Finance for Non-Finance Professionals

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Abstract

The following document is a collection of lecture notes that I took while taking the Coursera course "Finance for Non-Finance Professionals" by James P. Weston, the Harmon Whittington Professor of Finance at the Jones Graduate School of Management of Rice University. Any errors and omissions in these notes are naturally entirely my own, and all credit for the content goes to James. Needless to say, these lecture notes are by no means a substitute for his awesome course. Rather, consider this document as my way of remembering the highlights and notable takeaways that I frequently reference and want to remember, and if you find value in these lecture notes, then I highly recommend that you try out James's course. It's free and can be found here. Also, notable shout-out to Rainer Groh from the University of Bristol, who granted me the source files to his own notes on the Coursera course "Model Thinking" by Scott E. Page, and upon whose work this document's format is based.

1 Basic Principles of Financial Valuation Discounting

Hi! Welcome to my notes for Finance For Non-Finance Professionals, a Coursera course taught Prof. James P. Weston of Rice University. This course is broken down into 4 big sections, and in this first section, we're going to talk about the basic principles of valuation and discounting. We're going to start our discussion with a very basic treatment of interest rates: where they come from and how they get formed in the economy. We're then going to use those interest rates to compound rates of return over time, like putting money in the bank. What happens to it as it goes through time?

We're then going to flip that analysis over and think about discounting cash flows. Money coming in the future, how much is it worth to us today? Rather than putting money in the bank today, and letting it grow over time, we're going to discount future cash back into the present.

We're going to use that analysis of compounding and discounting to think about the basis of finance valuation. That's going to lead us to discounted cash flows or DCF valuation, which is really one of the most primal cornerstones of finance: valuation by how much cash is coming in, when is it coming in, and how hard do we discount it?

We'll compare that to ratio analysis, using P/E ratios and comparable transactions analysis to compare to DCF. We'll then end the section with a long series of applications and practical examples.

1.1 Human Nature and the Time Value of Money

The convergence of these two concepts, human nature and the time value of money, is the subject of **interest rates**: putting a price on time. At a high level, interest rates are what you charge to be patient. Let's think about this deal: I could give you $100 right now, or I can wait five years and I'll give you a hundred dollars five years from today. Which will you rather have?

If you ask almost anyone, anywhere in the world, that person'll almost always say "I'd rather have the money today than wait for it." Why? Why would people rather have stuff today than wait for it? There are 3 big reasons:

1. Opportunity costs
2. Inflation Expectations
3. Risk & Uncertainty (known and unknown risk)

Given these factors, at some point you'll accept a deal where I give you \$100, plus some interest, cashed out five years from now. Those 3 factors are the cornerstones of what that interest rate will be, and they're a reflection of perceived future value.

As such, interest rates are the **most important** prices in the economy. They are the central basis for all other prices in the economy.

1.2 Compounding and Earning Returns over Time

In Section 1.1, we talked about interest rates as a general matter. Now, we're going to take those interest rates and put them to use. Let's think about a very basic example. Let's say you had \$100 today, and you put it in the bank earning 11% interest. How much money would you have after one year?

Well that's a simple one. You would have \$100 + (11% of \$100), which is \$11. So add those two together, the principal plus the interest, and after one year, you would have \$111. Now if you left that money in the bank for a second year – you took that whole \$111 and put it in for a second year – how much money would you have after two years? Easy, again you're going to have the \$111 (principle) plus the interest that you earned during the second year.

Now you might think naively, well, if I'm earning 11% interest on the \$100, I'll get another \$11. So that would be \$122. But that's not quite right. And the reason it's not quite right is compound interest. You're going to earn interest on the \$11 that you earned last year. So you're going to have a little bit more than \$122. In fact, you're going to have \$123.21. That little extra bit of money is that 11% on the \$11 of interest that you earned last year.

So that interest that you're earning on the interest is what we call **compound interest**. The beautiful thing about compound interest is that it expands exponentially over time. Meaning, the longer you leave it in and the higher the interest rate, the more interest you earn on the interest that you had before. And that amount of money that you have explodes. It explodes exponentially over time.

Circling back to our example, you can see that there's a regular formula to compound interest:

$$\mathrm{FV} = \mathrm{PV}(1 + \mathrm{r})^{\mathrm{t}} \tag{1}$$

From this equation, you can calculate the Future Value (FV) from the Present Value (PV), the interest rate (r), and the time period (t). And likewise, knowing any 3 variables allows you to calculate the 4th.

1.3 Nominal vs. Effective Rates

Interest rates come primarily in 2 flavors: nominal rates and effectives rates. The nominal or "stated" rate is simply the period rate times the number of periods. So if you paid 1% per month, you would be paying 12% per year, or if you paid 2% per quarter, you'd be paying 2% times 4 quarters, or 8% per year.

On the other hand, the effective rate is the compound annualized rate, taking into account compound interest. This is the rate that investors earn, or that you'd actually be paying in a loan.

Example: A nominal interest rate of 6% per year, compounded monthly for a monthly rate of 6%/12, or 0.5%, has an effective rate equal to $(1 + 0.5\%)^{12} = 1.0617$, or 6.17%.

The general formula for the effective rate is:

$$R_{\text{effective}} = \left(1 + \frac{R_{\text{nominal}}}{n}\right)^n \tag{2}$$

Where n is the number of periods.

1.4 Discounting Future Cash Back to the Present

In Section 1.4, we're going to take the basic ideas of interest rates and compounding that we just learned and apply them to discounting future values back into the present. What does that mean? Simple, what is cash in the future worth to us today? That basic concept is called discounting.

So how do we do that? We can rearrange the compound interest equation (Equation 1) from Section 1.2 to come up with a new equation:

$$\text{PV} = \frac{\text{FV}}{(1+\text{r})^{\text{t}}} \tag{3}$$

So now we have a formula for the present value of future cash flows. Here, interest rates and the time period combine to smash down the present value.

Example: If I offered you \$175 payable 5 years from now, what is that offer worth if interest rates were 4%? Answer: PV = \$175 / $(1 + 4\%)^5$, or \$143.84.

Cash flows decay exponentially the farther out in time we go. Additionally, the level of perceived risk (the interest rate) can dramatically affect the offer as the deal is perceived to be more risky and the interest rate rises.

1.5 Discounted Cash Flow (DCF) as the Basis for All Valuation

Here it is, our first real valuation tool. DCFs form the basis for all financial valuations, as they're one of the best methods of valuing an investment. We can put a value on almost anything using this method, provided we make an accurate assessment of all of the future cash flows.

Quick review: Why do we investors buy different kinds of assets? If you think about all the things that you could do with your money today, you can buy real estate, or stocks, or bonds, etc. Why are you putting money into that investment? Why are you being patient with your money? You're being patient because you want to earn some rate of return on that money, and then use that money later. You're using real estate, stocks, bonds, or any investment as a vehicle for getting the wealth that you have today into the future, and earning some rate of return for being patient.

Example: Bonds are contracts between an issuer and a bondholder. The buyers of the bond lends some money (the principal) to the issuer, who then pays the amount of the bond back at maturity (the time that the bond is due), plus some percentage of the loan (interest) dished out equally over equal periods of time before and at the maturation date.

Consider a simple bond of \$3,000 that makes annual payments of \$250 for 5 years, if the discount rate is 7%. What is the bond worth?

Step 1: Write out the cash flows.

Step 2: Calculate what they're worth in today's money using Equation 3.

Step 3: Add up all present values to form the DCF.

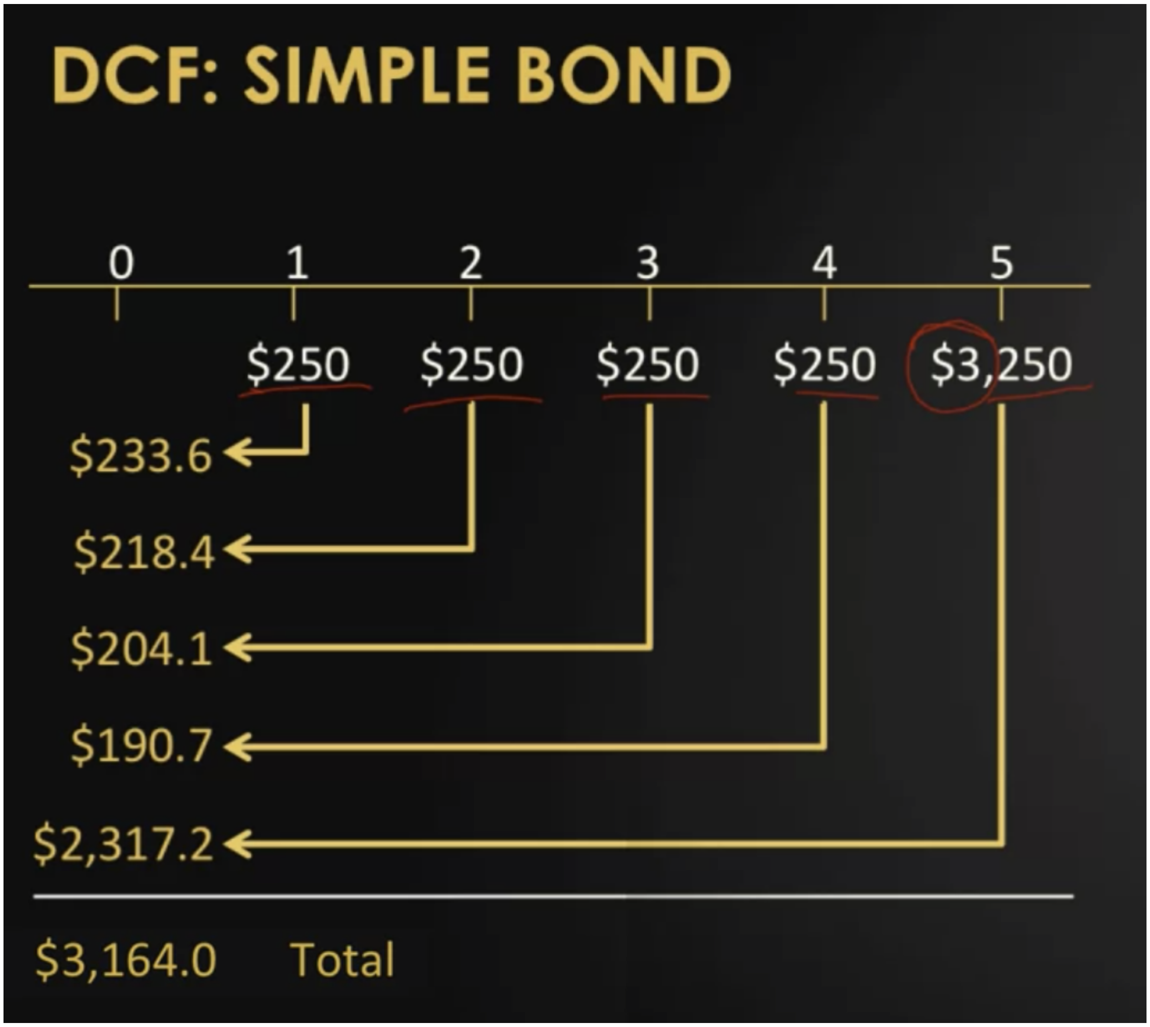


Figure 1: So the bond is worth $3,164. That's how much it would raise if sold today.

Why would anyone pay more or less? If the cash flows are the same, then they must be thinking that the investment is more or less risky and be using a different discount rate.

1.6 DCF Practical Example

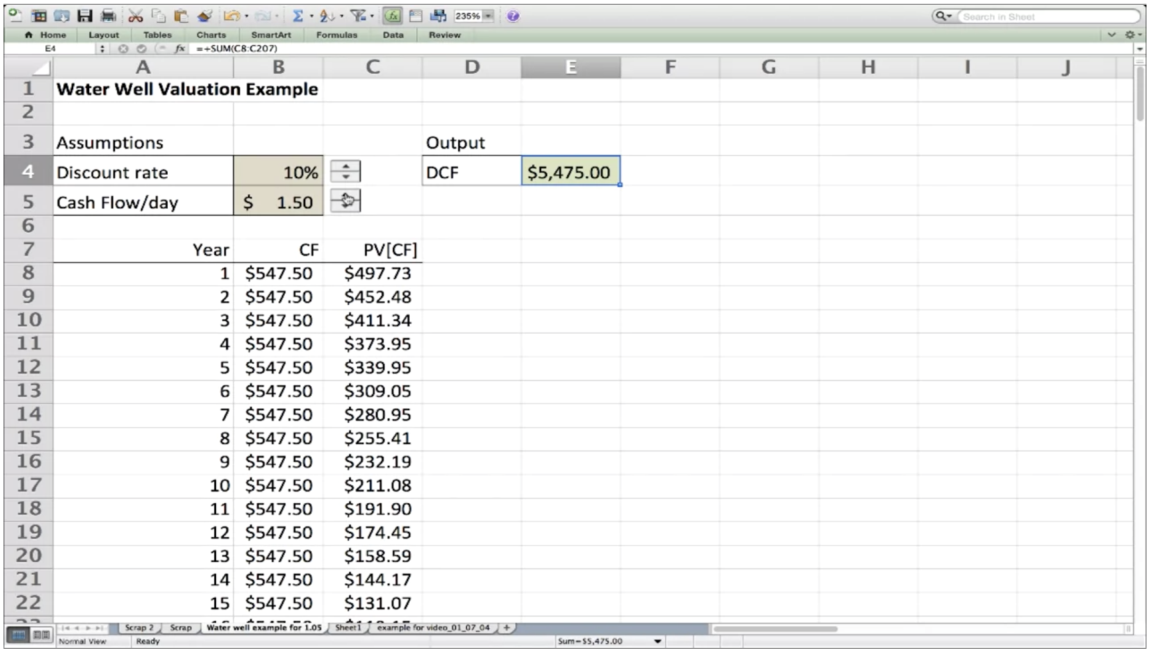
Example: Say we have a water well that provides $1.50 per day in profit. Is it worth infinity, since it provides a never-ending supply of water and money? No way, because we need to incorporate time by discounting the future cash flows. So then how much is is worth if the discount rate is 10%?

We can solve this problem using a spreadsheet model. Remember, the steps are as follows:

Step 1: Write out the cash flows.

Step 2: Calculate what they're worth in today's money using Equation 3.

Step 3: Add up all present values to form the DCF.



	A	B	C	D	E
1	**Water Well Valuation Example**				
2					
3	Assumptions			Output	
4	Discount rate	10%		DCF	$5,475.00
5	Cash Flow/day	$ 1.50			
6					
7	Year	CF	PV[CF]		
8	1	$547.50	$497.73		
9	2	$547.50	$452.48		
10	3	$547.50	$411.34		
11	4	$547.50	$373.95		
12	5	$547.50	$339.95		
13	6	$547.50	$309.05		
14	7	$547.50	$280.95		
15	8	$547.50	$255.41		
16	9	$547.50	$232.19		
17	10	$547.50	$211.08		
18	11	$547.50	$191.90		
19	12	$547.50	$174.45		
20	13	$547.50	$158.59		
21	14	$547.50	$144.17		
22	15	$547.50	$131.07		

Figure 2: In this example, the well would be worth $5,475.

By using spreadsheets, you can easily adjust parameters and modify the model according to new information.

1.7 Valuation by Comparables

Sometimes practitioners like to use valuation by "comps", or comparables (comparable transactions or prices), instead of using DCF since comps are quick & easy, but they can also be a little bit dangerous. There are 3 big assumptions you have to make:

1. You can identify close comparables.
2. You have a relevant value ratio, e.g. a P/E ratio, if comparing ratios.
3. The market values the comps similarly.

Comparables in use:

$$\frac{\text{Price of comparable}}{\textit{Attribute of comparable}} * \textit{Your attribute} = \text{Price of your asset} \tag{4}$$

Examples of attributes:

- P/E ratios
- Earnings Yield (earnings over price)
- Dividend Yield (dividends over price)
- Return on Assets (profit over total cost of the asset)
- EBITDA multiples

P/E ratios (price per earnings) are probably the most popular, and they say how much it would cost in the market to purchase a dollar of earnings. It's commonly stated as "trades at X times earnings." Here's an example: assuming Lowes and Home Depot are good comparables, if you know the P/E ratio of Home Depot is 25 and the earnings of Lowes is $2.46, what would the value of Lowes be?

$$\mathrm{P/E}_{\text{Home Depot}} * \mathrm{E}_{\text{Lowes}} = 25 * \$2.46 = \$61.60 = \text{Comp value of Lowes} \tag{5}$$

If Lowes' actual value in the market is $74, this comp is about 20% off. Sometimes that's good enough, and sometimes it's not. User beware here.

Comps rely on historical averages like the trailing 12 months, or the most recent quarter, or the past 3 years, and they're best used as back-of-the-envelope calculations. Also, for the P/E ratio example in particular, they can be unreliable with negative earnings, important for companies that aren't profitable. Both comps and DCFs provide useful information, and if executed correctly, both are valid. But use DCF when you can to round out the analysis and put them side-by-side. While both require forecasts, DCF is better grounded but does require much more work.

1.8 Bonds

Bonds are very simple debt instruments that promise to pay coupons (interest payments) and pay back the face value (principal). They are the simplest of all financial instruments. What kinds of bonds are there?

- U.S. treasury bonds
- Corporate bonds
- Municipals
- Sovereign debt

What makes bonds different values? Answer: the risks associated with paying back the face value (quantitatively captured by the discount rate), along with how much the face value is and how much / when the coupons are going to be dished out.

Example: The Treasury issues 3 year bonds with a 2.5% coupon rate. If the 6 month interest (discount) rate is 1.2%, what is the price of the bond if the face value is $100?

Step 1: Write out the known variables.

Step 2: Divide the 2.5% coupon rate by 2 to get the semi-annual rate, since you need to match the time periods of the coupon and interest rates.

Step 3: Calculate the DCF

6 time periods (semi-annually * 3 years):

$$\frac{\$1.25}{(1 + 1.2\%)^1} + \frac{\$1.25}{(1 + 1.2\%)^2} + \frac{\$1.25}{(1 + 1.2\%)^3} + \frac{\$1.25}{(1 + 1.2\%)^4} + \frac{\$1.25}{(1 + 1.2\%)^5} + \frac{\$1.25 + \$100}{(1 + 1.2\%)^6}$$

$$\$1.24 + \$1.22 + \$1.21 + \$1.19 + \$1.18 + \$1.16 + \$93.09$$

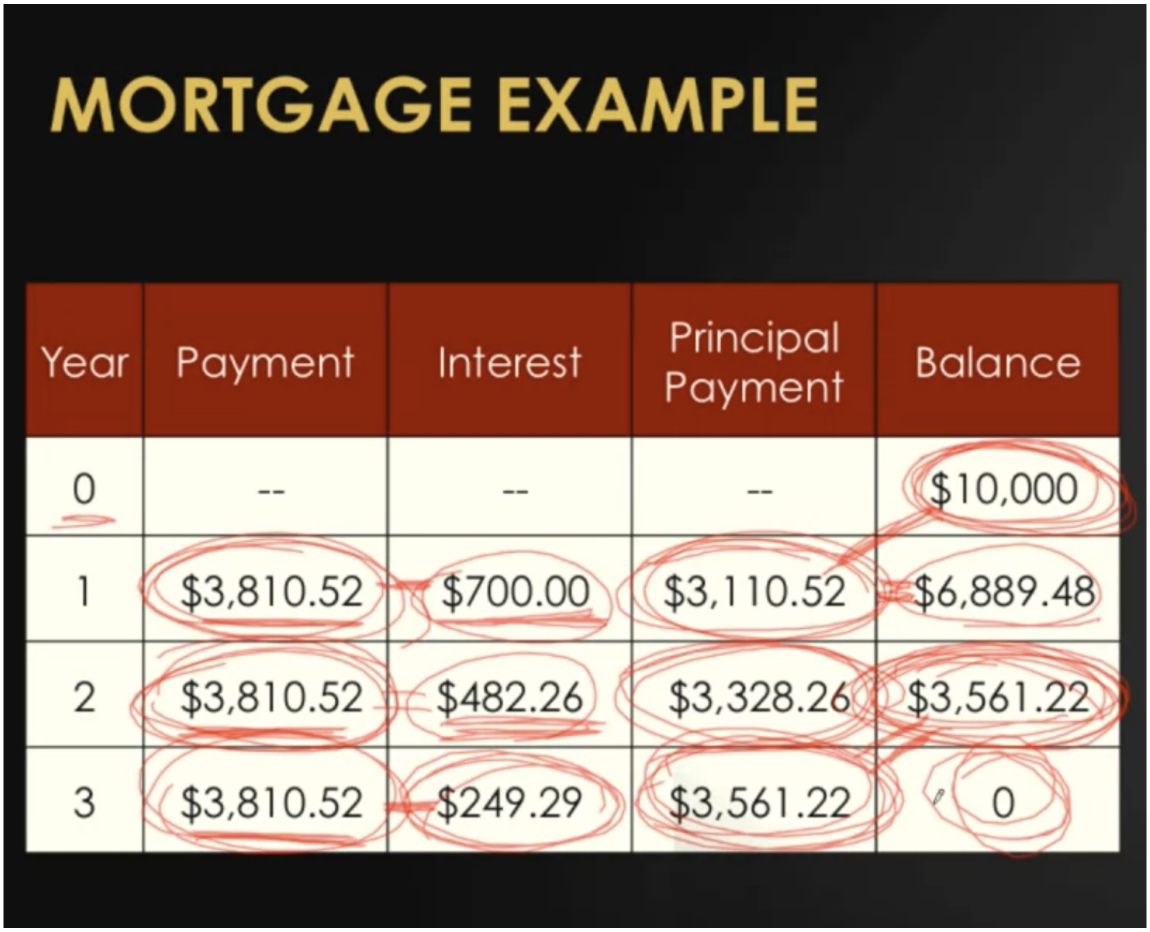
$$= \$100.29 = \text{price of the bond}$$

Figure 3: In this example, the bond would be worth \$100.29. That's what you would pay in the market.

1.9 Mortgages

Mortgages are very simple debt instruments typically seen when borrowing money to purchase real estate. Mortgage payments are usually the same every month or every quarter, and part of that payment is principal and part of that payment is interest. What percentage of each is interest and what percentage of each is principal wrapped up into what we call an amortization schedule.

Example: Assume a bank charges 7% interest per year. You borrow \$10,000 to be repaid in equal yearly installments of \$3,810.52 over 3 years. Let's amortize the loan schedule and compute the interest and principle repayments.



MORTGAGE EXAMPLE

Year	Payment	Interest	Principal Payment	Balance
0	--	--	--	$10,000
1	$3,810.52	$700.00	$3,110.52	$6,889.48
2	$3,810.52	$482.26	$3,328.26	$3,561.22
3	$3,810.52	$249.29	$3,561.22	0

Figure 4: Here's the amortization table, complete with the amount of interest and principal for each payment.

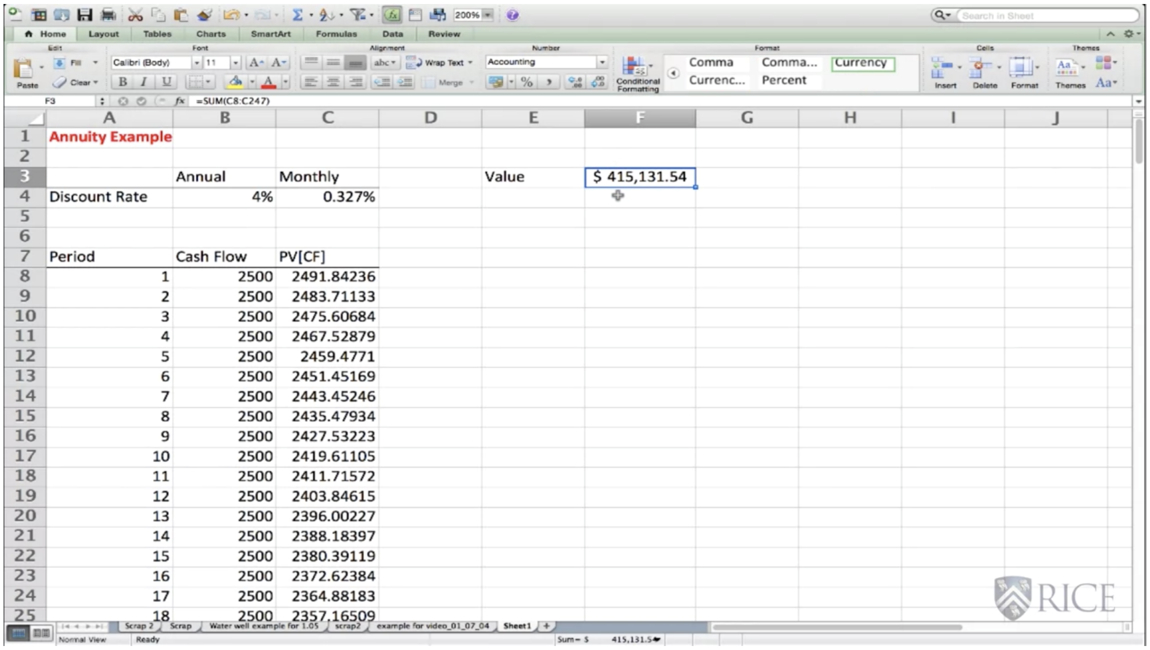
The calculation for getting the mortgage payment is out of the scope for this section; there are handy YouTube videos that cover this formula in more detail.

