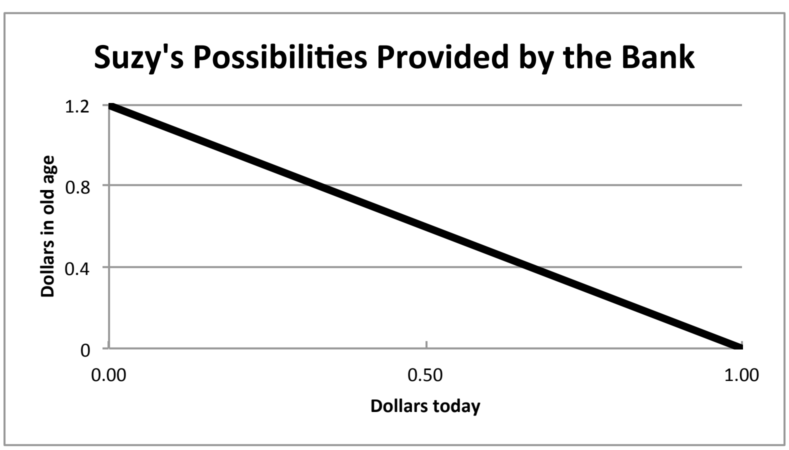
Note: all these possibilities are equally "correct."

In general:

Let $y = \$$ in old age and $x = \$$ today. Then FV reasoning tells us:

$$y = (1 - x)(1 + r)$$

- So the relation between consumption today and in old age is a straight line with a negative slope of $-(1 + r)$. For example, if she consumes everything today (1M) she will have nothing in old age. If she saves everything, she will have 1.2M in old age



- Suzy's preferences between now and old age determine where she is on the line
- This shows the trade-off between spending now and in old age. The slope is negative, and equal to $-(1+r)$. For every \$1 you do not spend now, you get \$1$(1+r)$ in old age
- Now suppose Suzy considers opening a restaurant. Start-up costs would be 0.7M. She could invest in this restaurant and have 0.8M in her old age. Should she invest? *No.*
- Why? If she puts the 0.7M in the bank, she has $0.7(1.2) = 0.84$M $\Rightarrow$ don't need to know anything about Suzy's preferences to make this decision
- Now suppose Suzy spies a plot of land for a vineyard that costs 0.7M and will yield 0.91 in old age. Should she invest? It seems the answer should be yes
- But what if she is planning to spend money on college and an MBA? This will cost her 0.2M. Now she only has 0.1M left. Should she still make the investment?

Suppose Suzy wishes to consume x\$ today. For now, let's say $x > 0.3$. She will need to *borrow* $x - 0.3$. In old age, she has 0.91 from the vineyard. She has also borrowed $x - 0.3$, and she needs to pay back the principal and interest on the loan. So:

$$y = 0.91 - (x - 0.3)(1 + r)$$

- What if $x \leq 0.3$? Then she will be able to invest $0.3 - x$ in the bank. In old age, she has:
$$y = 0.91 + (0.3 - x)(1 + r) = 0.91 - (x - 0.3)(1 + r)$$
- In fact, she can move everything to old age, in which case she has:
$$y = 0.91 + 0.3(1.20) = 1.27$$
- Mathematically, this equation says that if Suzy wants to consume everything today, she can consume x, where x solves:
$$0 = 0.91 - (x - 0.3)(1.2)$$
which implies:
$$x = \frac{0.91}{1.2} + 0.3 = 1.06M$$
Economically, what's going on? The bank knows Suzy will have access to this 0.91 in the future and is happy to lend her the PV of it now, knowing she will pay it back.

- Last point: We may be tempted to think the slope has changed, the reason being that the investment rate has changed. The investment in the vineyard has a return r_L, where:

$$r_V = \frac{0.91}{0.7} - 1 = 30\%$$

Note: $r_V > 20\%$. Shouldn't we re-draw the line with slope $-(1 + r_V)$? No because:

  1. Suzy borrows at r, not r_V (fortunately for Suzy who likes to consume today).
  2. Suzy cannot scale up her vineyard investment (unfortunately for Suzy who likes to consume tomorrow).

We've established that Suzy should invest in the vineyard as long as it yields more than the investment in the bank. In other words, as long as:

$$C_1 > -C_0(1 + r)$$

Recall $-C_0 = 0.7M$. Moving the RHS to the left and dividing by $1 + r$ leads to the NPV rule:

$$\text{NPV} = C_0 + \frac{C_1}{1 + r} > 0$$

We have just shown that following the NPV rule is optimal for Suzy, regardless of her preferences for consumption in youth or old age.

(c) Separation Theorem

Should corporations follow the same rule? The problem for corporations is different because there is not one shareholder, but many. For now, assume the corporation is all equity.

Consider a small corporation "Mini GM". This corporation has two shareholders:

1. JW's Grandma (100 years old and wants money now)
2. Child's investment trust (wants money later)

"Mini GM" has two possible projects:

1. Produce SUVs (income now)
2. Develop self-driving cars (income later)

Assume: (1) has NPV < 0, while (2) has NPV > 0. Is there a conflict between Grandma and the Child's investment trust over which project to pick?

- No – both are better off if Mini GM develops self-driving cars. The reason is Grandma can borrow, and then she / her heirs, can repay the loan using the project's cash flows
- *Both shareholders, regardless or their preference for current or future income, want the firm to choose the positive NPV project*

Another name for this result is the *Separation Theorem*. This is one of many we will see:

Separation Theorem *Investment decision does not depend on preferences of individual investors for current vs. future income*

- This implies all shareholders want the firm to use the NPV rule, which maximizes their share value. Then they will use the capital markets, e.g. a bank, to obtain desired consumption
- Let's consider the importance of this theorem: without it, the CFO's job would be impossible. The real GM CFO would have to poll thousands of people to see when they wanted their consumption, and somehow aggregate those preferences. Individuals, on the other hand, would have to always be lobbying for their wishes. Because the NPV rule works, we can diversify our wealth across corporations, and corporations can draw from the huge amount of resources available in capital markets

$\Rightarrow$ This rule will be the basis of all we do. We made some simplifying assumptions: single period and no uncertainty. These will be relaxed later. Some assumptions are more critical:

1. The borrowing rate is equal to the lending rate (alternatively, access to a secondary market in which to sell shares).
2. All investors have the same information (or they might disagree on NPV or even r).
3. Markets are competitive (no firm affects interest rates).

Why do these assumptions matter? Clearly, if many investors are unable to borrow, our argument breaks down because they would prefer consumption today. If investors cannot agree on what constitutes a positive NPV project, then they will want the firm to do different things. If a firm affects interest rates by its investment, then some investors may want the firm to take actions that raise rates, while others will want the opposite.

These assumptions are reasonably approximations in today's world economy, most of the time. Many people can borrow fairly inexpensively by using their home as collateral. Moreover, most U.S. shareholders are wealthy or are institutions and face low borrowing costs. They are also similarly well-informed. Finally, in the US, even very large corporations are small relative to the economy.

As you will see throughout this course, their is a tradeoff in building theories between simplicity and realism. The aim is to not exactly imitate the world, but to build a theory that is simple and makes reasonable assumptions, and then to see how far it takes you.