1.10 Annuities

Annuities are a series of equal payments at regular intervals.

- Regular deposits to a savings account
- Monthly mortgage payments
- Insurance premiums
- Pension payments

Example: You want to retire and maintain a monthly income of $2,500 for the next 20 years. How much would it cost to purchase this annuity if discount rates are currently 4%?



	A	B	C	D	E	F
1	Annuity Example					
2						
3		Annual	Monthly		Value	$ 415,131.54
4	Discount Rate	4%	0.327%			
5						
6						
7	Period	Cash Flow	PV[CF]			
8	1	2500	2491.84236			
9	2	2500	2483.71133			
10	3	2500	2475.60684			
11	4	2500	2467.52879			
12	5	2500	2459.4771			
13	6	2500	2451.45169			
14	7	2500	2443.45246			
15	8	2500	2435.47934			
16	9	2500	2427.53223			
17	10	2500	2419.61105			
18	11	2500	2411.71572			
19	12	2500	2403.84615			
20	13	2500	2396.00227			
21	14	2500	2388.18397			
22	15	2500	2380.39119			
23	16	2500	2372.62384			
24	17	2500	2364.88183			
25	18	2500	2357.16509			

Figure 5: It would cost $415,131.54 to purchase this annuity on the market. Note: the monthly discount rate is calculated via the compound interest equation, with the time period now a fraction of a year instead of a whole number: $(1 + 4\%)^{1/12}$ - 1. The one is subtracted to make the number a percent rate.

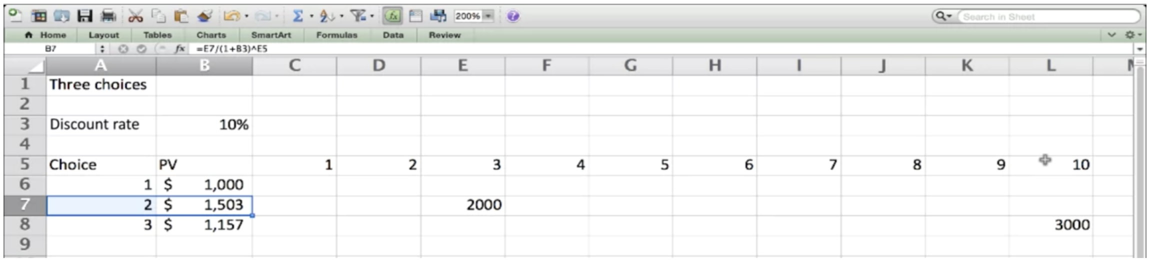
So using the very basic principles of compounding and discounting, we can figure out more complicated instruments like this annuity, and price it, and figure out what the right ballpark is for something that has a whole stream of cash flows coming in in the future. If we know when those cash flows are coming in, and we know what discount rate to hit them with, we can put a reasonable value on it.

1.11 Capstone Example

You have a choice between 3 options:

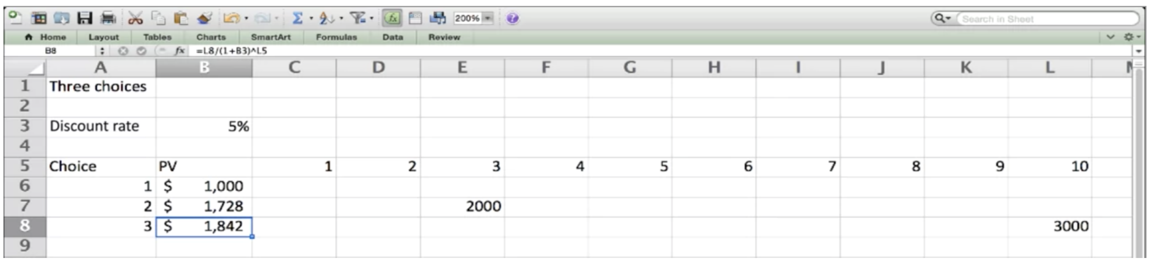
1. Take $1,000 in cash now
2. Receive $2,000 at the end of 3 years
3. Wait 10 years and receive $3,000

Which is the best choice if the discount rate is 10%? 5%? 50%?



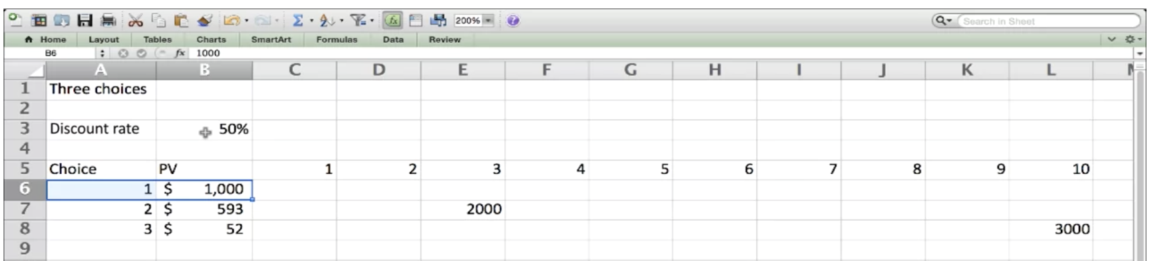
	A	B	C	D	E	F	G	H	I	J	K	L
1	Three choices											
2												
3	Discount rate	10%										
4												
5	Choice	PV	1	2	3	4	5	6	7	8	9	10
6	1	$ 1,000										
7	2	$ 1,503			2000							
8	3	$ 1,157										3000
9												

Figure 6: Option 2 is the best option.



	A	B	C	D	E	F	G	H	I	J	K	L
1	Three choices											
2												
3	Discount rate	5%										
4												
5	Choice	PV	1	2	3	4	5	6	7	8	9	10
6	1	$ 1,000										
7	2	$ 1,728			2000							
8	3	$ 1,842										3000
9												

Figure 7: Option 3 is the best option.



	A	B	C	D	E	F	G	H	I	J	K	L
1	Three choices											
2												
3	Discount rate	50%										
4												
5	Choice	PV	1	2	3	4	5	6	7	8	9	10
6	1	$ 1,000										
7	2	$ 593			2000							
8	3	$ 52										3000
9												

Figure 8: Option 1 is the best option.

So it turns out that the answer is really dependent on the discount rate. When we made the discount rate really low, it was worth it to be patient. And when we amped up the discount rate all way up to 50%, when we were really risk-averse, the answer changed to "man, forget about 10 years – we want the money today!" So the answers of the financial valuation, and that trade-off between money now vs. money later, depends critically on how much money's coming in, when that money's coming in, and how hard we're discounting it. And that's a good way to wrap up this section, which was all about the basics of valuation, compounding, and discounting.

1.12 Conversations with a Practitioner

Practitioners use all of these techniques we've been talking about (comparables, ratios, and DCFs) to build a model that applies a weighting factor representing a confidence level that we have in each of those methods. Comparable transactions are generally very valuable, but the DCF probably always has the highest weighting factor.

Wall Street analysts, often called sell-side analysts, are the ones who dig into companies, model them thoroughly, and provide their estimate to the street about buy/sell/hold. They also incorporate all three methods into their valuation, but some of their customers looking at stocks or buying companies aren't quite as sophisticated as your typical corporate finance department or your sell-side analysts, for sure. So, comparables and ratios are much simpler to find the numbers on public websites, much easier to communicate, and easier to understand.

On the other hand, if we were going to buy a large public company, we might go through the hard work of doing the DCF to give a more accurate and precise measure of the valuation. Whereas, if we were going to buy something like a pizza parlor, or a bar, or restaurant, where it's really hard to measure what future sales are going to be, we might do some comps or some ratio analysis, just to make sure we were in the right ballpark.

So when there's a lot of uncertainty, the simpler methods tend to dominate, and where you can get better forecasts of what the assumptions going into the DCF might be, that makes the return on doing the hard work of a DCF much better.

2 How to Spend Money (Capital Budgeting Tools)

How the firm spends money is called the capital budgeting process. It involves how the firm takes in money that it's got, how it spends it within the firm, and/or how it gives it back to the capital market through dividends or repurchases. The major tools that firms use inside to decide where to allocate money within the firm are:

1. Net Present Value
2. Payback Period
3. Accounting Ratios
4. Internal Rate of Return (IRR)

We'll talk about all of these in this section.

2.1 Overview of the Capital Budgeting Process

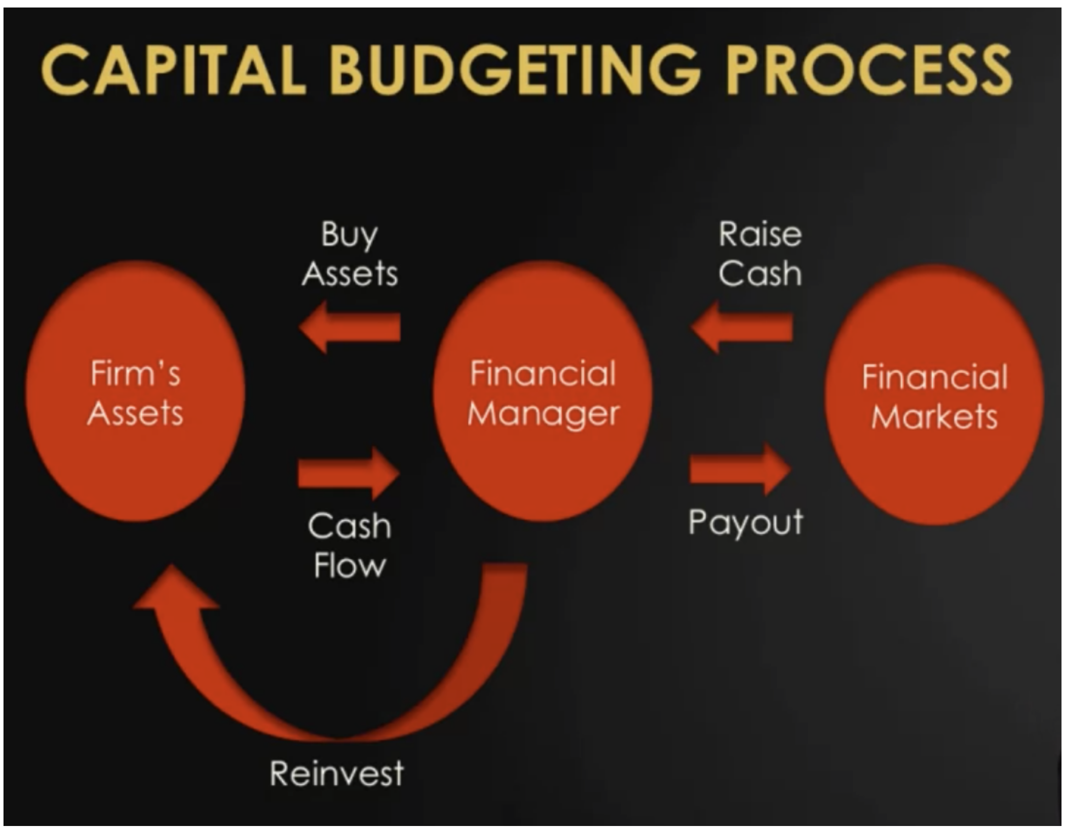


Figure 9: Overview of the capital budgeting process.

If we use other people's money, either through debt or through equity, we have to pay them for it. What are we going to pay them? Implicitly, we're going to pay them that r, that discount rate, that compound rate, that interest rate that we talked about all through the last section. And so capital budgeting is really the science or the decision-making that goes on behind how, when, and where the firm should spend its money in order to maximize the return that it can give to its investors, its bondholders, and its stockholders. Similar to being an individual investor, we would ask the firm questions about:

1. Timing
2. Risk
3. Opportunity cost

Their responses will be in the form of capital budgeting measures, which should be:

- Arms-length (no inside dealing)
- Objective
- Transparent

If the measures meet these three criteria, then they're probably good tools for deciding how and where to spend money. We're going to use those measures to:

- Accept or reject a project
- Find the best of a set of projects
- Rank different projects

It's basically a cost/benefit analysis, but it can get tricky to measure once we get into multiple projects and multiple timings of the projects.

2.2 Net Present Value (NPV)

Net present value is going to be the standard bearer for a lot of the capital budgeting work that we're going to be talking about in this section. It's one of our main capital budgeting tools. It pulls right out of the work that we've done so far with compounding and discounting and using rates of return. With net present value, the basic idea is to add up the all of the present values of future cash flows, just like we've been doing, and compare that against the initial investment. From there, we're going to ask a very simple question: does all the present value of all of the money coming in over the life of the project, does it outweigh how much money we have to spend in order to do the project? Net present value is just that, it's the net between the present value of these two streams, money going out and money coming in. We're going to invest if the NPV > 0. If it's greater than zero, then the costs are less than the benefit (aka, the benefits exceed the costs), and we should do the project and make the investment. That's our decision rule. The NPV formula is:

$$\text{NPV} = \text{-Initial Cost} + \frac{\text{CF}_1}{(1+\text{r})^1} + \frac{\text{CF}_2}{(1+\text{r})^2} + \frac{\text{CF}_3}{(1+\text{r})^3} + ... \tag{6}$$

Where CF_1 is cash flow in the 1st time period, CF_2 is cash flow in the 2nd time period, etc.

Example: Analyze the table of cash flows and compute the NPV if the discount rate is 10%?

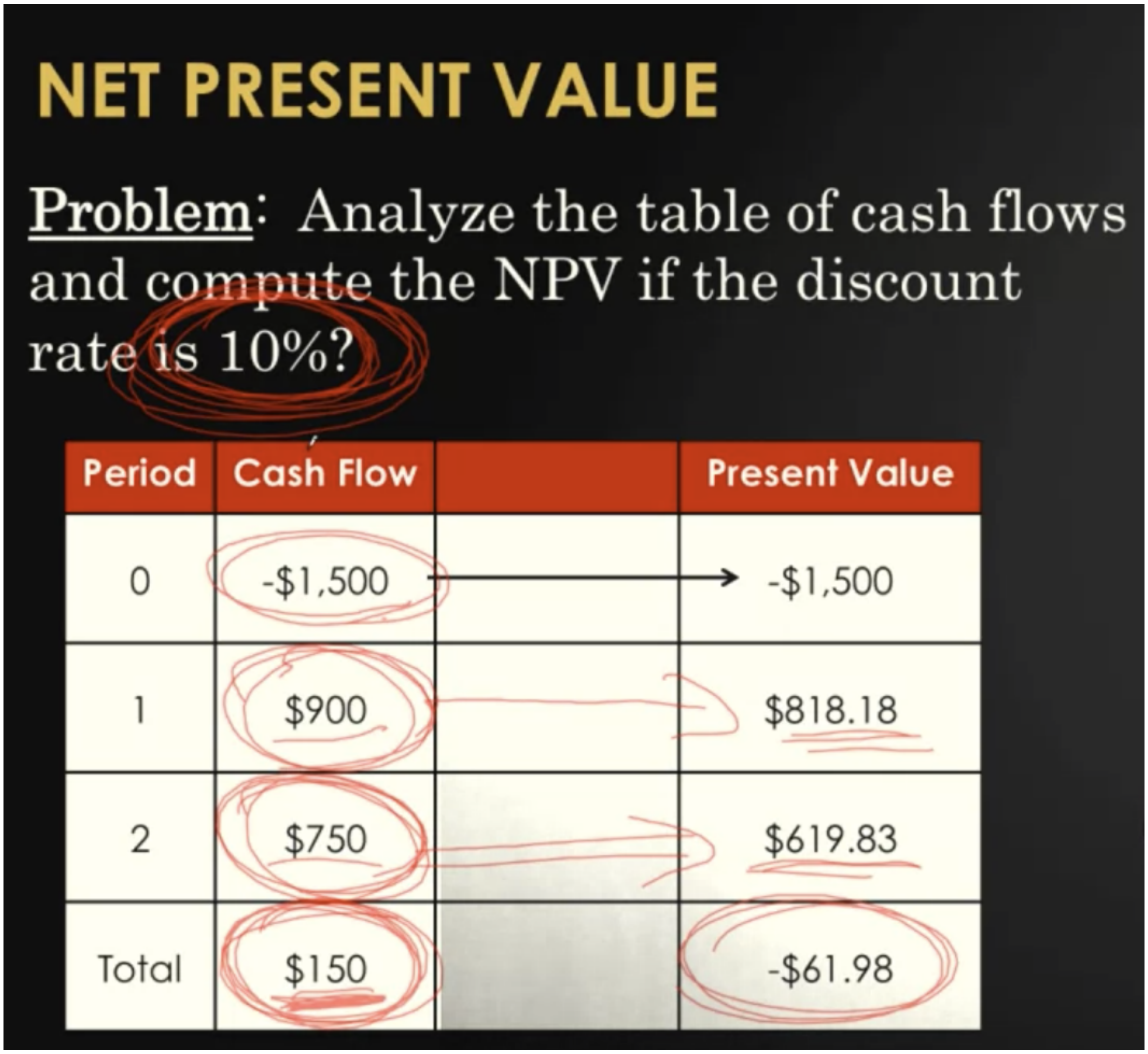


Figure 10: NPV example. This project is generating cash, and it's profitable... but not discounting for time. The 10% discount rate is the main reason why we wouldn't want to do the project.

So let's think about this table of cash flows that we have up here and at a discount rate of 10%, let's think about whether it's worth it to do the project. So what do we have? We have here in period 0 that I'm going to spend $1,500, and the question is now: is it worth it to spend that $1,500?

Well, what's coming in off the project? We have a cash flow of $900 coming in at the end of year 1, and we have a cash flow of $750 coming in at the end of year 2. And if we just sum up the cash flows, we get an answer of $150. So this project is generating cash. It's profitable. The money coming in is bigger than the money going out. This is a key concept here. The money coming in is bigger than the money going out. 150 is bigger than 0. That's the sum of all the cash flows, but that's *without any discounting*. We haven't accounted for the fact that we have to wait a year to get the $900, and then wait another year to get the $750. Remember from the last section that if you ask me to be patient, then you have to pay me? So what do we have to pay? In this case, we have to pay that 10% discount rate.

So now if we take those cash flows and discount them to the present value, we get $818.18 for period 1, and if we take that 750 and discount it 2 periods at 10%, we get $619, which is less than $750. Now, when we sum the present value of all those cash flows, we get -$61, which suggests that the project destroys value, that it's not worth doing. It's a profitable project, but we don't want to do it.

Now why would we ever not want to do a project that's profitable? And the answer is it really all comes down to this 10% up here. What does that 10% tell us? That 10% tells us what the hurdle rate is for the profitability of the project. This project might be profitable but it is not profitable enough with a 10% discount rate.

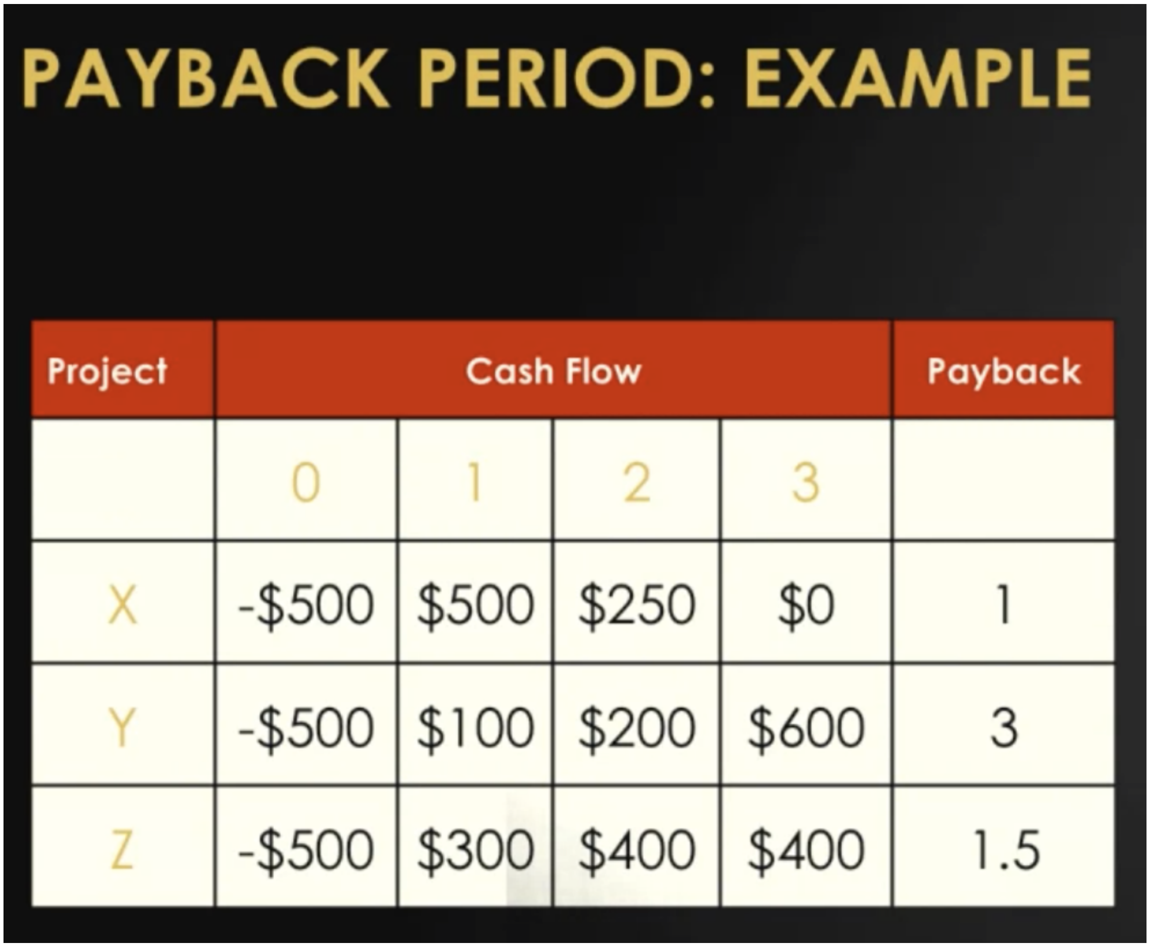
Let's recap why is the NPV our standard bearer for our capital budgeting tools.

- NPV incorporates:
  - Timing
  - Opportunity Cost
  - Risk
- NPV is objective.
- NPV is arms-length.
- NPV is transparent.

2.3 Payback Period

How long does it take to earn back an initial investment? That's the concept behind payback period. Decision rule: invest if the payback is less than X month, years, etc.

Example: how long does it take for me to pay back a new refrigerator?



Project	Cash Flow				Payback
	0	1	2	3	
X	-$500	$500	$250	$0	1
Y	-$500	$100	$200	$600	3
Z	-$500	$300	$400	$400	1.5

Figure 11: Payback period example. Payback can come at the end of a period (e.g. 3) or come in-between periods (e.g. 1.5). It has a nice feel to it, sits well in our psyche, but it's dangerous.

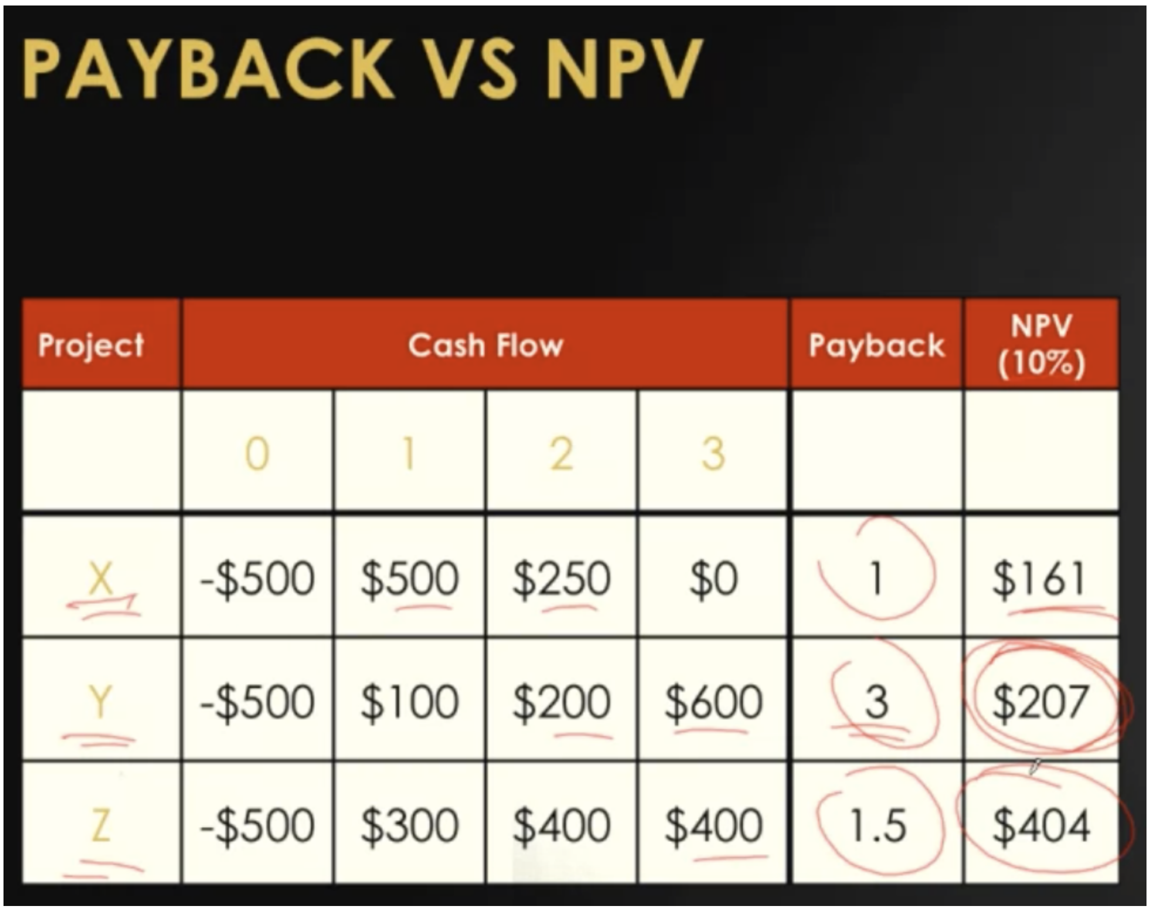
Good things about payback:

- Time is money! Incorporates the notion that the further out things are in the future, the less valuable they are to me today.
- Reflects opportunity cost. You can't do something with money you don't have.

Bad things about payback:

- Neglects cash after the payback. What if the project is a cash cow after the payback period?
- Neglects discounting for time. What is a year vs. 3 years from now?
- Neglects risk. How risky is it that you'll have money coming in in 5 years? 10 years?
- Arbitrary cut-off. Different projects have different timing schedules (e.g. oil rig vs. glass windows), who's saying what's a good payback for each?

Example: Payback vs. NPV



Project	Cash Flow				Payback	NPV (10%)
	0	1	2	3		
X	-$500	$500	$250	$0	1	$161
Y	-$500	$100	$200	$600	3	$207
Z	-$500	$300	$400	$400	1.5	$404

Figure 12: Payback vs. NPV. Payback and NPV can provide different answers (e.g. what's last in payback is middling in NPV). NPV incorporates more information when making a decision.

Payback is often a weak capital budgeting tool. It measures time to recovery. Use caution when using it. Try to push back if payback period is the only metric for decision-making – why not put it next to an NPV to make sure it's the right choice?

2.4 Accounting Ratios

Measure the ratio of A/B; take 2 pieces of accounting data and put one over the other, like net income and divide by sales. Decision rule: invest if the ratio is greater than some cut-off value.

Example: Is the profitability to invested capital, which we might call the Return on Invested Capital (ROIC), bigger than whatever the firm uses as a cutoff, maybe 10%, 20%?

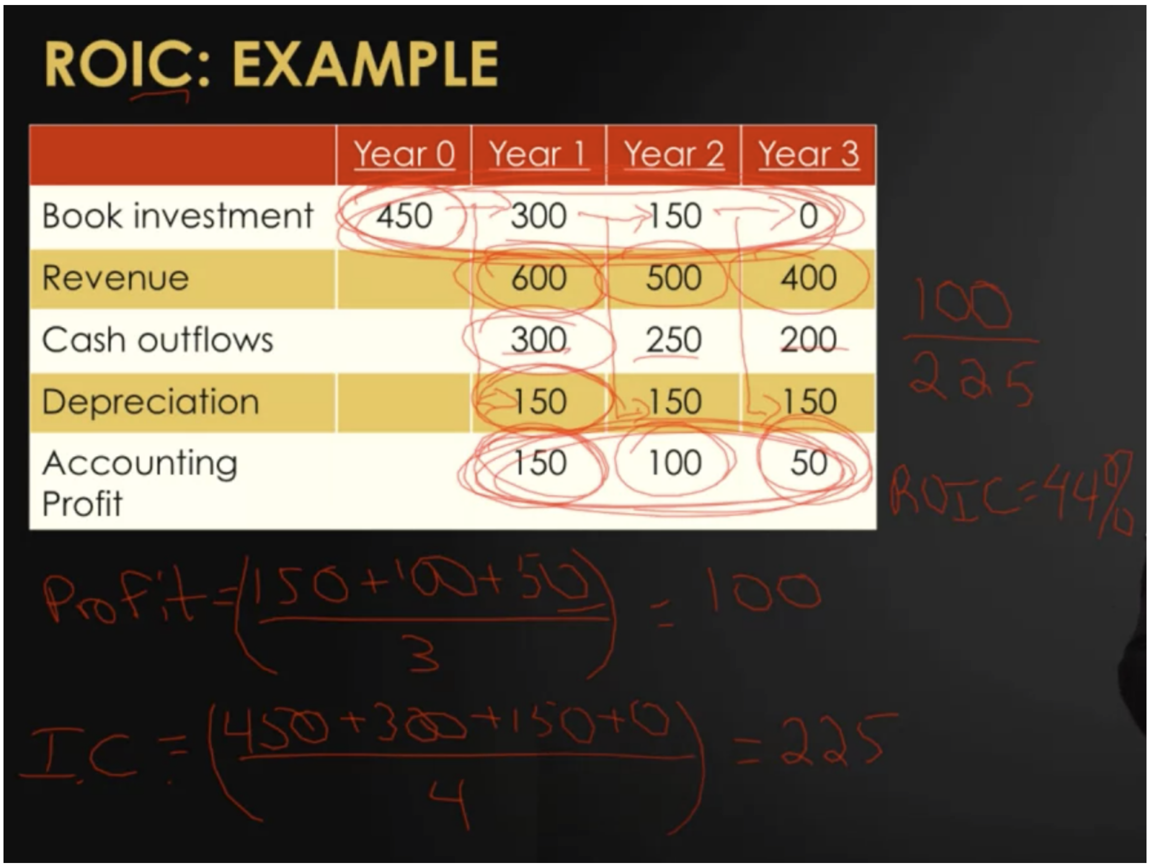


Figure 13: ROIC example: average profit divided by average invested capital.

Okay, so let's walk through somewhat specific example of return on invested capital. Our decision rule's going to be: is the return on invested capital bigger than some X? So we want to compute two things. We want to compute the average accounting profit on the project and we want to compute the average invested capital.

So in this project we're investing \$450 in order to generate sales of \$600, \$500, and \$400 over the next three years. It costs \$300, \$250, and \$200 to generate those sales. That's the cash outflow associated with costs of goods sold and selling & administrative expense. There's also a depreciation expense here. Now what is that depreciation expense? That reflects the fact that the book value of the asset declines from \$450 to \$300 to \$150 to \$0, which is straight line depreciation. Depreciation describes how the asset becomes worth less over time. Each of those declines in the value of the asset gets written down as an expense. So that \$150 decline comes down here as depreciation expense, etc.

So now we can compute the accounting profit. \$600 - \$300 is \$300. \$300 - the \$150 depreciation expense gives us an accounting profit of \$150. Do the same thing in period 2. \$500 - \$250 - \$150 gives us an accounting profit of \$100. Same process for year 3. Now we have everything we need to compute the two things that we need for the ratio. How much profit on average was generated by the project? \$150, \$100 and \$50, those are our three accounting profits. We're going to take the average of those to get \$100. How much capital did it take to generate those profits? \$450, \$300, \$150 and \$0, those four numbers. So the average invested capital is \$225. And now \$100/\$225 is 44%. So now, we think to ourselves: is that 44% big enough? And that's the capital budgeting decision. If that 44% is above our cutoff, we do the project. If that 44% is below, we don't do the project.

Good things about accounting ratios:

- More money is better!
- Reflects the use of capital.

Bad things about accounting ratios:

- Neglects timing.
- Includes accounting distortions (like depreciation, which is a non-cash expense) which don't truly reflect cash flow.
- Neglects risk.

So the advice on all these accounting ratios is that they're okay in isolation, they're informative. They get used a lot internally, but always put them next to a net present value. If you put them next to a net present value, the arbitrary cut-off more or less goes away because the net present value can function as our North Star for whether or not this project generates value.

2.5 Internal Rate of Return (IRR)

What discount rate makes the NPV = 0? Decision rule: invest if that discount rate $<$ some r, which is the IRR. IRR asks "how hard can we smash this project down with a bigger and bigger discount rate before we drive all the value out of the project?" If the NPV goes negative with a small discount rate, it's a crummy project. But if we can smash it with a cinder block, say a 20% or 30% discount rate and it's still positive, then that's a good project. It's a measure of resiliency in the cash flows. We take the NPV and squish it down into a percentage, which is easier to intuitively grasp compared to a random NPV.

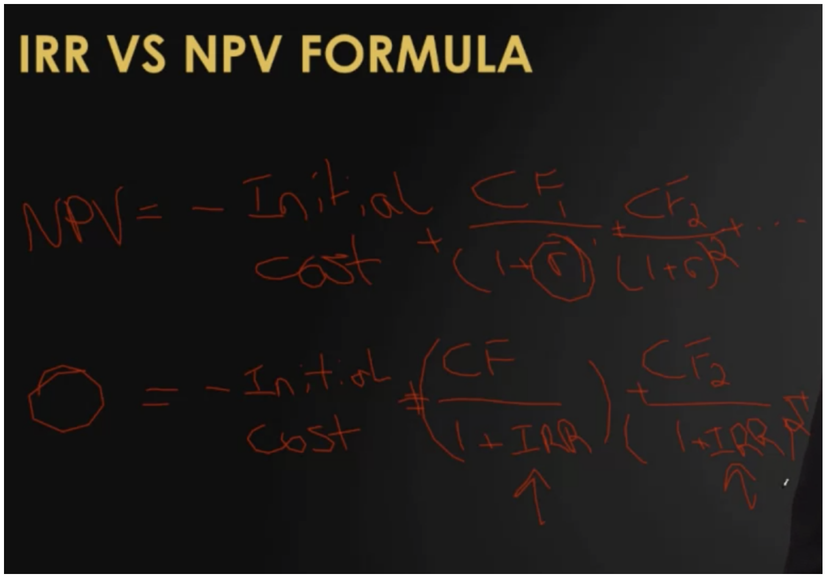


Figure 14: NPV vs. IRR formulas. IRR asks “what discount rate sets the NPV equal to 0?”

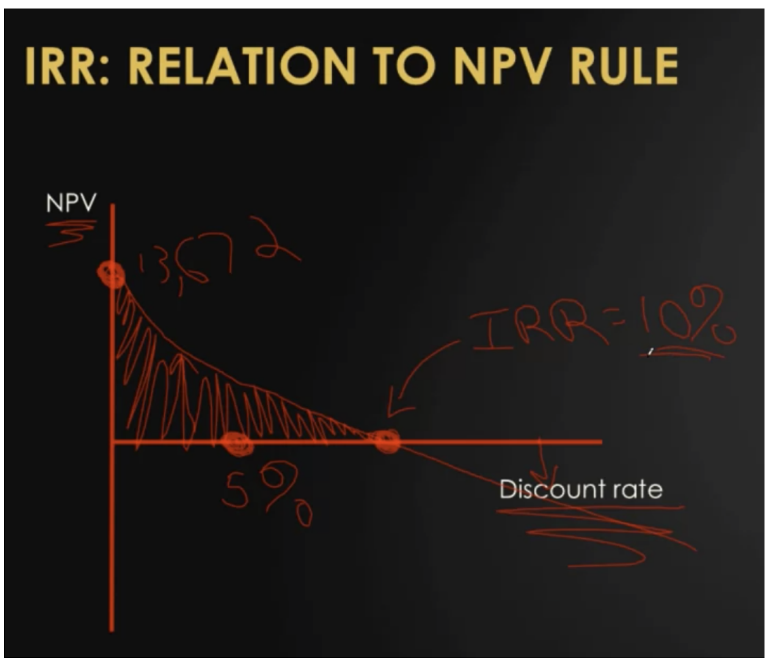
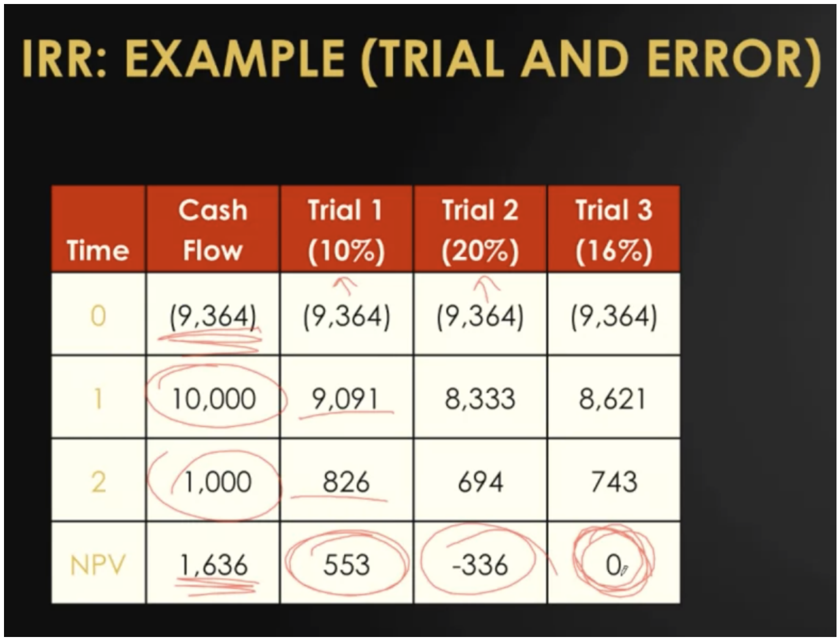
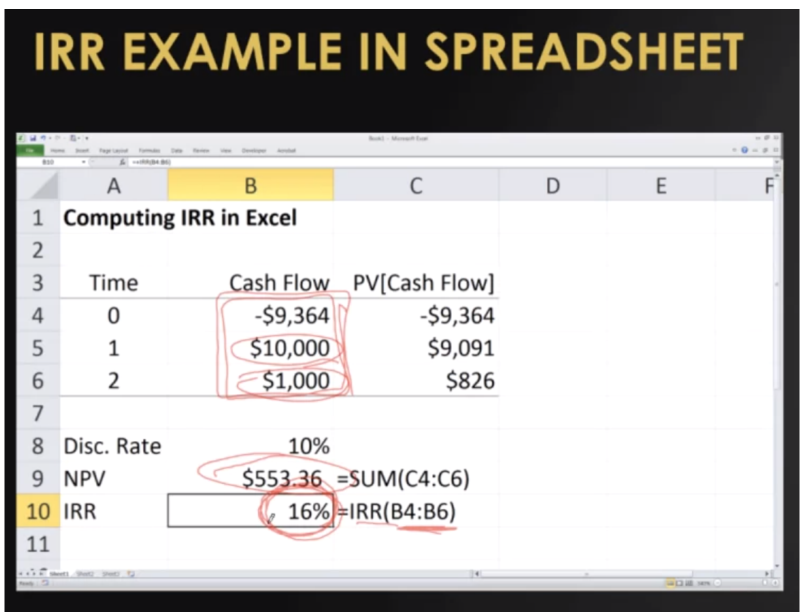


Figure 15: Graphical representation of NPV vs. IRR. If the discount rate is less than the IRR, then NPV is positive and it’s a good project (generally).



Time	Cash Flow	Trial 1 (10%)	Trial 2 (20%)	Trial 3 (16%)
0	(9,364)	(9,364)	(9,364)	(9,364)
1	10,000	9,091	8,333	8,621
2	1,000	826	694	743
NPV	1,636	553	-336	0

Figure 16: IRR can be found with a trial-and-error approach, but it's easier to find in Excel.



	A	B	C	D	E	F
1	Computing IRR in Excel					
2						
3	Time	Cash Flow	PV[Cash Flow]			
4	0	-$9,364	-$9,364			
5	1	$10,000	$9,091			
6	2	$1,000	$826			
7						
8	Disc. Rate	10%				
9	NPV	$553.36	=SUM(C4:C6)			
10	IRR	16%	=IRR(B4:B6)			
11						

Figure 17: Excel has a built-in IRR function to help find it quickly and easily.

So internal rate of return is very similar to NPV, but it scales that NPV into a percent. It's a more intuitive measure because it gives us a sense of what kind of rate of return the project is yielding. And it accounts for the timing, the opportunity cost, and the risk of the project in a very similar way to what NPV does. So IRR is one of our good capital budgeting tools. We should always compute it alongside of our NPV.

2.6 Wrinkles with IRR

In the last section, we introduced internal rate of return as one of our capital budgeting tools for how to spend money within the firm. We liked it – it has most of the same benefits of net present value, which is our gold standard capital budgeting tool, but there are a some complications in practice that we have to watch out for:

1. Loan-type flows (cash influx now and paid back later) where the +/- sign of the cash flow changes
2. Scale problems (we got rid of the absolute scale of how good a project is by shrinking NPV into a percentage)
3. No IRR or Multiple IRRs for some projects (no mathematical solution to some problems)

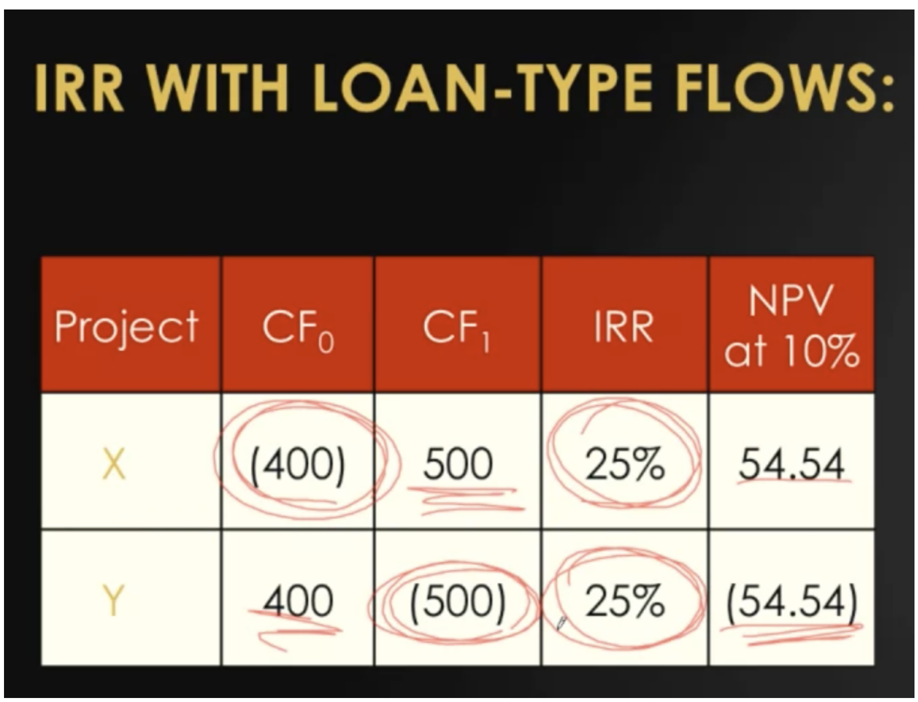


Figure 18: We have to be careful with loan-type cash flows where the cash flow +/- sign between periods is different. Here, the IRR is the same while only one project has a positive NPV.

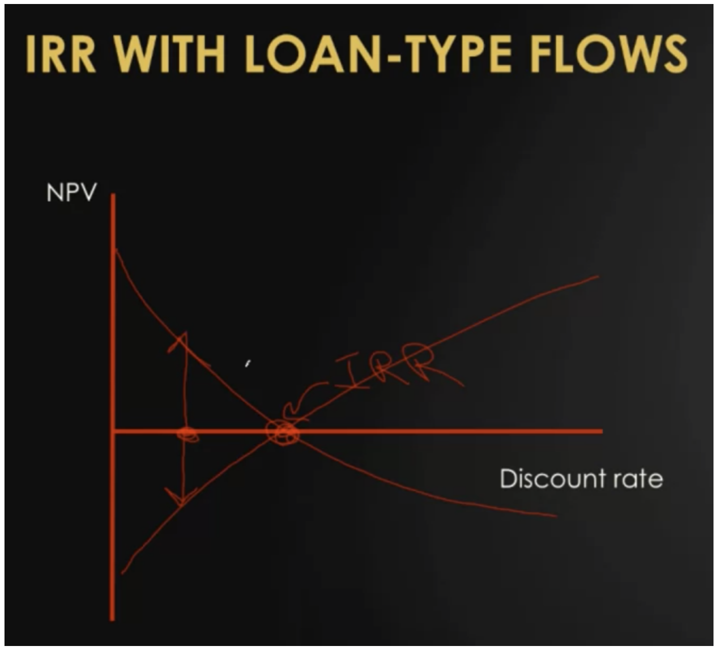
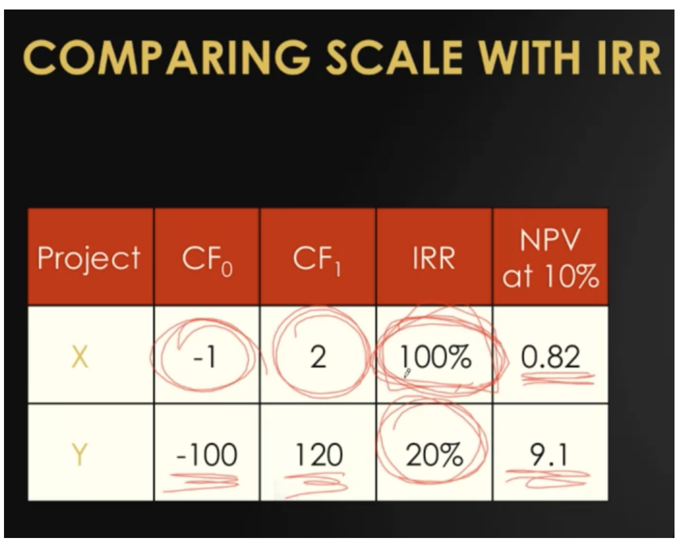


Figure 19: Graphical representation of how IRRs same while the NPVs can be + or -.



Project	CF_0	CF_1	IRR	NPV at 10%
X	-1	2	100%	0.82
Y	-100	120	20%	9.1

Figure 20: IRR scaling issue: Project X is generating a 100% return on investment (what IRR is telling us) while Project Y is generating only a 20% return on investment; however, it has a higher NPV because it is providing more absolute value to the firm.

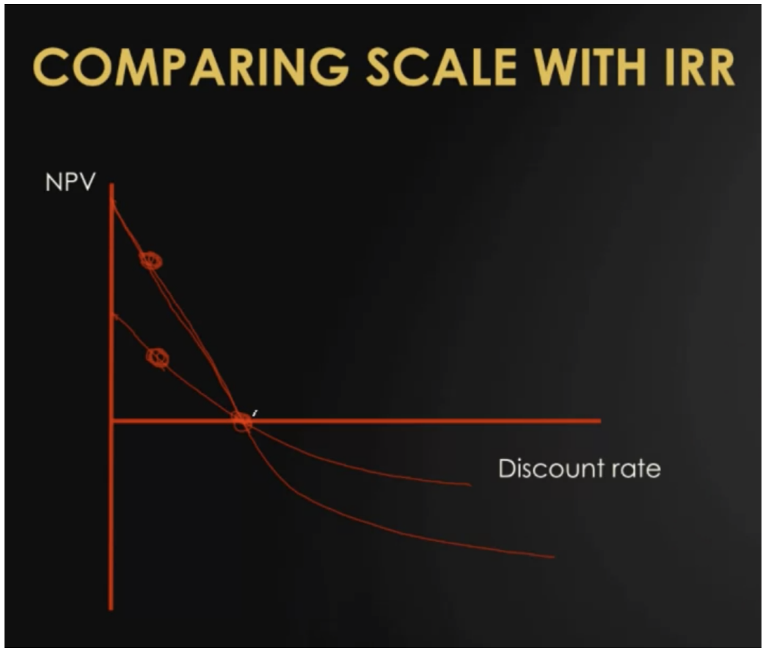


Figure 21: Graphical representation of how IRRs can be the same while one NPV > another NPV.

Project	CF_0	CF_1	CF_3	IRR
X	-100	235	136.5	[5%, 30%]
Y	-100	120	-50	--

Figure 22: Different rates might set NPV = 0, and there could be no rate that sets the NPV = 0.

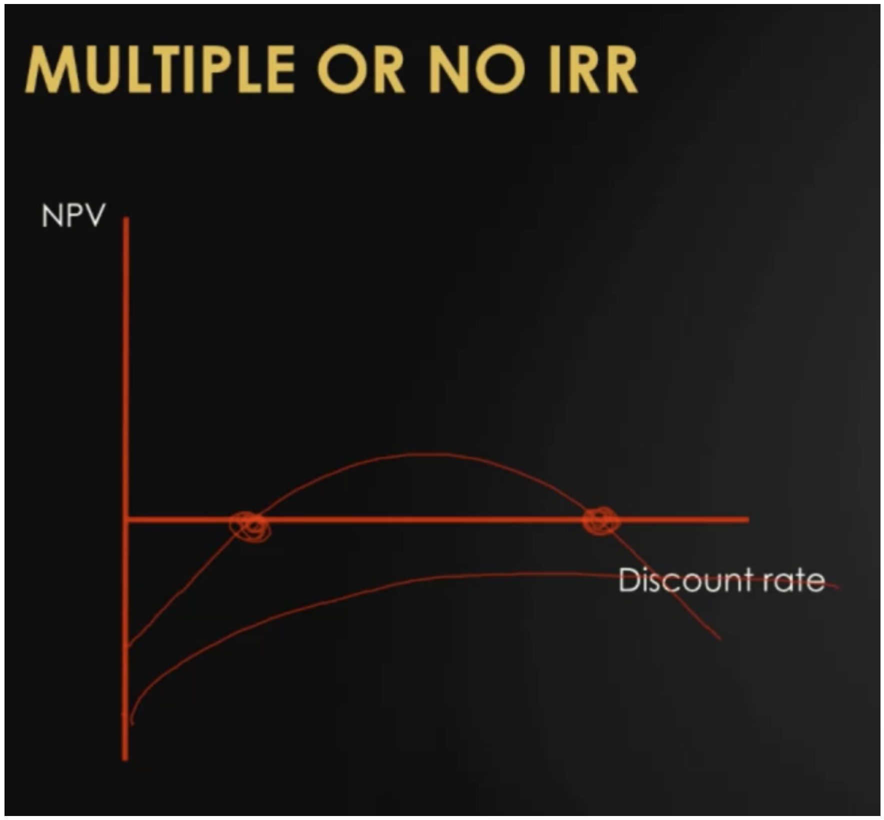


Figure 23: The IRR is just a solution to a math equation. It could well be that the project looks something like the NPV gets bigger for a while, then starts to go down. This project would have two IRRs like we had in the last example. It could also be that the project is such a total loser that it never gets up to a positive NPV. That would have no IRR because it never crosses the x-axis. Again, how do we solve the problem? It's easy. Just put that IRR next to an NPV and you can always check whether or not the IRR is giving you the right capital budgeting decision.

OK, so IRR is a good capital budgeting tool. But we need to be careful. If there are changes in sign (cash flow timing issues), scaling problems, or whether or not there's an answer or solution, always check next to a net present value. As long as you put that IRR next to an NPV, it's a perfectly legitimate – in fact, it's a nice way to get a scaled-down or smushed-down version of what the return on the project is relative to the discount rate.

2.7 Using All the Metrics Together

Most CFOs rely on multiple metrics. There are costs and benefits to doing things like payback, IRR, net present value, and accounting ratios. And what's important to realize is that each one of those data points represents some interesting piece of information. What's good about doing lots of different capital budgeting tools is that it rounds out the portfolio of tools that we can bring in to help make good financial decisions.

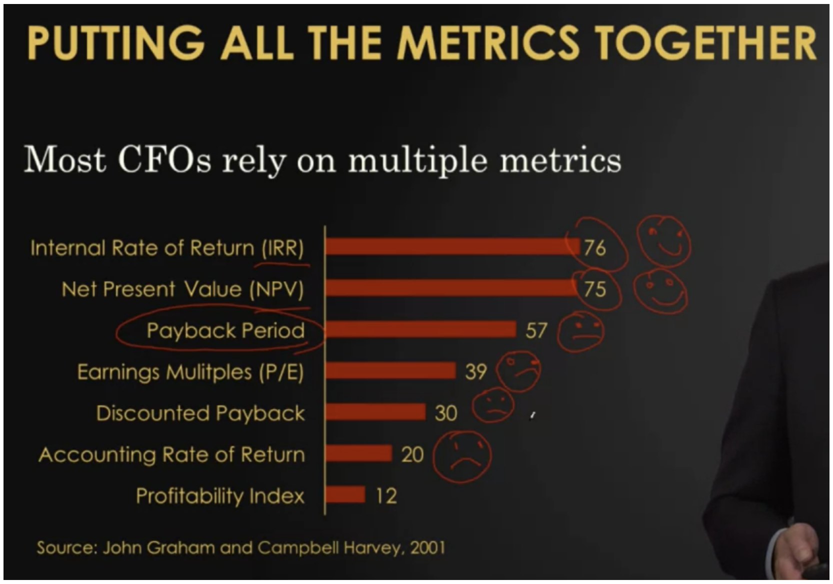


Figure 24: John Graham and Camp Harvey of Duke University run a survey where they asked CFOs what capital budgeting metrics they used in practice. The list generally jives with what we consider to be gold standards of metrics. Interestingly, NPV and IRR predominate in larger companies, while payback tends to predominate in smaller companies.

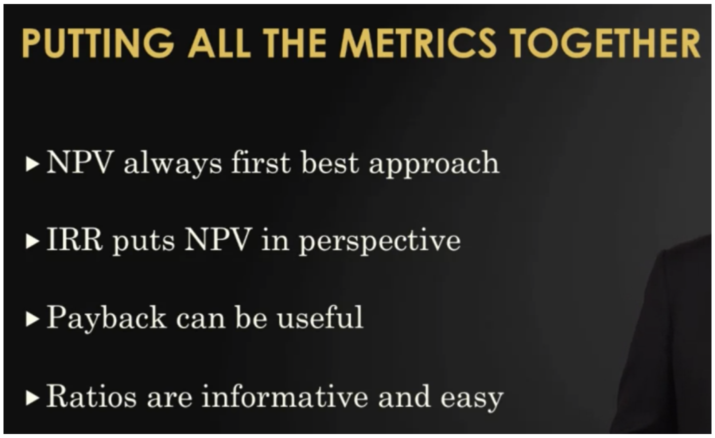
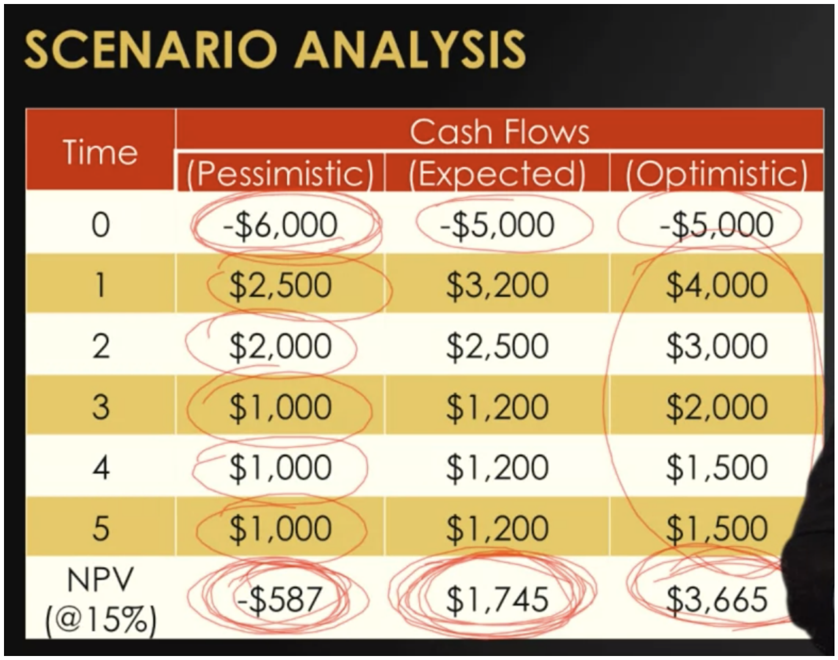


Figure 25: NPV should always be the first approach. IRR helps put NPV in perspective by shrinking it into a percentage return. NPV and IRR should always be used in the capital budgeting process. Payback can be useful, especially if two NPVs are close and one has a much better payback. There's nothing wrong with using payback to help round out that capital budgeting decision. Accounting ratios is can be informative, especially for internal mechanisms of control, but I would be cautious of using the accounting ratios that don't necessarily reflect timing, risk, and cash creation.

2.8 Sensitivity Analysis

Everything depends on forecasts, but all forecasts are wrong! When the weatherman says it's going to rain with a 20% probability, he's wrong, because it never rains with a 20% probability. It either rains or it doesn't rain. So once you get the realization of that uncertainty, you go back and say, well, the forecast was wrong. All forecasts are wrong conceptually. And that's just a concept that you need to be comfortable with. What's important in terms of making decisions under uncertainty is that we not say, well, because we can't forecast things perfectly, we should just forget it, and just kind of go with your gut and wing it. That's the wrong thing to do. Even though we live in an uncertain world where we never really know what's going to happen, and all forecasts are essentially wrong from their conception, that doesn't mean we shouldn't try to make the best forecast possible. And that's what these capital budgeting tools are helping to do, using arm's length, objective, and transparent metrics for making capital budgeting decisions. The fact that we never really know what the answer is going to be shouldn't prevent us from trying to make the best answer that we can.

So what we're going to talk about now is that we had to make a set of assumptions at the onset. What do we think the 1st year, 2nd year, and 3rd year sales are going to be? What do we think, when we finish the project, the closing cost is going to come in at? How much is the project going to cost to do? We have some sense of it. We have some forecasts for it. But we're probably going to be a little bit off, plus or minus. And what we want to think about now is, well, how sensitive is our decision to a lot of those assumptions? And we can do that really easily within the framework of the capital budgeting tools that we've already talked about. And we'll think about what are the main value drivers, and if we tweak those, if we wiggle them around a little bit, how much does that change the answer? And that sensitivity analysis, or scenario analysis, will give us an idea of how comfortable we are with the forecasts that we've made for the project.



SCENARIO ANALYSIS

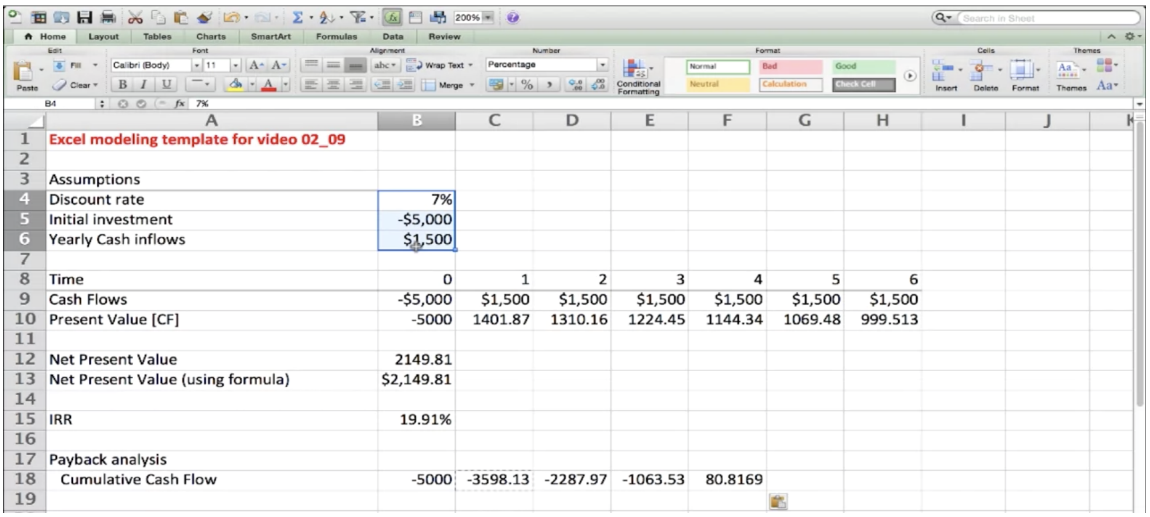
Time	Cash Flows (Pessimistic)	Cash Flows (Expected)	Cash Flows (Optimistic)
0	-$6,000	-$5,000	-$5,000
1	$2,500	$3,200	$4,000
2	$2,000	$2,500	$3,000
3	$1,000	$1,200	$2,000
4	$1,000	$1,200	$1,500
5	$1,000	$1,200	$1,500
NPV (@15%)	-$587	$1,745	$3,665

Figure 26: OK, so what have we done? We've pulled, and we've twisted, and we've played with those assumptions a little bit, and said OK, now we're getting a better sense of how viable and sensitive the project is. Instead of just looking at that $1,745 and making the decision based only on that number, we're kind of wiggling those numbers around a little bit and saying, OK, what would be a good case scenario? What would be a bad case scenario? And now, hopefully the worst case scenario is that we lose $587. Now we can think about, well, is it worth it to gamble the $5,000 in order to maybe make even more money? I mean, $587 is not as negative as $3,665 is positive. And we can start thinking about making those kinds of trade-offs now that we've fleshed out the project a little bit more. Sort of articulated the uncertainty by mapping out a couple of different things that could happen and weighing those off against each other.

So with sensitivity analysis, we could expand to lots of different scenarios. We could do five different scenarios and calculate those sensitivities. How sensitive is the NPV to the discount rate, to the first-year cash flows, to the initial cost? Spreadsheets make a lot of this easy because all we have to do is change the input on one of the assumptions, and the rest of the assumptions kind of flow through to the NPV. Forecasting, you might be getting the sense now, is more of an art than a science. All of this really, finance and economics, is a social science. There's never 100% right answer. We're never really going to know, except ex-post, whether we should or shouldn't have done the project. But that shouldn't stop us from trying to make the best forecasts possible and making arm's length, transparent, and objective capital budgeting decisions. We have to understand the limitations of the things that we're calculating in order to feel comfortable making good financial decisions.

2.9 Spreadsheet Modeling

Spreadsheet modeling is a really powerful tool for the financial analyst to use for computing a lot of the capital budgeting topics that we've been talking about in Section 2. Spreadsheets are powerful because once we build a big spreadsheet model, we have it forever. We can then take that spreadsheet model and use it in lots of different applications just by tweaking and pulling and adding rows and cells to adapt that spreadsheet model to whatever our specific problem is. Most spreadsheets have built-in spreadsheet functions for finance calculations like NPV, IRR, discounting, and compounding, making doing the financial analysis that we're talking about much easier in practice.



	A	B	C	D	E	F	G	H
1	Excel modeling template for video 02_09							
2								
3	Assumptions							
4	Discount rate	7%						
5	Initial investment	-$5,000						
6	Yearly Cash inflows	$1,500						
7								
8	Time	0	1	2	3	4	5	6
9	Cash Flows	-$5,000	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500
10	Present Value [CF]	-5000	1401.87	1310.16	1224.45	1144.34	1069.48	999.513
11								
12	Net Present Value	2149.81						
13	Net Present Value (using formula)	$2,149.81						
14								
15	IRR	19.91%						
16								
17	Payback analysis							
18	Cumulative Cash Flow	-5000	-3598.13	-2287.97	-1063.53	80.8169		
19								

Figure 27: Spreadsheets have an organizational structure to them, and there's a set of best practices that we can use as a financial analyst for making sure that the spreadsheet is robust and the model is tight and well-organized. So let's first talk about spreadsheet organization. You can see that we have a title up top, and what we have listed first are the assumptions that are going to go into the model. Those include our discount rate, 7%, and we're going have an initial investment of $5,000. And that's going to generate yearly cash flows in the future for first six years of $1,500. Now, we have all of our assumptions listed up here in one place. And that's always good spreadsheet hygiene, or best practices. If we go and send this to a colleague or coworker, or if the project gets morphed and somebody is looking at this spreadsheet five years later, having assumptions hidden in strange places throughout the spreadsheet is going to cause everybody headaches and confusion. If we assume anything else, maybe some inflation or some other costs, that all has to go up here under the assumptions. That's the best thing to do. Everything's in one place. That also means that we know what to change. If we want to change any of the assumptions, we're going to do that all up here in one place.

Looking at the net present value, the IRR, and the payback, this looks like a good project. The project has about a 19.1% IRR, the NPV is bigger than 0, and it has a reasonable payback of around four years. I would say the project is a go, an accept project. And what we can see now is that having built in all of these tools and assumptions into the spreadsheet, we have a nice, flexible, adaptable, well-organized model for doing all of our capital budgeting analysis. So from here, we've now figured out approximately how the layout of a typical spreadsheet model goes, with the assumptions up top, the cooking down below, and a clearly articulated answer that depends on the assumptions.

2.10 Conversations with a Practitioner

As a financial analyst, you're going out and you're talking to the operations, and marketing, and strategy, because it's an important thing to remember that the positive NPV projects usually don't come from the finance people. So where do those projects come from? They're typically generated from the people and other departments who are on the front line, who understand the competition, the challenges facing the company over the next few years, the threats, the customers, and the product line. All those other areas of the business where people are actually selling things. The finance group then gets those numbers and makes those budgeting decisions.

Do people ever take what we think are negative NPV projects? Certainly, that's a real possibility. Maybe they're simply overestimating the expected cash flows, but there's also another scenario where it's common to see a negative NPV project: government regulations, where you're either regulated, or environmentally-driven, into doing a project whether it's a negative NPV or not. Maybe an environmental cleanup to do, for instance. So it's still important even when you're regulated into doing the project, and it's still consistent with best practices, to do an NPV and IRR to make sure that even though you have to lose money on this project, you're losing that money as gracefully as possible. In most cases, companies have investors, whether private or public, and banks give loans, and you have to present your cash flow expectations to them in an NPV to really justify the projects and pull in the capital budgeting piece.

3 Measuring Cash Creation and Flow

What we're going to talk about in this section is what to discount, and what we want to discount in all of our financial analysis is *cash*. Cash is king! We want to focus on cash because cash is what we actually spend as investors, and what we get back for investing our money is actual cash. That's the reason we're doing the investing. So we're going to go on a treasure hunt through the financial statements to try to find where all of the cash is.

We're going to begin with a review of the 3 financial statements. We'll talk about measuring cash creation, where to find it on the income statement, the balance sheet, and the cash flow statement. And we'll talk about free cash flow, or FCF, as a synthesis measure through the accounting statements – how to come up with a good, consistent, best practice for measuring cash creation through these financial statements. We'll also talk a little bit about taxes since they can impact cash flows directly, and then we'll talk about terminal values and salvage values, and how to sell off assets at the end of a project in order to generate cash. And then we'll come back around to taking that cash and doing discounted cash flow valuation, coming full circle to Section 1.

3.1 Brief Overview of the Financial Statements

In Section 3.1, we're going to give a very brief overview of the financial statements, which are really accounting statements, that we're gonna use as our treasure map for finding where the cash within a company is. We'll start off with a discussion of the balance sheet, then we'll move to the income statement (or the profit and loss statement), and we'll end with a discussion of the cash flow statement. These three financial statements are the three main statements that accountants use to communicate the financial condition of the company to investors or outsiders.

1. Balance Sheet. The balance sheet answers a very basic question: What does the firm own? Assets of the firm are listed on the balance sheet along with where those assets came from, and similarly, the liabilities and the equity of the firm are listed along with the investors of the firm that purchased those assets.

2. Income Statement (Profit & Loss Statement). The second statement, the income statement, answers another very basic question: How is it going, with the assets that you have? That income statement details whether the firm is making money or losing money by using the assets that it has on the balance sheet.

3. Cash Flow Statement. Sometimes, because of the way accountants record things with the accrual method of accounting, it's hard to track cash between the balance sheet and the income statement. It's not always a direct comparison, and so the cash flow statement, the third financial statement, reconciles those two. It helps us track each dollar bill and how it moves between the financial statements of the balance sheet and the income statement.

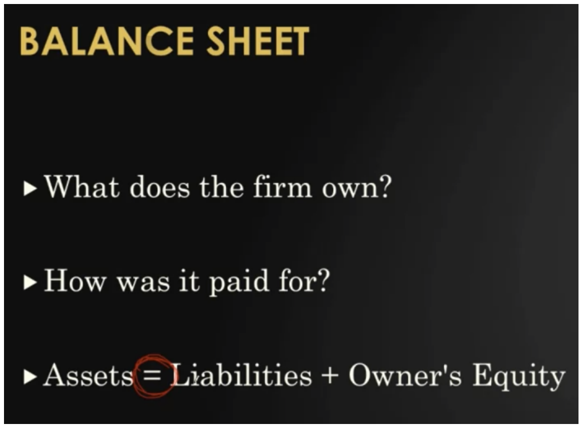


Figure 28: Let's start off our discussion with the balance sheet, the first financial statement. What does the firm own? How was it paid for? And that has to tie together with the equal sign in the middle. That's really the nature of the balance sheet is that equal sign in the middle. That equal sign says that the balance sheet has to balance. The assets have to be equal to where those assets came from. The left-hand side of the balance sheet lists everything that the firm has; the right-hand side of the balance sheet lists where everything came from. Everything was purchased by the firm by either equity holders or we used banks' money or bondholders' money, i.e. liabilities. So everything that the firm has, the assets, are owed to someone. They're either owed to bondholders or banks in liabilities or they're owed to the owners of the firm, the equity holders in the firm.

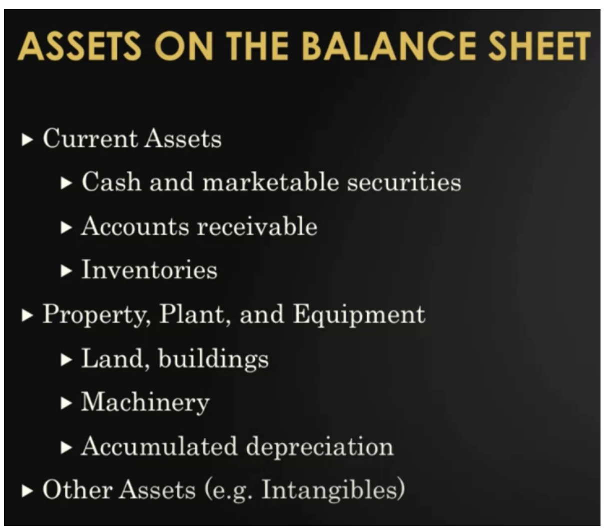


Figure 29: Here are the Balance Sheet assets. Accounts receivable is money that is due to us, even if we don't have it right now. Other assets (e.g. intangibles) could be things like the brand of the company, which can be hard to define accurately.

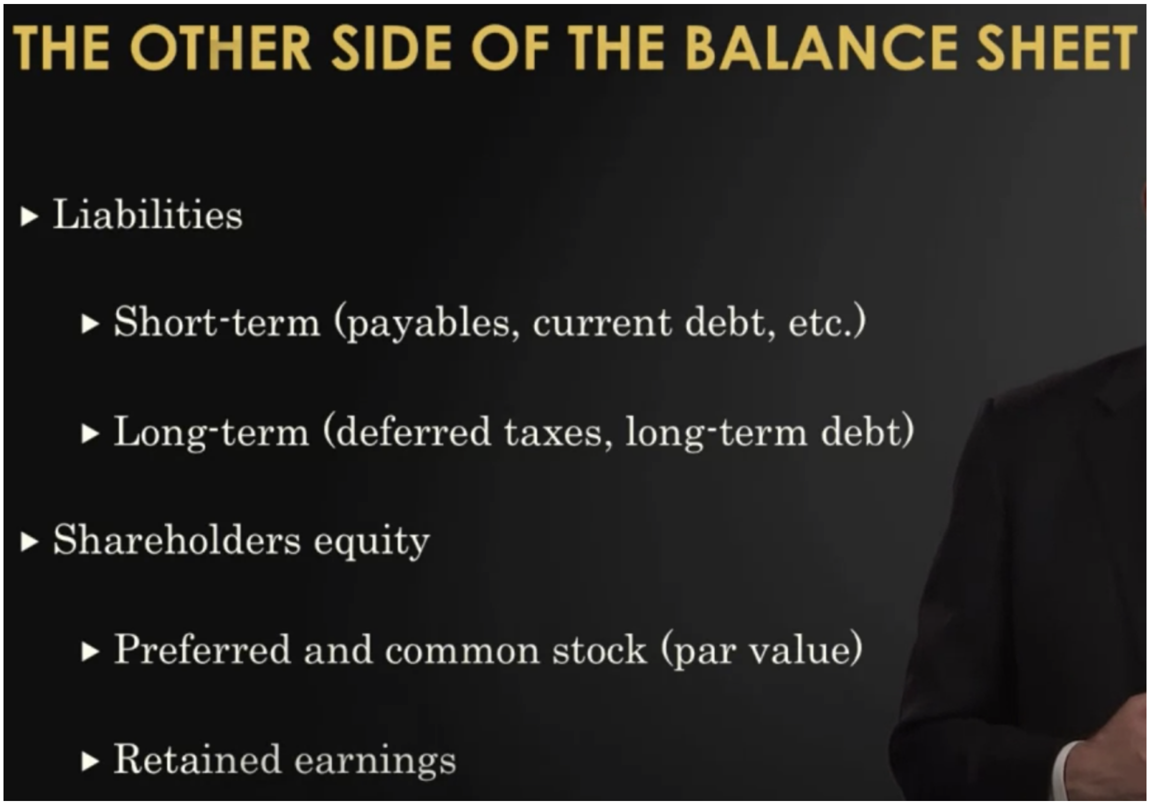


Figure 30: Here's the other side of the balance sheet. Retained earnings is money that the firm has earned but hasn't paid out to anybody yet – it's been retained inside the firm.

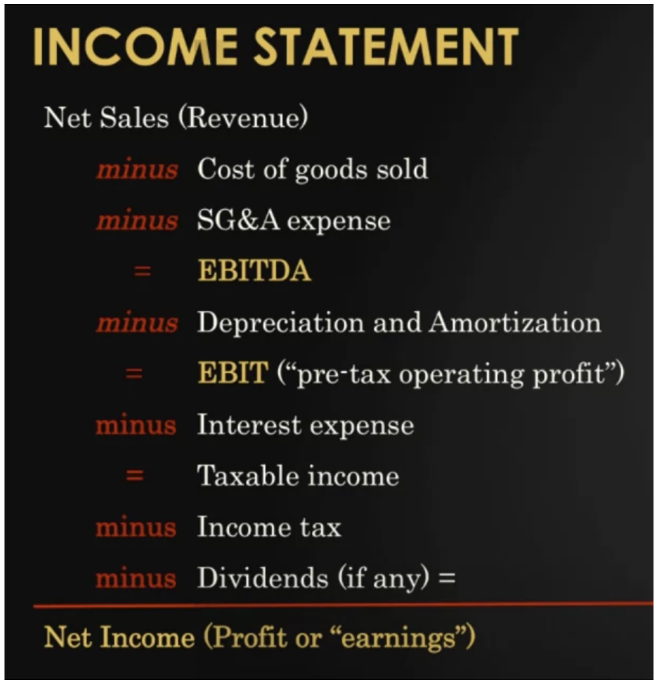


Figure 31: At the very top line, the Income Statement is going to track whether the firm is making money or losing money with the assets that they have. The top line of the income statement is net revenues, net sales. How much did you sell? Price times quantity, minus how much it cost us to generate those sales (cost of goods sold) minus what we call selling & administrative expense – how much did we spend, say, on advertising or administrative costs? That gives us EBITDA, what accountants call earnings before interest, taxes, depreciation and amortization. EBITDA is our basic measure of profit. It's how much money we've made after we get rid of the cost of producing those sales. If we take out depreciation and amortization, or how much my assets have deteriorated in value, that gives us EBIT, which we sometimes call pre-tax operating profit, earnings before interest and taxes. Take out interest expense, that gives us taxable income. Take out income tax or any dividends if we're paying any dividends to my shareholders, and that gives us net income or profit or earnings in the simplest accounting sense, the bottom line. So the income statement moves us from the top line, net revenues, to the bottom line, net income or how much profit did we make, earnings.

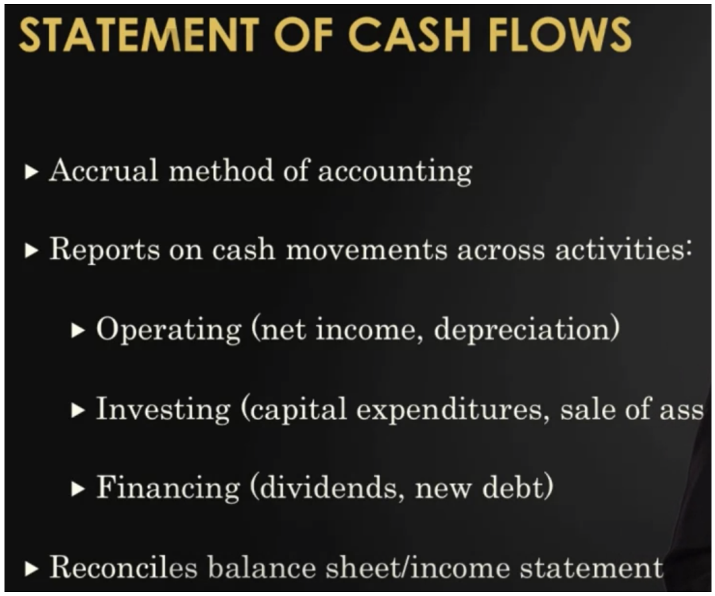


Figure 32: OK, the statement of cash flows, our third main financial statement that accountants produce for us, deals with the accrual method of accounting, which is that we book sales before we actually get the cash. And so the statement of cash flows helps us reconcile the fact that the income statement doesn't track actual dollar bills, but generates accrual revenues. So the statement of cash flows is going to report on cash movements across operating expenses. It's going to tell us how much net income and depreciation there was. It'll inform investing activities – it's going to tell us how much we spent on new property, plant, and equipment or on capital expenditures. It's also going to detail any assets that we sold that might have generated cash. And it's going to detail for us the cash effects of financing. Maybe we paid out dividends, that's cash out. Maybe we issued new debt or new equity, that's cash back in. The statement of cash flows is going to help us detail and track all of the cash that's coming in or out of the business through either operating, investing, or financing activities. That'll in turn reconcile cash movements between the balance sheet and the income statement.

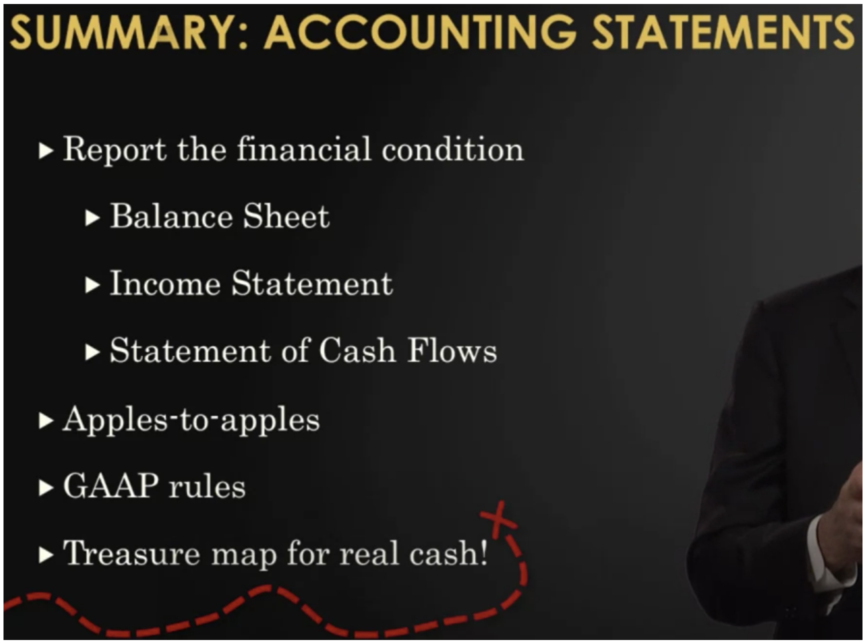


Figure 33: OK, to sum up, the three accounting statements give us a report on the financial condition of the company with a nice apples-to-apples comparison between any two companies. The fact that accountants produce these three financial statements makes it very easy to look at any company's audited financial statements and get a nice, clear, cogent, distilled report on the financial condition of the company. It follows generally accepted accounting principles. However, the thing is that these three financial statements really don't tell us exactly what cash was created through each of the quarters or each of the years. What we need to do, in finance, is use those three financial statements like a treasure map and hunt for cash creation through each of the three financial statements. The purpose of the accounting statements is to conform with accounting rules. It's not that accountants are trying to hide anything or not be transparent – they're following the accepted accounting principles – but the accepted accounting principles give a report on the financial condition of the company that might not exactly tie up to cash creation. Our job is to uncover where all the cash is. And what we're going to do in this section is focus on each one of those places where cash might be hidden and seek through each of those financial statements to try to uncover where all the cash is. And at the end, we'll come up with our measure of free cash flow.

3.2 Hunting for Cash Creation

In Section 3.3, we're going to talk about hunting through the financial statements for cash creation, and we're going to come up with our measure of free cash flow.

- Earnings =/= Cash. Let's start off with the fact that earnings – accounting earnings or net income – is not cash. Those can be two separate things. A firm might have really high earnings, but not have any cash. And we're going to think about why that might be or what could possibly be going on, where a firm could be profitable, but not have any cash.

- Accruals =/= Cash. One of the reasons is that accruals – what accountants call when they book sales – are sometimes booked before the cash actually comes in. So that might be one reason why there's some slippage between accounting earnings and actual cash.
- Book Value =/= Market Value. Accounting is more of a historical record of what's happened, and so a lot of times accountants will write down things at their book value, or what they paid for something maybe 20 years ago, that might not be related to what it's worth in the market today. That difference, or that slippage between book value and the market value of an asset, could also create a difference between earnings and cash.
- Accounting Cost =/= Economic Cost. We might have a machine that we take a depreciation expense on; in other words, we write down the fact that the machine has devalued. But it's actually the same machine. It hasn't gone down in value. It hasn't deteriorated. It hasn't fallen apart. But we take the depreciation expense anyway for tax purposes. Well, that also will create a slippage between actual cash going out of the firm, and real economic cash– whether actual dollar bills are being created or lost.

So we can't spend earnings. It's not actual cash. I can't pay it out as a dividend. Why is that?

- Non-Cash Expenses. There are some non-cash expenses that we write down. That's a funny thing, right? Non-cash expense. Sometimes for accounting purposes – for good reasons, from an accounting perspective – we'll write down an expense against revenues, but there's no actual cash leaving the business because of that expense. So we'll detail where that happens and try to unroll it and get back to our measure of cash.

- Extraordinary Items. Sometimes accountants write down extraordinary items. They'll say, we made a lot of money this quarter, except that we don't have any money, because we wrote down an extraordinary cost that was a one-time only cost, and so we don't have to book it as an expense, we're just going to subtract it off at the end after we've reported earnings. That's a funny thing, and we'll have to try to undo that as well.

- Balance Sheet Changes. There are also changes in the balance sheet affecting how much stuff we have – assets that we've bought or sold that don't get written down on the income statement. Therefore, they don't get recorded at bottom-line net income or earnings, but there's actually a huge cash outflow because of money we spent, or cash inflow because of stuff but we sold. We'll have to go back and sweep that up as well.

The idea here is that we're going to walk through each of the items in the income statement, balance sheet, and statement of cash flows, in order to find cash – actual dollar bills – that we can get our hands on to give to investors. Why? Because in the end, from an investor's perspective, *the only thing that matters is actual cash in-hand.* And because not all cash is paid out, we need a measure of cash creation that's consistent with the financial statement recordings and can be used across different firms at different times. So what's the solution? *Free cash flow.* Free cash flow is going to tell us how much money we could completely scrape out of the business that we could, we may not want to, but we could if we wanted to pay out to investors. It may be that we take all that free cash flow and pump it right back into the business to buy more assets, but free cash flow (called FCF) is going to give us our measure of how much cash creation is really going on through those financial statements.

So what is Free Cash Flow (FCF)?

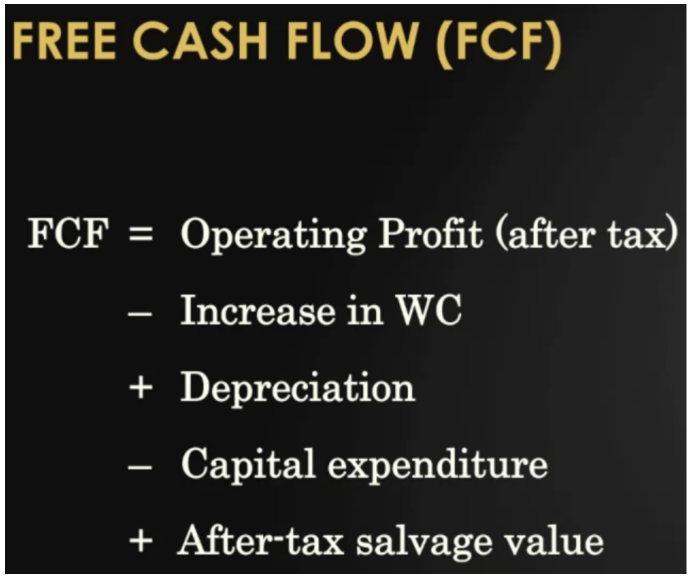


Figure 34: Free Cash Flow Equation. *Free cash flow is cash creation.* Operating profit (after taxes) is a good place to start. Did you make money or lose money? Operating profit comes from the income statement. Next, we subtract increases in working capital (WC), which is a real cash drain on the firm. Depreciation is money that never left us, so we add that back. Capital expenditure is money that we spent on new assets but that doesn't get recorded up in operating profits. After-tax salvage value is money for stuff that we sold at the end of a project but similarly doesn't get recorded up in operating profit.

To sum up, all those capital budgeting metrics that we talked about: NPV, IRR – those are all based on real cash. Free cash flow is what's going to drive valuation within the firm. *Cash creation*, not earnings, is what's going to drive valuation. And *Free cash flow is cash creation.* So measuring free cash flow is paramount, and that's what we're going to spend the rest of this section doing, going through each of those adjustments in the formula for computing free cash flow.

3.3 Working Capital Adjustments

What is working capital?

- WC = Current Assets - Current Liabilities. Current assets and current liabilities are short-term: due in less than one year.
- Measure of operating liquidity: it says how much money the firm has in its wallet.
  - Represents an opportunity cost: it's money that we have tied up in either payables or receivables or inventory that is already spoken for.
- Not stated as an expense on the income statement (it's a balance sheet change!), but it is a real cash flow or drain on the firm, so we have to take it into account.

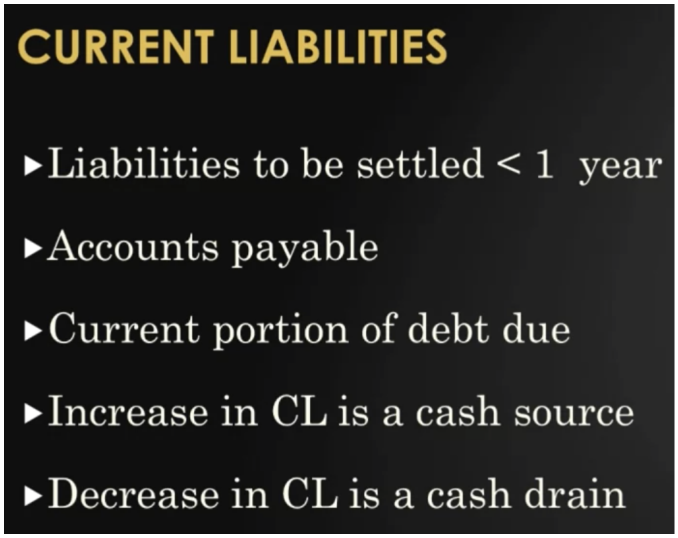


Figure 35: Let's talk first about current liabilities. That's stuff that we owe to other people that's due in less than a year. An example might be accounts payable: pur suppliers come in and deliver a good or service, but we haven't paid them for it yet, which is nice. That's money sort of coming in because we snagged the good or service, but we haven't paid them off for it yet. It's a payable. It's a liability. It's kind of like trade credit: free money now, but we have to pay it off later. Also, the current portion of debt that is due within a year is another current liability. What does this mean? It means that any increase in current liabilities is a source of cash. Think about the trade credit example. We have the good or service, but we haven't actually delivered the cash that it represents yet. That's like a source of financing. So any increase or raise in current liabilities is money, is actual cash, coming into the firm. Similarly, any decrease in current liabilities is a cash drain. As we have to pay off those suppliers, the cash leaves the firm. Current liabilities goes down. That means cash leaving the firm. Again, these are balance sheet changes, and so they aren't reflected in net incomes or earnings.

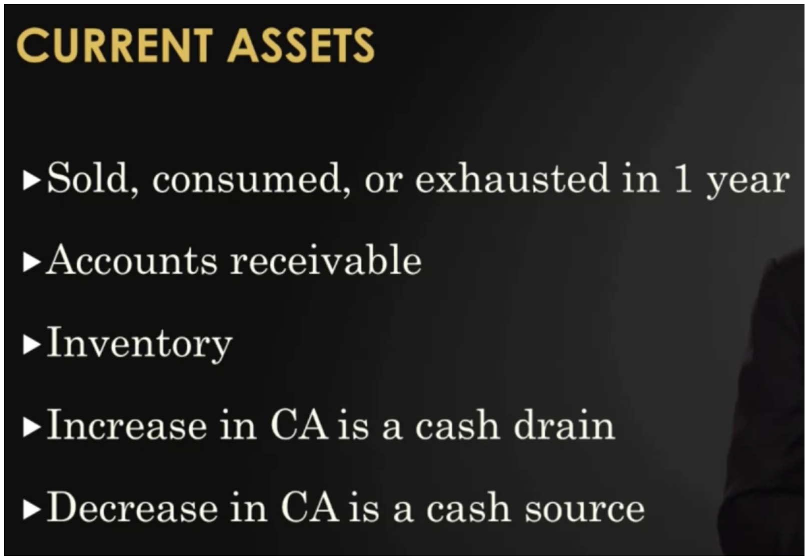
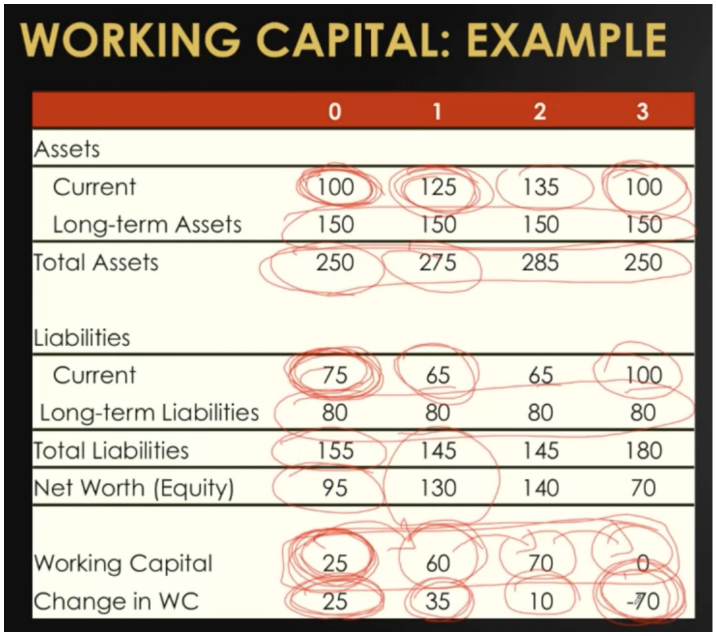


Figure 36: On the flip side is current assets. That's stuff, assets, that we've sold, consumed, or exhausted in less than a year – short term assets. Accounts receivable is a good example. That's money that we've given to somebody for a good or a service, like our customers, but we haven't received the money yet. The real value, the economic product, is moved out of the firm. That's a cash moving out of the firm. Another one is inventory. If we put money into buying inventory for warehouse, it's just sitting there. We've spent the money to buy the inventory, but as it sits in the warehouse collecting dust, it's a cash outflow. We haven't reflected it in sales yet because we haven't sold it, which means it's a balance sheet change that isn't reflected in net income or earnings. We have to go back and collect the cash. And that's what we're going to do. So here, any increase in current assets is a cash drain on the firm, stuff that we've shipped out that we haven't collected the cash for yet. The more we ship out but don't collect, the more of a cash drain that is on the firm. Similarly, any decrease in current assets is a source of cash. As we collect from our customers, that brings cash in. Current assets goes down. Cash comes in.



WORKING CAPITAL: EXAMPLE

	0	1	2	3
Assets				
Current	100	125	135	100
Long-term Assets	150	150	150	150
Total Assets	250	275	285	250
Liabilities				
Current	75	65	65	100
Long-term Liabilities	80	80	80	80
Total Liabilities	155	145	145	180
Net Worth (Equity)	95	130	140	70
Working Capital	25	60	70	0
Change in WC	25	35	10	-70

Figure 37: OK. Let's walk through a really simple example. Here are a series of balance sheets laid out, where we have current assets listed here for three years – 100, 125, 135, 100; and we also have long term assets, which are just 150 the whole way through. Add those two together, and that gives us total assets of 250, 275, 285, and 250 for our three years. OK, on the other side of the balance sheet, we have liabilities – 75, 65, 65, and 100 of current liabilities, and then long term liabilities of 80 kind of the whole way through. Add those together for total liabilities. Why? *Because the balance sheet has to balance.* So assets have to equal liabilities once we add in equity. So the 250 has to equal 155 plus 95 for everything to add up. Now let's go through and compute working capital. In year 0, in our initial outlay, what's working capital going to be? Let's see. What are current assets? 100. What are current liabilities? 75. What's 100 minus 75? 25. OK, in the next year, current assets: 125. Subtract current liabilities, 65. What's working capital? 60. Repeat for our working capital account. *What creates the cash flow is the change in working capital* because again, money going into the wallet or coming out of the wallet – not how much money is in the wallet – is what comprises the flow. So to start up this project, what do we need? We need an initial inflow of working capital of 25 – that's the initial investment. Now what happens to working capital as we go from year zero to year one? Working capital changes from 25 to 60. What does that mean? That means an increase in working capital of 35. That's a cash outflow of 35. Then working capital changes from 60 to 70. That creates an increase in working capital of 10. Yep, so that's another cash outflow of 10. What happens from year two to year three? Working capital decreases from 70 to 0. Maybe we're settling all our accounts receivable and payables. Maybe we're selling off everything else in the inventory, in the warehouse. That creates a change in working capital of minus 70. The minus change in working capital at the end is the money coming back out of the wallet into the firm. So again, it's changes in working capital that create the cash flow.

- FCF = Operating Profit (after taxes). It's a good place to start. Did you make money or lose money? Operating profit after tax, our measure that came from the income statement.

  – Increase in Working Capital (WC). An increase in WC is a cash drain on the firm.

  + Depreciation, AKA cash that never left us.

  – Capital Expenditure, AKA money that we spent on new assets but doesn't get recorded up in operating profits.

  + After-tax salvage value, AKA money for things that we sold at the end of a project but that similarly doesn't get recorded up in operating profits.

Putting that back together with our free cash flow formula, we take operating profit, and then we subtract any increase in working capital. Remember, an increase in working capital is a cash outflow. A decrease in working capital is a cash inflow. So to compute free cash flows, we want to subtract any increase in working capital. That gets tricky because it's a double change. Let's walk through it again. When we're computing free cash flow, we want to subtract off any increase in working capital because an increase in working capital means a cash outflow from the firm. Good. As we go through the rest of this section, we'll talk about depreciation, capital expenditures, and salvage values, put those together for a measure of free cash flow.

OK, to wrap up – working capital represents an opportunity cost. Increases in working capital are a real cash drain that are reflected on the balance sheet, but aren't reflected in measures of net income or accounting earnings. That means we have to go back for our measure of free cash flow and mop up the differences in cash. Free cash flow needs to account for working capital changes.

3.4 Depreciation, Amortization, and Capital Expenditures

What are depreciation, amortization, and capital expenditures?

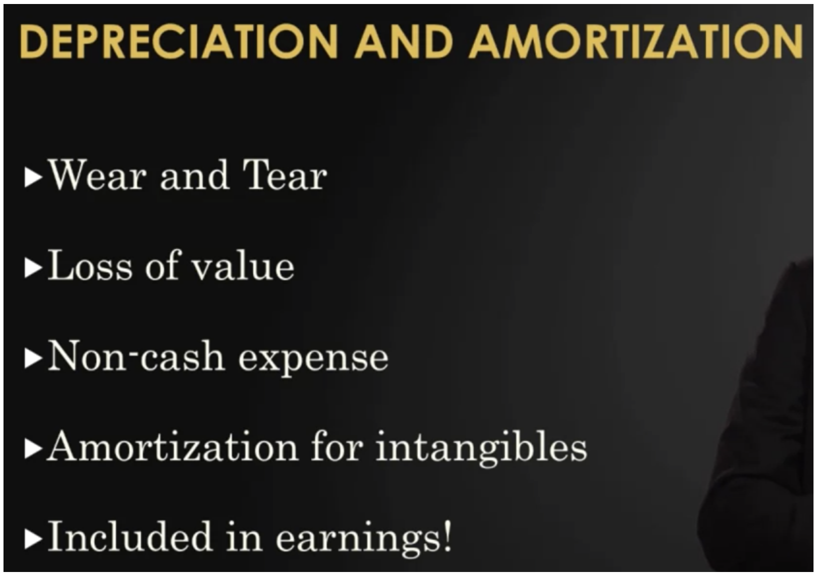


Figure 38: Depreciation and amortization is the real wear and tear that happens to our machinery, to our real, physical property, plant, and equipment as we use it. They lose value. As they lose value, we treat that as an expense because eventually we're going to have to replace it, and so we're going to write that down in the income statement to reflect that the assets have gone down in value. We're going to take it as an expense. But it's a non-cash expense because we haven't replaced it yet. In the income statement, we specifically term it a "depreciation expense", which means I'm writing it down as a reduction in my net income, or my profits, or my earnings, but it's not actual money that's left the firm. It's just an accounting term that reflects the economic depreciation. So you can see that it's going to create a wedge between accounting earnings and actual cash flow. Amortization is the same thing, but it's like an intangible, a brand value that might lose value or gain value over time. We're going to write that down as an expense too. OK. So these are included in earnings but what they aren't is real cash. And so we have to go back and undo them.

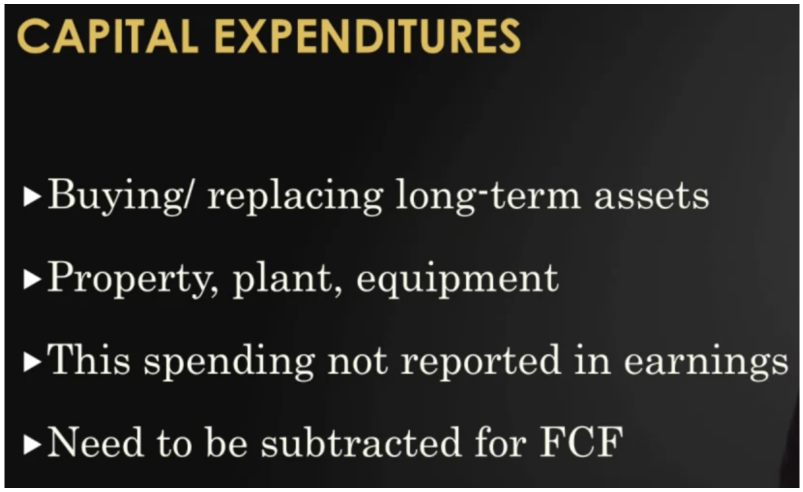


Figure 39: The flip side to depreciation is capital expenditures: money that we actually spent on new assets – AKA, buying or replacing long term assets. Any increase in net property, plant, and equipment is capital expenditures. Cap-Ex is spending – sometimes really big spending – but we don't report it in earnings because earnings, in the accounting sense, is *only* meant to be a reflection of the ongoing cost of generating the sales. Cap-Ex, as it's useful lifetime is spread over multiple years and multiple sales, therefore has its cost expensed over the entire lifetime of the purchase in order to reflect the cost of doing business for each individual sale. But it is real money, so it gets written down on the balance sheet. Since it's not on the income statement, we need to find it and add in the cost back into the income statement's operating profits.

So we're going to match the duration of the asset to the duration of the revenues, by spreading that expense over the useful life of the asset like spreading butter on toast. That's called the matching principle of accounting: stating the money spent on assets as those assets generate revenue over their life. It's a nice thing to do from an accounting perspective because it reflects the ongoing cost of doing business. But from a cash perspective, it's dead wrong because it's not telling us how much cash really left or came in. That's why we need to modify the net operating profit to reflect the cash that's not being expensed but has actually left the firm.

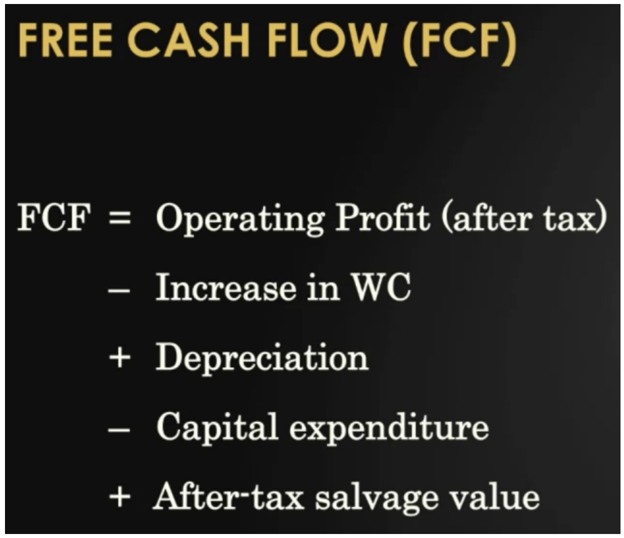


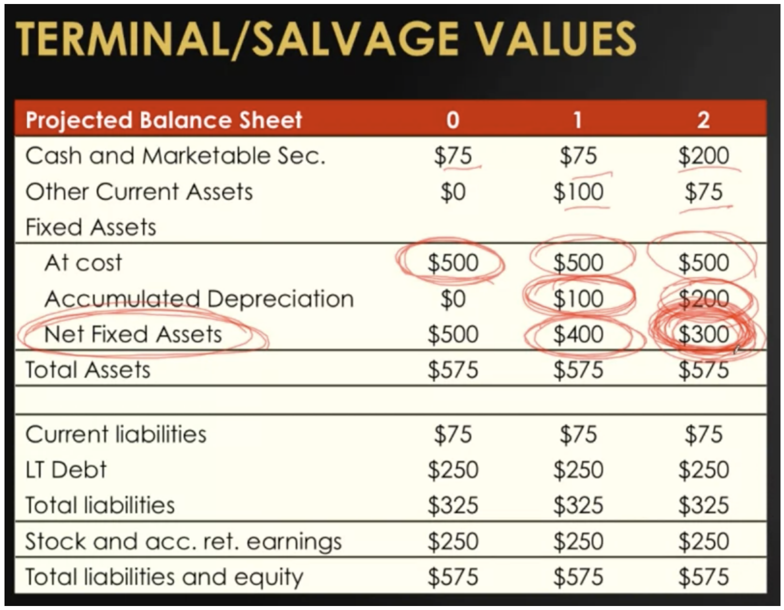
Figure 40: So let's go back and recall. We're going to take operating profit after tax, and we're going to subtract the increase in working capital. We're then going to add back depreciation because that's money that never really left us. We're then going to subtract off capital expenditures because that's money that actually did leave us. And finally, in Section 3.5, we'll talk about salvage values. All those things together are going to give us our measure of free cash flow, AKA the *real, actual cash creation* through the accounting statements.

To sum up, depreciation and amortization is a non-cash expense that's reflected in earnings but doesn't reflect the real cash movement. We're going to add it back for purposes of free cash flow. Capital expenditures are a real cash outflow that aren't reflected in profit or earnings. We're going to simply subtract that out to make sure the free cash flow accounts for Cap-Ex. So accounting for depreciation and cap-ex is relatively easy, but we've got to make sure that we actually do it when we're constructing our measures of free cash flow.

3.5 Salvage and Terminal Values

Salvage and terminal values – what happens when we sell assets on the balance sheet at the end of a project or at the end of the useful lifetime of the asset, respectively. Balance sheets account for real items: real, physical objects that don't just evaporate at the end of a project or at the end of their lifetimes. We have to make sure that our balance sheet "sweeps clean": that we've accounted for all of the assets when we finish a project. That means we have to sell off everything that's left on the books at the end of a project, and that we're accounting for the terminal (end) values of what's left.

So, everything left on the balance sheet has to be sold – everything has to go!


TERMINAL/SALVAGE VALUES

Projected Balance Sheet	0	1	2
Cash and Marketable Sec.	$75	$75	$200
Other Current Assets	$0	$100	$75
Fixed Assets			
At cost	$500	$500	$500
Accumulated Depreciation	$0	$100	$200
Net Fixed Assets	$500	$400	$300
Total Assets	$575	$575	$575
Current liabilities	$75	$75	$75
LT Debt	$250	$250	$250
Total liabilities	$325	$325	$325
Stock and acc. ret. earnings	$250	$250	$250
Total liabilities and equity	$575	$575	$575

Figure 41: OK, let's walk through a really simple example. We have a very simple balance sheet listed here. We have cash and marketable securities in each of three years – $75, $75, and $200, plus other current assets, and then we have fixed assets at cost. Now it looks like we spent, in year zero, $500 to buy an asset. That $500 that we spent is always kept "at cost" at $500 because that's how much actual cash that we spent. But what's going to happen to the value of that asset over time? According to this balance sheet, it's going to depreciate by $100 in each period, which accumulates over time. Now what does that leave us with? "Net fixed assets" – that's fixed assets at cost minus the accumulated depreciation. In other words, what's the economic value of that asset on the balance sheet once we've accounted for the fact that it's deteriorated a little bit? Well, in year one, that $500 has gone down by $100 to give net fixed assets of $400. In year two, the $500 has gone down by a total of $200, so we're left with net fixed assets of $300. *That's* the number to focus on, the last balance sheet value at the end of the project. In this case, it's at the end of year two. We have an asset, net fixed assets, that's worth $300 that we have to sweep clean. We have to do something with it. Maybe we're going to give it to another division. Maybe we're going to continue to use it in more years of the project. But we can't simply ignore it. We have to account for the terminal or salvage value at the end of the project.

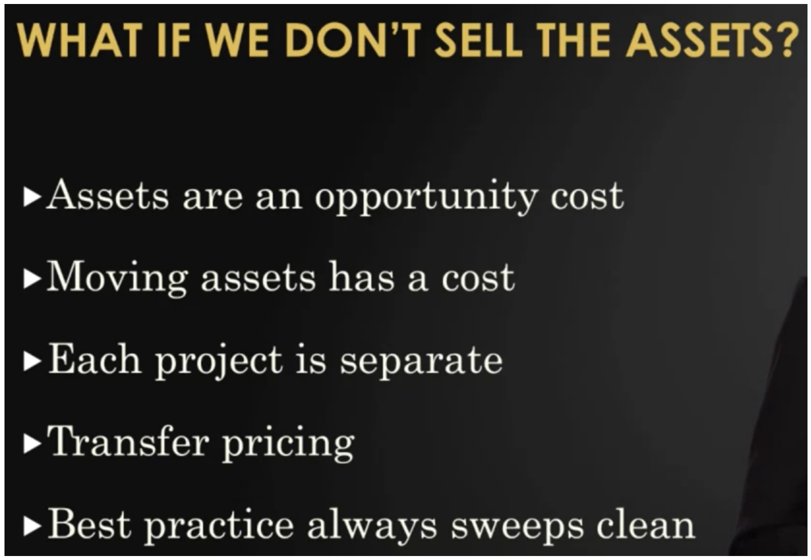


Figure 42: What if we have no plans to sell the asset? Doesn't matter. Assets are still an opportunity cost. Even if we were going to take that asset and burn it, we still have to account for the fact that that asset is a real asset, in the last example, worth $300, that we could pay out to investors. Maybe we're going to use that asset and we're going to deliver that machine to another division or another factory. That's fine. But we have to make that factory pay for it. In other words, that factory, when we move that asset over, is actually going to buy it from my project. Moving that asset has a cost, and each project has to be separate. That's really what we call transfer pricing – in accounting, it's a huge area of research and activity, moving assets within the firm. Each project really has to stand alone and justify the use of the asset.

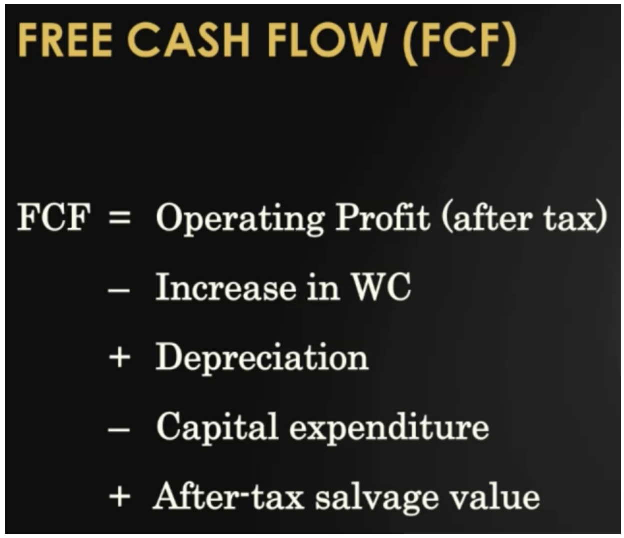


Figure 43: OK, getting back to our measure of free cash flows, we're pretty much done now. We take operating profit after tax, we subtract the increase in working capital, add back depreciation, subtract out capital expenditures, and now we'll add back any after-tax salvage and terminal values. That's it. That's our measure. That's our treasure hunt through all of the financial statements. We can get to a measure of real cash creation by doing these five things carefully.

To sum up, asset sales have to be included in our measure of free cash flow. Even if we're not going to sell the assets to outside vendors, we still have to include them in our free cash flow measure because they represent an opportunity cost and real cash potential. "The balance sheet always has the sweep clean" is another way of saying that we have to make sure that we're selling everything at the end of the project. Each project has to stand alone. Even if we're not selling them, if we're giving them to another project or moving them to another division, we have to let that division or that project justify the use of the asset with their own NPV and their own IRR. Our NPV and IRR have to reflect the fact that our balance sheet sweeps clean. If we're going to use an asset, we have to reflect both its up-front purchase and its sale at the end through its terminal or salvage value.

3.6 Taxes

Taxes are an important part of cash flows, but we didn't spend that much time talking about them in any of our previous sections, and so let's pause just for a minute and speak a little bit about taxes.

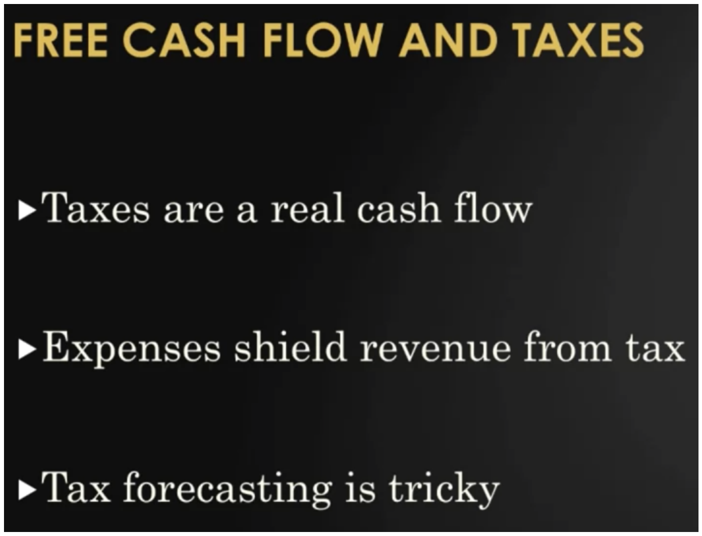


Figure 44: Taxes are a real cash flow. The money that goes out to the government, to the states, and to the municipalities represents real dollar bills, and so it's important to account for them. This concept here is key: expenses shield revenue from tax. If we think about it that way, at the very top of our income statement, we have revenue, and everything that gets listed after that is really a *tax shield*. If we had no expenses, we would just pay taxes on all of our revenue. Anything that we can subtract off of revenue before reporting a profit number lets us shield that money from taxes. For example, interest on debt or a bank note is expensable before taxes, meaning we can subtract interest expense from our revenue before we pay our taxes and therefore have less taxable income. When we come back around to the cost of capital lesson in Section 4, we'll talk about the importance of that from capital structure perspective and why it makes debt financing cheaper. Tax forecasting is really tricky, and in a full semester course on financial statements analysis, we would get into a lot more detail. More on the next page.

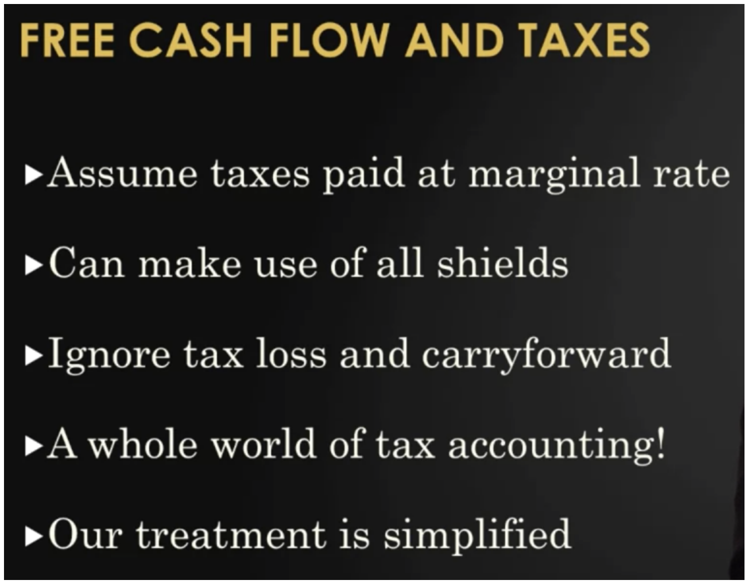


Figure 45: We're assuming taxes get paid at whatever the firm's marginal rate is. Now, if we were doing more complicated tax planning, lower levels of profit might be taxed at a lower marginal rate and higher levels of profit might be taxed at a higher marginal rate, but we're going to assume for all of our analysis that there is an average rate that the firm pays on all of its profits. We're also going to assume that the firm can make use of all of its tax shields. That's not always true, but we're going to assume for simplicity that it is. Additionally, sometimes firms that have losses in one division can offset or put off taxes and worry about them later in what we call tax loss or carry forwards. We're going to ignore all that for the purposes of this. We don't want to get too deep into tax law and tax codes, so we're going to give it a very shallow treatment, except to say that taxes represent real cash flows. They're important, and we've incorporated them in our measure of free cash flows, which is completely net of taxes. So all of the taxes that we pay are baked into our measure of net operating profit after tax, and all the tax effects of asset sales, or capital expenditures, we're assuming those measures are also net of tax. All of the tax accounting has already been incorporated into our measure of free cash flow, and our treatment on taxes here is a little bit simplified, and intentionally so.

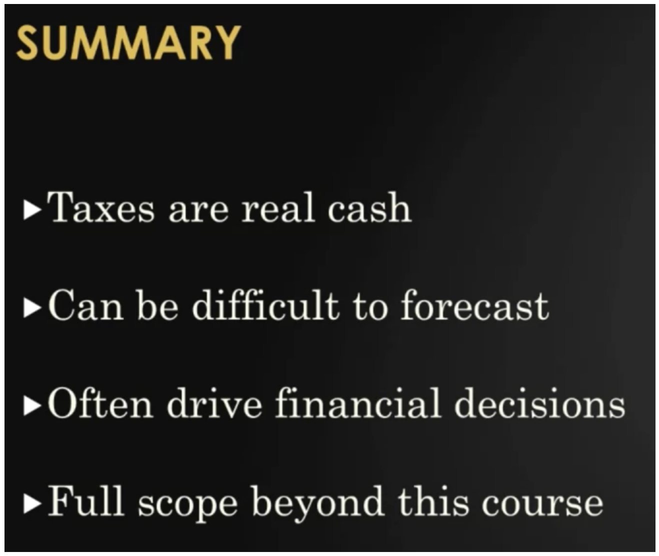


Figure 46: Taxes represent a real cash flow, and they can be difficult to forecast. There's a whole area of tax accounting and planning that we hire professional accountants to do for us. They often drive financial decisions, like the fact that interest expenses are tax deductible makes debt sometimes a more attractive financing vehicle. And the full scope of tax treatment is beyond this short course, but we needed to talk about what our assumptions were about taxes, and reassure ourselves that all of the tax net effects are already baked into our measure of free cash flow.

3.7 Calculating Free Cash Flow

So this one's going to be a doozy of an example. Stay strong.

Remember, our free cash flow (AKA, *cash creation*) measure starts with operating profit – after-tax operating profit – AKA, how much cash is being generated on the income statement. Subtract off any increase in working capital, because that's a cash drain on the firm. Add back the depreciation expense, because that never really left. Subtract off capital expenditures – money that we spent that we didn't record up in the income statement. And add back any after-tax salvage value or asset sales that reflect real cash coming in that we didn't report up in the income statement.

Example time. Let's go.

Year	0	1	2	3
Revenue		$500	$500	$500
Total costs		$300	$300	$300
Depreciation		$100	$100	$100
EBIT		$100	$100	$100
Taxes (30%)		$30	$30	$30
NOPAT		$70	$70	$70
Capital Spending	$500	$0	$0	$0
Net PP&E	$500	$400	$300	$200
Cash from operations	$0	$170	$170	$170
Working Capital	$150	$100	$50	$0
Terminal (Asset Sales)	$0	$0	$0	$200
Free Cash Flow	**-$650**	**$220**	**$220**	**$420**

Figure 47: Putting it all together in this example. Start in Year 0. What are we doing here? We have some capital spending of $500. We're going to spend that $500 and then we're not going to spend anything for the next three years. So this is really an upfront expense of $500. That gives us net property, plant, and equipment of $500 at the beginning. Next, no cash from operations in the first year. Pretty standard. Working capital (AKA, the initial investment in working capital) of $150 in Year 0. OK. Then what happens? We're going to start generating some revenue. By the end of Year 1, we're going to have recorded some cash flow on the income statement of $500 in Years 1, 2, and 3. OK. That's the sales coming in, revenue. To generate those revenues, it took total cost of $300 in each of those years. And we have a depreciation expense of $100 each period. That should be reflected in the decline in net property, plant, and equipment of $100. And sure enough, $500 goes down to $400, $400 to $300, $300 to $200. OK. That then gives us earnings before interest and taxes of $500, minus $300 is $200, minus the $100 depreciation expense gives us EBIT of $100. At a 30% tax rate, we tax that EBIT at 30%. That gives us a tax of $30. $100 in EBIT minus the $30 in taxes gives us $70 in net operating profit after tax. Net operating profit after tax or NOPAT. And that's the same each year. $500 minus $300, minus the depreciation, gives us $100 each year. Minus the taxes, gives us a NOPAT of $70. What was the change in working capital? Working capital went from $150 in Year 0 down to $100 in Year 1. So maybe that was inventory in the warehouse, where we invested in $150 worth of product in the warehouse and worked it down to $100. Then again to $50, and again to $0. So a change in working capital of $50 in each period.

OK, so now we have all of our ingredients to cook. Let's compute the FCF on the next page.

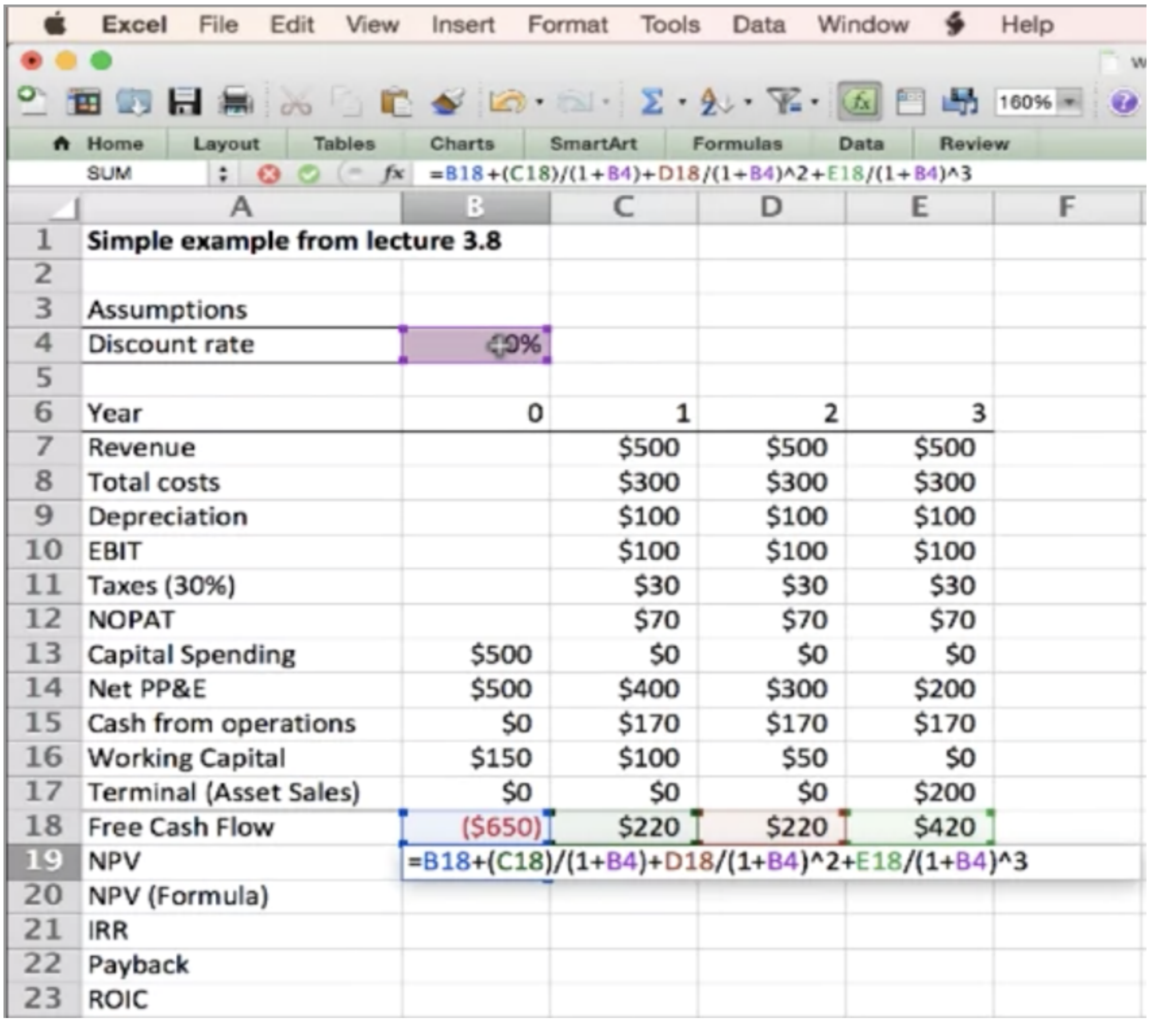
Year	0	1	2	3
Revenue		$500	$500	$500
Total costs		$300	$300	$300
Depreciation		$100	$100	$100
EBIT		$100	$100	$100
Taxes (30%)		$30	$30	$30
NOPAT		$70	$70	$70
Capital Spending	$500	$0	$0	$0
Net PP&E	$500	$400	$300	$200
Cash from operations	$0	$170	$170	$170
Working Capital	$150	$100	$50	$0
Terminal (Asset Sales)	$0	$0	$0	$200
Free Cash Flow	**-$650**	**$220**	**$220**	**$420**

Figure 48: Let's start in Year 0. Do we have any cash from operations? Any net operating profit after tax? No. No depreciation either. So what do we have? Just some capital spending of $500 and the initial investment in working capital of $150. So that's what it took to get the project off the ground. That gives us a total spending, a cash outflow, of $650. Now let's move to Year 1. Looks like we finally have some cash coming in, with a net operating profit after tax of $70. Now wait, hold up. That's $70, but that $100 in depreciation never left, so we need to add it back. That gives us cash from operations of $170, AKA NOPAT plus depreciation. What else happened here? No capital spending happened, and we also have a decrease in working capital of $50. Now remember, if we were going to subtract off any increase in working capital, then really we're just adding the decrease in working capital. So that's freed up $50 in cash flow. $170 plus $50 gives us $220. So again, net operating profit after tax of $70. Add back $100 in depreciation. Subtract off $0 in capital expenditures. Add back $50 to account for the working capital changes to give a total free cash flow of $220. The next year is going to be the same. In the last year, things are going to be a little bit different because in the end, we have leftover assets. We're going to need to add $200 back as our project's terminal value, as we need to pretend as though we're selling the assets at their book value. So adding that back – $220 plus the $200 in asset sales – gives us a free cash flow of $420. So our total cash creation for the project: -$650, $220, $220, and $420. And that's the cash flow that we're going to use for our NPV calculations.

3.8 Using Capital Budgeting Tools

We're now going to take that previous example and use it to create our capital budgeting tools: NPV, IRR, Payback, and ROIC. Let's begin.

How do we get NPV?

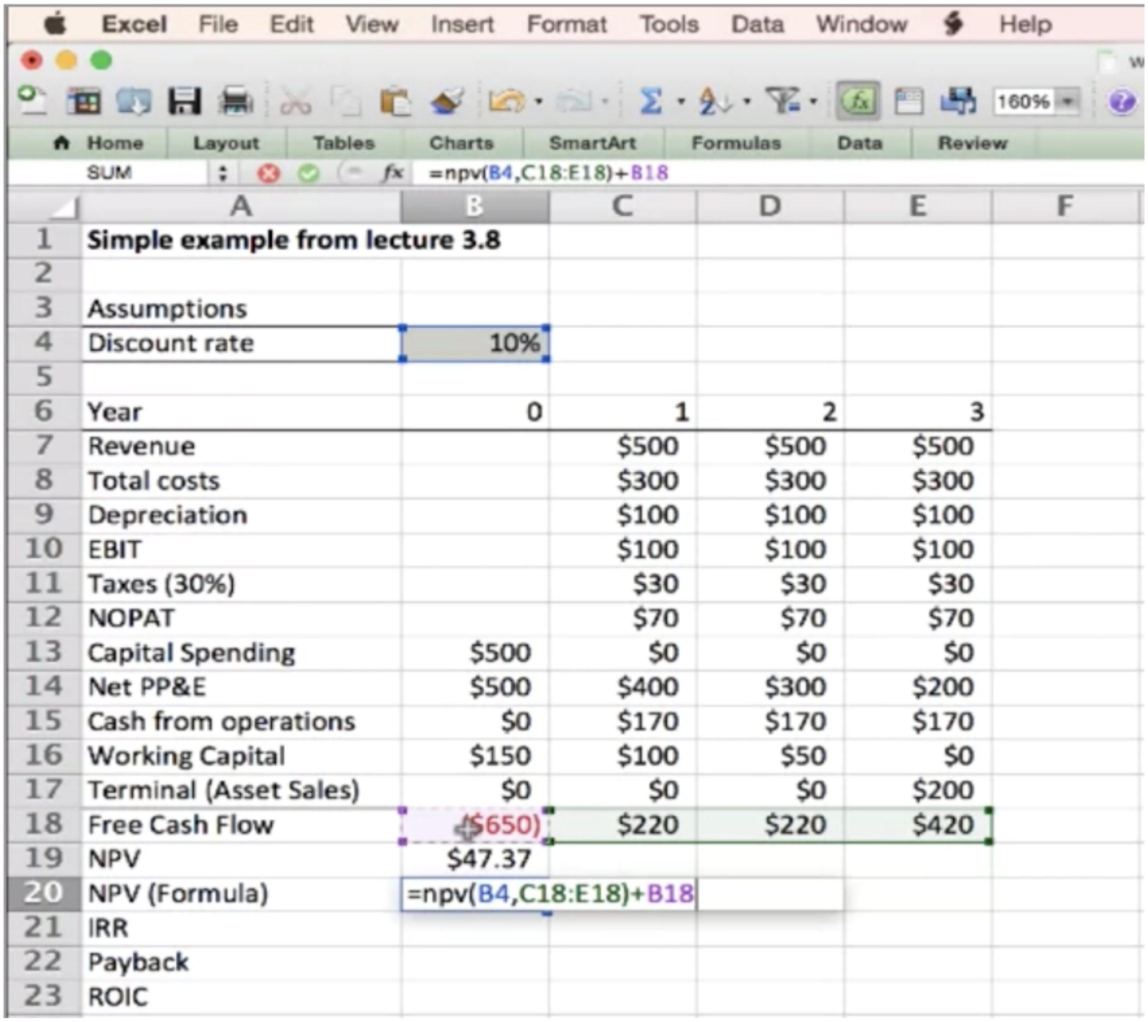


SUM =B18+(C18)/(1+B4)+D18/(1+B4)^2+E18/(1+B4)^3

	A	B	C	D	E	F
1	**Simple example from lecture 3.8**					
2						
3	Assumptions					
4	Discount rate	[illegible]0%				
5						
6	Year	0	1	2	3	
7	Revenue		\$500	\$500	\$500	
8	Total costs		\$300	\$300	\$300	
9	Depreciation		\$100	\$100	\$100	
10	EBIT		\$100	\$100	\$100	
11	Taxes (30%)		\$30	\$30	\$30	
12	NOPAT		\$70	\$70	\$70	
13	Capital Spending	\$500	\$0	\$0	\$0	
14	Net PP&E	\$500	\$400	\$300	\$200	
15	Cash from operations	\$0	\$170	\$170	\$170	
16	Working Capital	\$150	\$100	\$50	\$0	
17	Terminal (Asset Sales)	\$0	\$0	\$0	\$200	
18	Free Cash Flow	(\$650)	\$220	\$220	\$420	
19	NPV	=B18+(C18)/(1+B4)+D18/(1+B4)^2+E18/(1+B4)^3				
20	NPV (Formula)					
21	IRR					
22	Payback					
23	ROIC					

Figure 49: Calculating NPV from Free Cash Flow by hand.

How do we get NPV?



SUM =npv(B4,C18:E18)+B18

	A	B	C	D	E	F
1	**Simple example from lecture 3.8**					
2						
3	Assumptions					
4	Discount rate	10%				
5						
6	Year	0	1	2	3	
7	Revenue		$500	$500	$500	
8	Total costs		$300	$300	$300	
9	Depreciation		$100	$100	$100	
10	EBIT		$100	$100	$100	
11	Taxes (30%)		$30	$30	$30	
12	NOPAT		$70	$70	$70	
13	Capital Spending	$500	$0	$0	$0	
14	Net PP&E	$500	$400	$300	$200	
15	Cash from operations	$0	$170	$170	$170	
16	Working Capital	$150	$100	$50	$0	
17	Terminal (Asset Sales)	$0	$0	$0	$200	
18	Free Cash Flow	($650)	$220	$220	$420	
19	NPV	$47.37				
20	NPV (Formula)	=npv(B4,C18:E18)+B18				
21	IRR					
22	Payback					
23	ROIC					

Figure 50: Calculating NPV from Free Cash Flow using the Excel formula.

How do we get IRR?

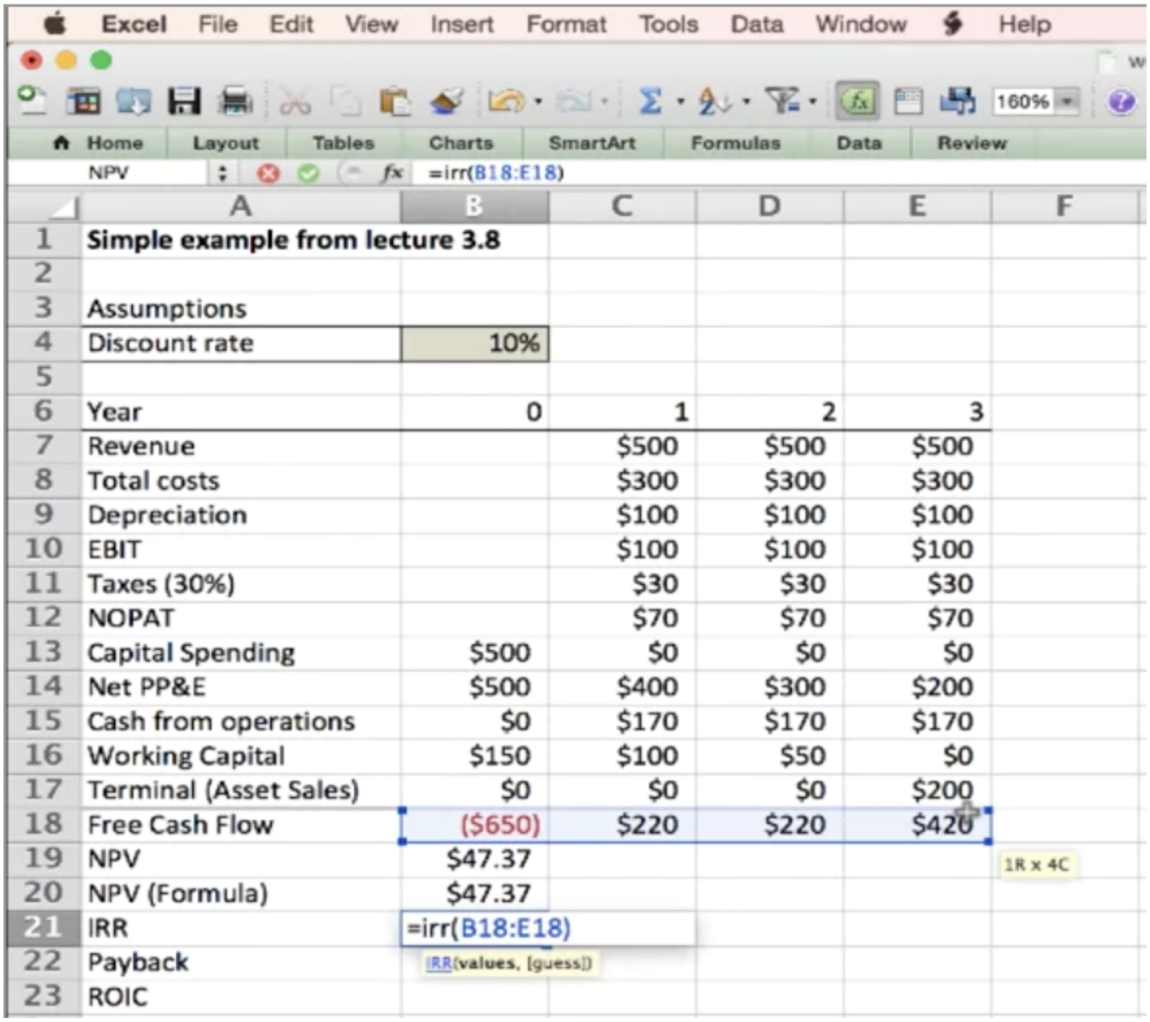
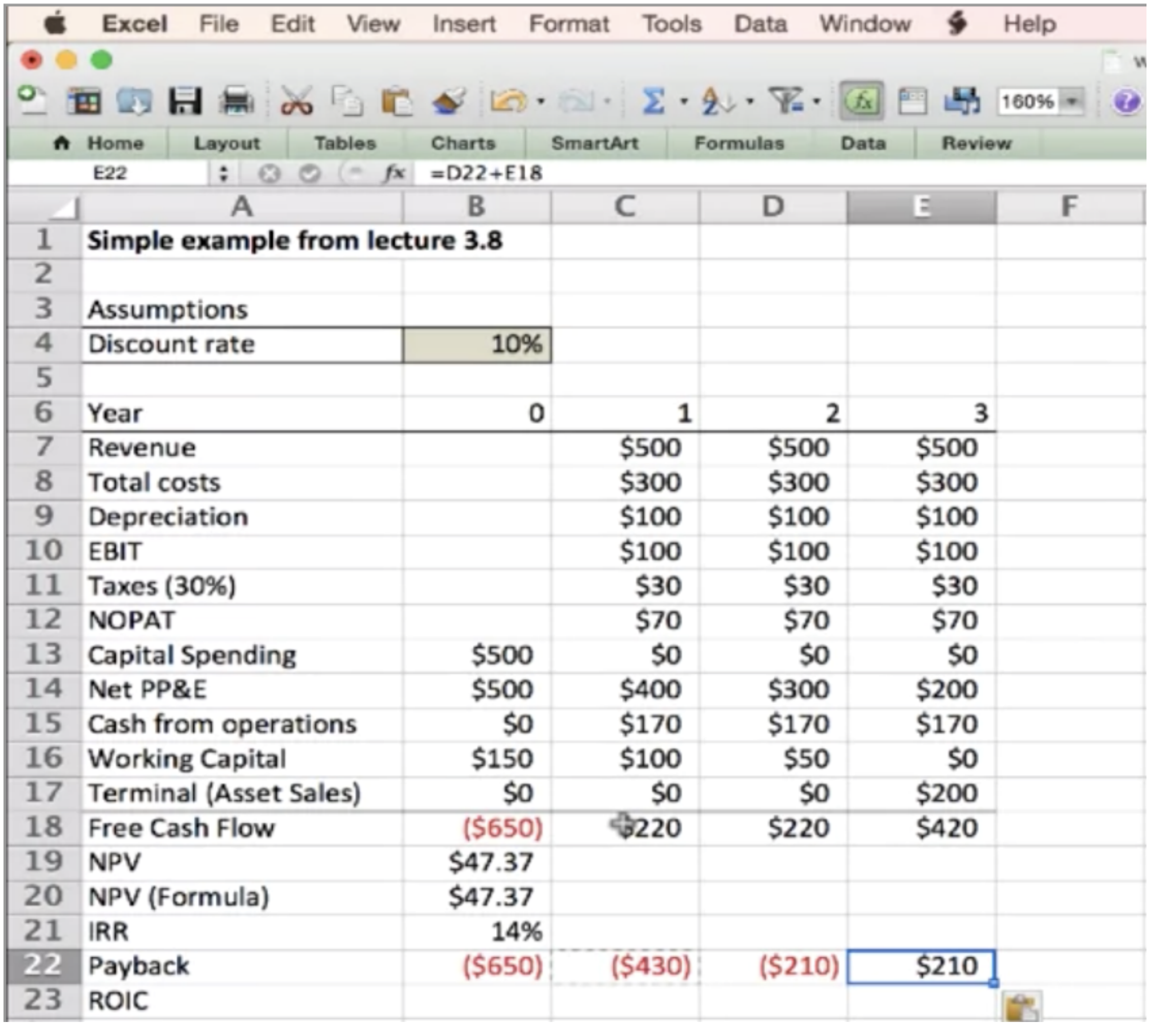


Figure 51: Calculating IRR from Free Cash Flow using the Excel formula.

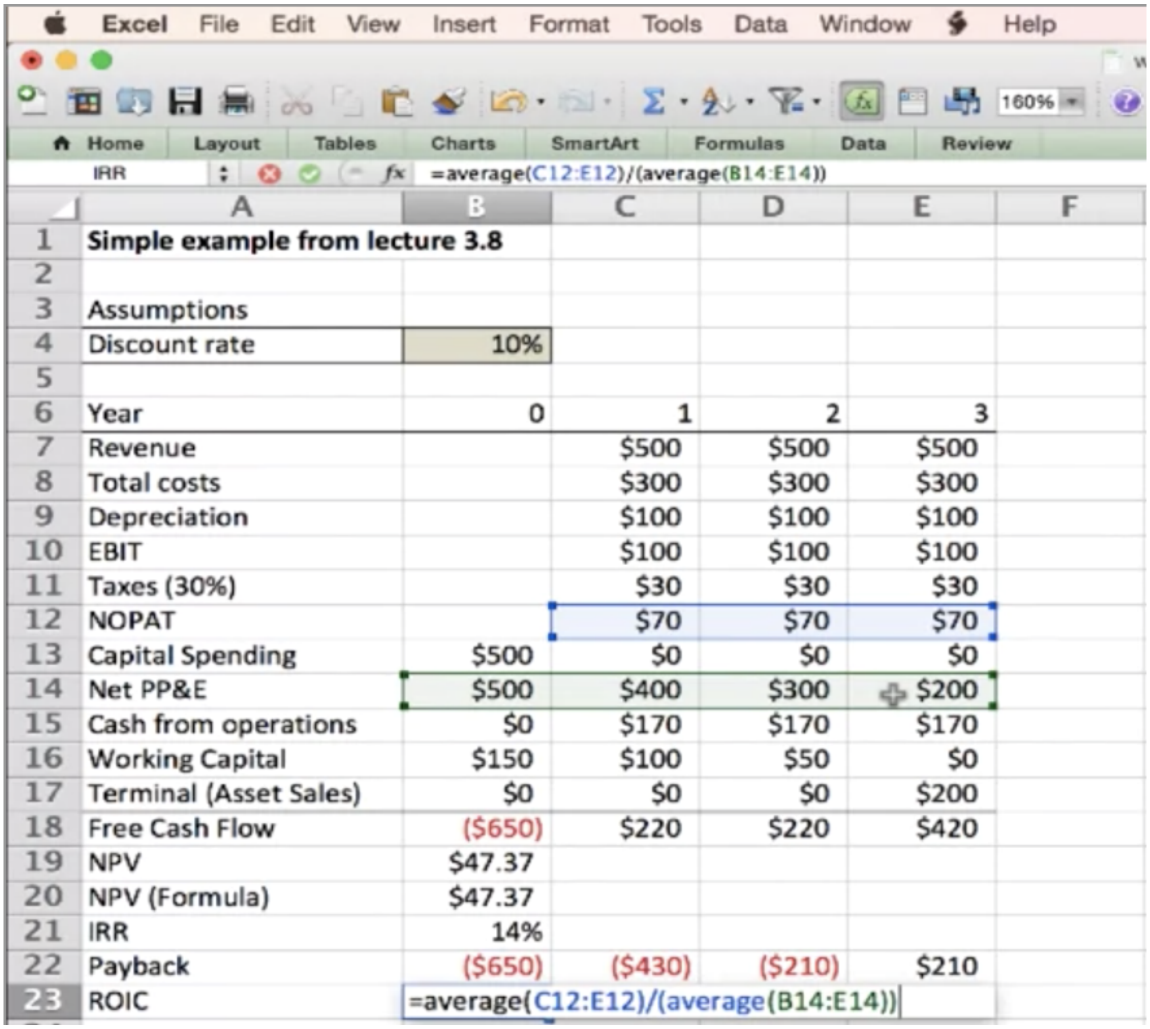
How do we get Payback Period?



	A	B	C	D	E	F
1	**Simple example from lecture 3.8**					
2						
3	Assumptions					
4	Discount rate	10%				
5						
6	Year	0	1	2	3	
7	Revenue		$500	$500	$500	
8	Total costs		$300	$300	$300	
9	Depreciation		$100	$100	$100	
10	EBIT		$100	$100	$100	
11	Taxes (30%)		$30	$30	$30	
12	NOPAT		$70	$70	$70	
13	Capital Spending	$500	$0	$0	$0	
14	Net PP&E	$500	$400	$300	$200	
15	Cash from operations	$0	$170	$170	$170	
16	Working Capital	$150	$100	$50	$0	
17	Terminal (Asset Sales)	$0	$0	$0	$200	
18	Free Cash Flow	($650)	$220	$220	$420	
19	NPV	$47.37				
20	NPV (Formula)	$47.37				
21	IRR	14%				
22	Payback	($650)	($430)	($210)	$210	
23	ROIC					

Figure 52: Calculating Payback Period from Free Cash Flow. Start with the initial investment and just add the cash flows up until that number turns positive.

How do we get Return on Invested Capital?



	A	B	C	D	E	F
1	**Simple example from lecture 3.8**					
2						
3	Assumptions					
4	Discount rate	10%				
5						
6	Year	0	1	2	3	
7	Revenue		$500	$500	$500	
8	Total costs		$300	$300	$300	
9	Depreciation		$100	$100	$100	
10	EBIT		$100	$100	$100	
11	Taxes (30%)		$30	$30	$30	
12	NOPAT		$70	$70	$70	
13	Capital Spending	$500	$0	$0	$0	
14	Net PP&E	$500	$400	$300	$200	
15	Cash from operations	$0	$170	$170	$170	
16	Working Capital	$150	$100	$50	$0	
17	Terminal (Asset Sales)	$0	$0	$0	$200	
18	Free Cash Flow	($650)	$220	$220	$420	
19	NPV	$47.37				
20	NPV (Formula)	$47.37				
21	IRR	14%				
22	Payback	($650)	($430)	($210)	$210	
23	ROIC	=average(C12:E12)/(average(B14:E14))				

Figure 53: Calculating ROIC from Free Cash Flow (FCF). ROIC is the average net forecasted profit (AKA, net operating profit after tax) divided by the average net capital investment (AKA, CapEx). Here, remember: NOPAT is over 3 years (because it only exists for 3 years) and CapEx is over 4 years (because it exists for the entire duration of the project).

OK, so from a capital budgeting perspective, we've now calculated four tools. Our NPV tells us that the project is generating more than a 10% rate of return because it's earning a positive NPV of $47.37. The IRR tells us that we're earning 14% on this project. That's above our 10% discount rate. So both of those capital budgeting tools would tell us to do the project. The payback tells us that the project is earning back its initial investment sometime during the third year. And from an accounting perspective, we're earning a return on invested capital of 20%. So this project is a go.

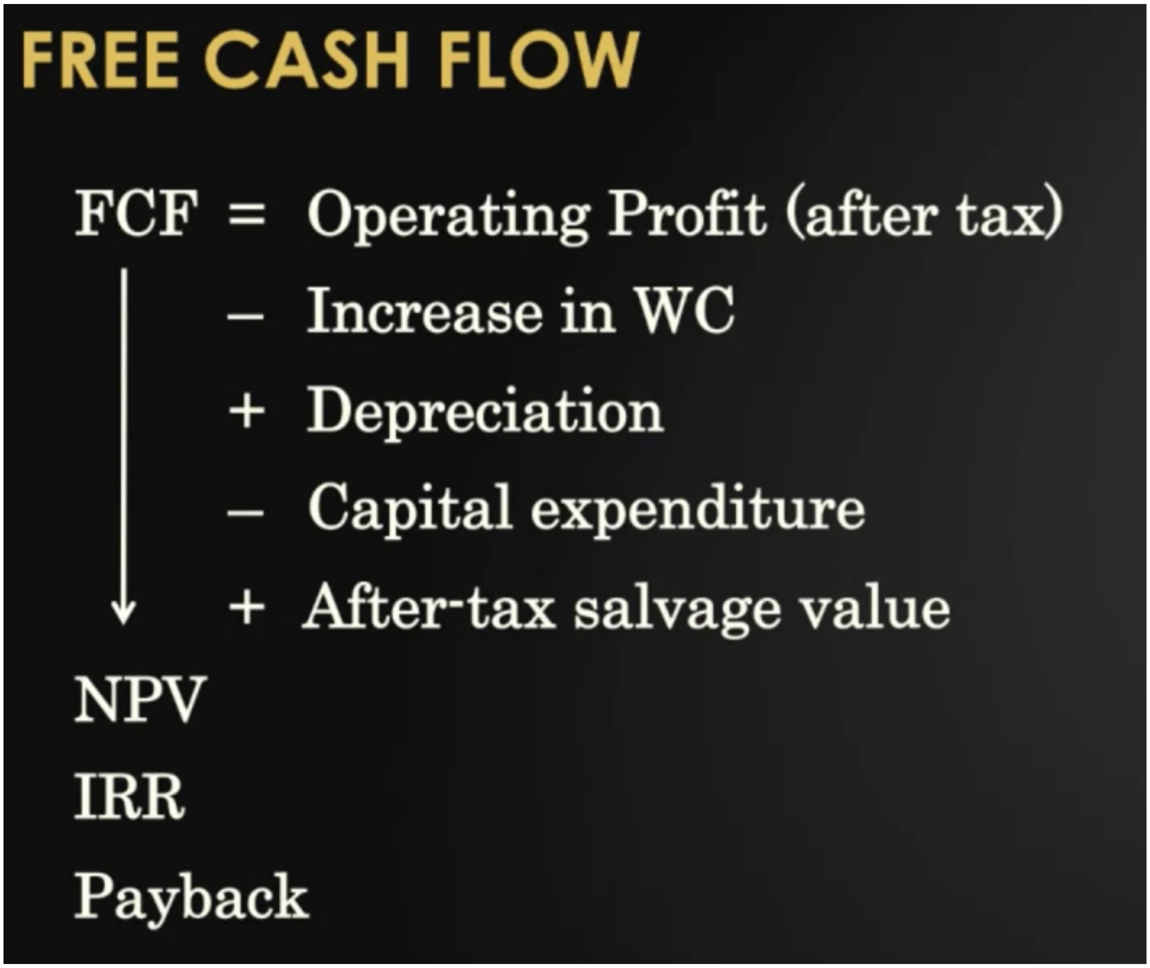


Figure 54: We've now tied together now our free cash flow analysis to our capital budgeting tools. Our measure of free cash flow is really our primary measure of whether value is being created inside the firm because it tells how much cash is actually getting created. With that FCF, we can then calculate the NPV, IRR, payback period, and ROIC from the resulting the cash flow. Tying these concepts together really gets us a long way down the road in terms of thinking about general valuation and general capital budgeting for any firm in different circumstances.

3.9 Conversations with a Practitioner

Inside the firm, accounting statements & their metrics, like *earnings*, are the focus. This is what we report to the outside world, to Wall Street, and this is what we're audited on. However, these investors and regulatory bodies also want to understand what kind of cash is the firm creating, so inside the firm, we also have to take our accounting statements and convert them into a finance measure like EBITDA: earnings before interest, taxes, depreciation and amortization. So at the CFO level, we need to have a sense of both the accounting and the free cash flow measures, but our quarterly reporting and annual reporting are all done in terms of accounting standards. We will never see EBITDA in an accounting report. Why? Because these two sets of professions are actually answering two different questions. The accountants need to report on the financial condition of the company for regulatory purposes, following generally accepted accounting principles, whereas, as investors, we want to know how much cash we're getting. It's the difference between a snapshot view of the current daily activity and a liquidation event. That drives a wedge between these two competing interests, and so we have to report the accounting numbers first and then build up our cash flow analysis from that.

So what pulls these two things together? There's like a rubber band that connects free cash flow with earnings. Firms can't generate a whole lot of cash for a long time but keep reporting negative earnings, or else something doesn't add up. And we can't pay out tons of dividends, but have no earnings to back it up. These two methodologies might stretch a little bit, but they always come back together to create a coherent picture of the company's performance.

Ultimately, at the end of the day, the equity investor, really cares about getting a dividend. Now, a dividend is therefore seen as important, but it can also be tricky. Once a company incorporates a dividend, it will be expected quarter after quarter. We'd never want to cut the dividend. When we look at how the market reacts to dividends, the market always appreciates dividend increases, but really punishes a firm for cutting or omitting their dividend. Therefore, firms tend to pay dividends out of what we call permanent earnings. In a fairly cyclical industry, we generally send out a fairly conservative dividend to make sure that when we get into a downturn, we didn't touch the dividend. And as the company swings back up into high cycle, we can incorporate occasionally a special dividend that rewards the extra-good quarter.

So that dividend gets paid out from the free cash flow. You can't use earnings to pay dividends because dividends are actual cash checks that get cut out to investors, and earnings aren't actual cash. So focusing on dividends as a portion of your permanent earnings means focusing on the cash creation of the business. Fundamentally, that's what drives valuations – whether or not investors are getting their money back.

In the next section, we're going to wrap up this course by looking at the trade-off between risk and return, and what discount rate to put into for spreadsheet models.

4 How Much Does Money Cost? Evaluating the Cost of Capital

In Section 4, we'll be talking about the cost of capital, that r, that discount rate. How much does it cost a firm to raise money, or how much the firm should be discounting future cash flows? The first three Sections, we've been doing a lot of discounting and compounding and talking about rates of return, but we haven't actually talked about where that rate of return comes from and what discount rate should we use for different kinds of firms with different risks.

Figure 55: So we're first going to talk about the difference between different kinds of capital: debt vs equity. We're going to use that to talk about the cost of equity as opposed to the cost of debt – as it turns out, those two sources of capital have different discount rates because of their differences in risk. We're then going to put equity and debt together into the weighted average cost of capital, which is really the firm's overall discount rate. How risky is the firm overall once we blend its debt financing with its equity financing, what we call its *capital structure*? We'll wrap up with a nice capstone experience by first taking that weighted average cost of capital, creating our free cash flow analysis, and then using those two things to do the capital budgeting analysis that we talked about in Section 2, which builds on the discounting and compounding that we did in Section 1. So we've covered all the discounting and compounding and free cash flow analysis, and now we're putting that together with where that discount rates come from. And we'll have wrapped up Finance for Non-Finance Professionals!

4.1 Debt vs. Equity Financing

This week, we're talking about the cost of capital, that r, that discount rate. Here, we're going to talk about the difference between the two different sources of capital: debt and equity, and how the firm finances itself with those two different kinds.

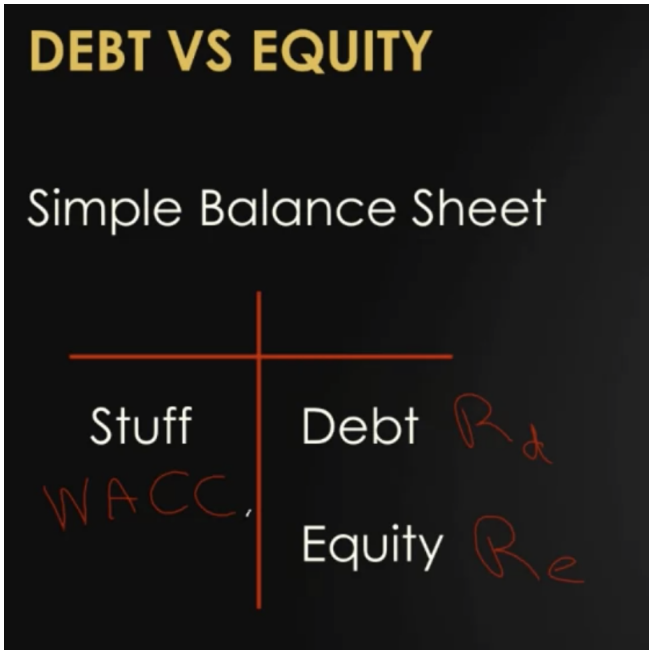


Figure 56: Alright, let's look at this very simple balance sheet. We have a T table, and on the left, we have a bunch of stuff (the assets of the firm), and then on the right, we have where that stuff comes from. Spoiler: the assets could come from either debt financing, or they could come from equity financing. Everything else in between, whether it's convertible or preferred debt, or convertible shares, or some kind of preferred stock or common stock, everything is really some combination of basic debt and basic equity. So we're going to base this section on just on basic debt and basic equity. And the idea here is that those two different sources of capital have very different risks. So if we think about discounting cash flows and what that's going to be based on, in the past, in the first three sections, we really just used one discount rate, one R, that we were smashing down on cash flows in order to take present values. And what we're going to have now are two sources of capital. And so there's going to be an R that's associated with debt capital and there's going to be an R that's associated with equity capital. And when we put those two together in combination, we're going to have a weighted average of those two sources of capital. The return required to the debt holders is D, and the return that's required by the equity holders is E, and when we put those two together, that's going to form the weighted average cost of capital, or the firm's WACC. So this little balance sheet gives us sort of a roadmap for where we're headed this week. We're going to spend a bunch of time talking about the cost of equity, the cost of debt, and then putting those together in our assessment of the weighted average cost of capital.

Figure 57: So let's first talk about debt financing. Debt financing is, in finance or economics, a non-contingent claim. It's not contingent on what happens to the firm. No matter what happens, you have to pay back your principal and your interest. You can't say to the bondholders, well, we had a bad quarter so I'm going to skip this payment, or else the bondholders are going to force you into bankruptcy. It's like missing a payment on your mortgage. You have to pay that. It's a non-contingent claim. Along those lines, debt financing is usually collateralized, in the sense that there's usually some asset that backs up the debt. If you miss a payment, the bank can come and e.g. take your house. Your house is collateral on the loan. Debt financing also has priority in bankruptcy. If the firm ever enters bankruptcy, there is a hierarchy of who gets paid first: the senior debt holders have first claim in bankruptcy, followed by the junior debt holders, then the junior unsecured debt holders, then equity via preferred stock, and then finally, common stock at the very bottom. The way we think about risk in terms of default and default repayment is what we call the priority structure of claims in bankruptcy, and a lot of what we talk about in assessing risk for debt has to do with where you line up if things go really south. Of course, there's also a lot of monitoring and restrictions on debt that prevent certain actions, and those are called *restrictive covenants*. Debt contracts are often very thick with a lot of rules and regulations on what the firm can and can't do. If you borrow money to buy a house, somewhere in that debt contract, if you read it carefully, is that you have to actually use the money to buy the house – you can't then take the money and party it up in Vegas. That would be against the rules in the debt contract. In contrast, equity contracts are always like, well, here's the money, give me a piece of ownership and good luck, partner! Debt can also take lots of different forms in its maturity structure with payment structures like balloon payments or coupon payments, but we're going to keep it simple and talk only about straight debt.

Figure 58: Where does debt financing come from? Most of it comes from banks, with straight loans, lines of credit, mortgages on commercial property, or commercial & industrial loans that go to support the building of machinery or shipyards or drilling rigs – commercial industrial loans. Also, if we don't raise money from the bank, we can go to the public and raise money from public investors or private individuals (a more diversified set of investors) that want to give us money through bond issues.

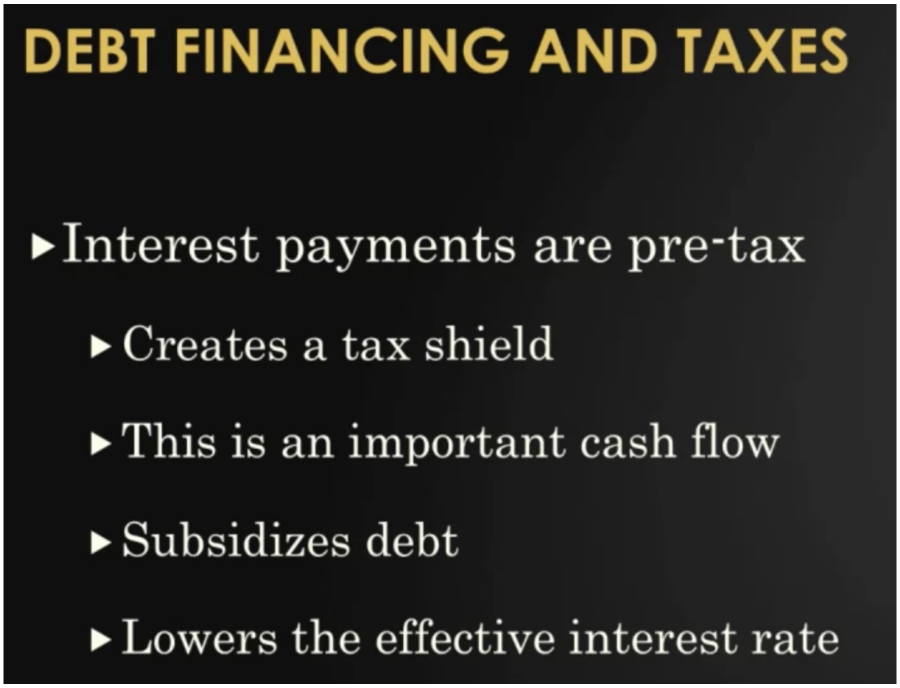


Figure 59: An important part of debt financing is that interest payments are made *pretax*. That's a nice thing. In a sense, the tax code, at least in the U.S., creates a tax shield for debt. That's an important cash flow, because what that really means is that if we're paying 5% on our debt but we get to subtract it before we pay my taxes, then levering up, taking lots of debt, can help us reduce our tax. And if you remember from the lessons in the last section, taxes are a real cash flow. So, in a sense, the U.S. tax code subsidizes debt. Debt is cheaper than it ought to be in the absence of that tax shield. The fact that we can expense debt pre-tax creates a subsidy for debt, and that subsidy lowers the effective interest rate.

Figure 60: OK, so let's now switch gears and talk about equity financing. Equity financing is the ownership of the company: ownership and control. When you issue equity, you're issuing shares in the company, which also means you're issuing ownership in the company. That's a contingent claim, meaning you get paid off when things go well and you don't get paid off if things don't go so well. The equity holders get all the residual cash, everything that's left over. They get all the upside. Think about that. If the firm does extraordinarily well, you don't go and you don't pay the bank extra interest. You don't pay them back more than you owe. You only pay them back exactly what you said you would. All the gravy, all the residual, all that money on top trickles down to the equity holders at the bottom. But, of course, the equity holders are taking all the risk. They get wiped out in bankruptcy.

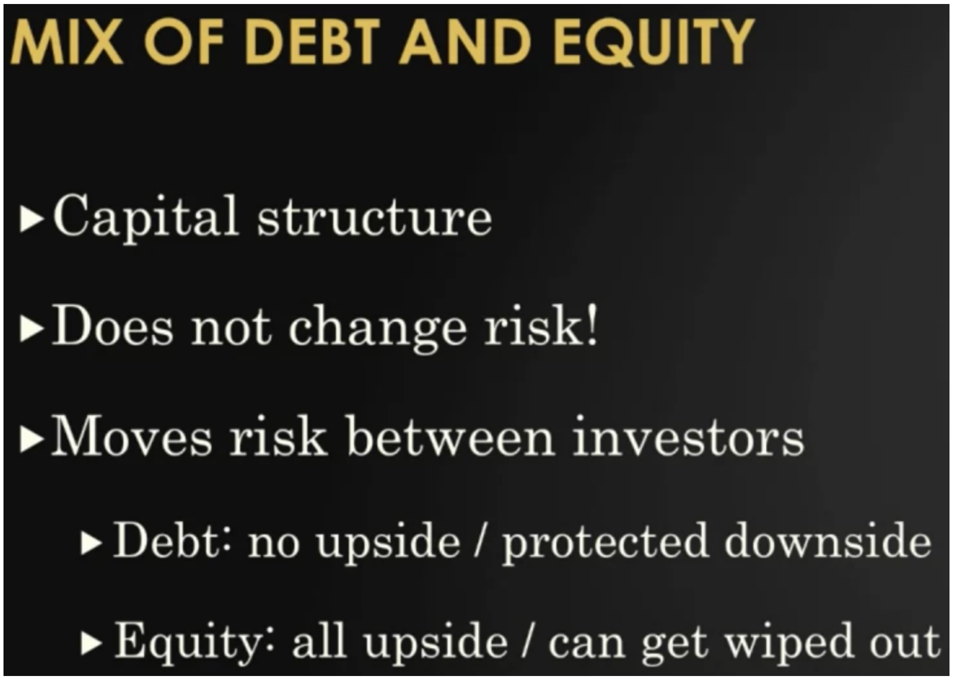


Figure 61: So with that out of the way, now let's talk about the difference between debt and equity. The mix of how much debt we use and how much equity we use is what we call the firm's *capital structure*. This is an important part to remember, that *the capital structure doesn't change the risk of the firm*. This is very counterintuitive, but if we lever up, if we take on a ton of debt, like a really huge amount of debt, people think that that makes the company riskier but, actually, it doesn't. All it really does is shift the risk. The firm is risky enough as it is. What the capital structure does is slice that risk up into different pieces. If we take on a whole lot of debt, that doesn't make the company riskier. What it does is make the equity riskier. So, really, the underlying capital structure doesn't change whether things are good or things are bad. If we're running a fast food chain, if we're running a McDonald's franchise, does taking on a whole bunch of risk make people not want to buy our French Fries? Does it make them not want to supersize their Cokes or their burgers? Of course not. It doesn't change the underlying business risk. But taking on a lot of debt does push the risk over to the equity holders. Capital structure doesn't change the risk of the firm. It changes how that risk of the firm gets sliced up among different investors. That's an important concept: capital structure only moves risk between investor classes. OK. So the debt gets none of the upside risk, but it gets protected on the downside through its collateralization. On the other hand, the equity gets all of the upside but gets wiped out in the existence of bankruptcy. So what we're really doing by issuing debt and equity is taking all of the possible outcomes of the firm and sorting them like a distribution – maybe the McDonald's franchise does really, really well, and maybe it goes under and can't service its debt – and slicing up all those different possibilities and selling those risks to different classes of investors. And the way that we slice up the debt contracts and the equity contracts is what we call the firm's capital structure. And what we're going to do is think about how we slice up that risk and how we put discount rates on the different kinds of risk.

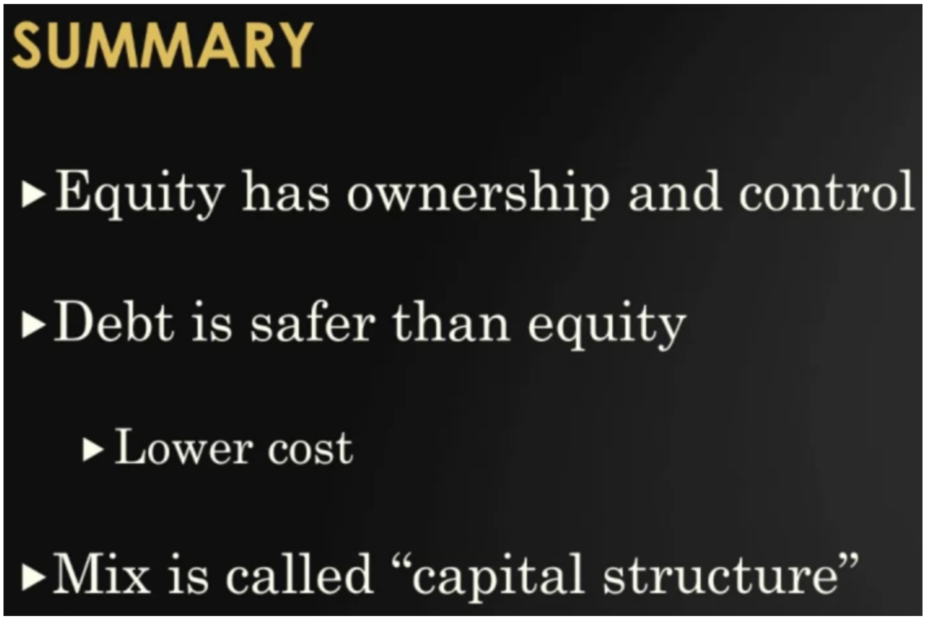


Figure 62: OK, so equity has ownership and control, and debt is a safer bet than equity. It has a lower cost of capital. And how we mix up those two is called the firm's capital structure. And what we're going to do for the rest of the section is try to figure out how that risk, how those different classes of risk, are related to the different returns that investors require for providing debt and equity financing.

4.2 Risk Free Rate

Our discussion of the cost of capital is going to start at the very base, what we're going to call the risk-free rate.

Figure 63: What is the safest possible thing you could do with your money? You have some money. You're not going to use it right now. You want to use it maybe in a year, three years, five years from now. How do we get that money into the future? What's the safest possible thing? The only thing that matters is having that money later on down the line. Well, we could put it under my mattress, but maybe my house burns down. Maybe the money deteriorates because of inflation. Maybe we simply forget about it. So there's still some risk here. What if we put it in a bank? Maybe the bank gets robbed. But wait. My money's insured. By whom? Ah, the federal government. Maybe they'll pay us back. But we're a little bit worried about the bank, maybe inflation still renders the money useless. So what about gold? Well, gold is a volatile commodity. Maybe it goes up and down in price, and then it's at a lower price when I need it. That's certainly not the safest thing to do. So let's go back to the bank. If we had put my money in the bank and the bank got robbed, at least in the United States, we would have Federal Deposit Insurance. And so we could go to the FDIC, and they would give us our money back. But where's the FDIC getting their money? The FDIC is backed up by the U.S. Treasury, so why don't we get rid of all the middlemen? Why don't we get rid of the bankers, and the FDIC, and just go straight to a U.S. treasury bond? The U.S. Treasury bond is really the safest thing that we could possibly do with our money.

Figure 64: So let's think about this from a default standpoint. The United States government is not going to default on their bonds (most likely), at least anytime soon, while the U.S. is the reserve currency of the world. What could they do if they run out of money? Well, they could just print more. They might cause terrible inflation, but we'd all be screwed in that scenario. So as long as the U.S. government can print more money, they're probably not going to default on their treasury. So for the short term, the U.S. treasury can print money to get out of its debt. And that means, in a sense, that the U.S. treasuries are really backed by their ability to collect future taxes from U.S. citizens in the future. And given the strength of the U.S. economy and our position as the reserve currency of the world, U.S. treasuries really are the safest possible thing that we can do with my money right now. So that gives us a floor. That's a really good thing. The fact that we've got the U.S. Treasury out there as the safest possible thing we can do with my money, that gives us a baseline, a foundation, a floor to start thinking about risk.

Note: this course came out before 2020/2021, when the U.S. government created ridiculous sums of money (over $8 trillion dollars! That's with a T!) out of thin air due to a panic created by Covid 19, a Presidential race, and unethical politics. Some of it helped U.S. citizens and businesses, but most of it didn't. Inflation is coming, people – be prepared!

Figure 65: So any rate of return, whether that's from General Electric bonds or Facebook stock (AKA, what we expect to earn), needs to be *at least* be the risk-free rate. That's the foundation, the floor, the very bottom. We need to earn at least that. Because if we're not going to earn that on Facebook stock, why not just put our money in treasury bonds? So anything that's riskier than that, which is anything else, is going to have to earn some *risk premium*. And what we're going to talk about now is what kind of risk premium to put on assets with different kinds of risk.

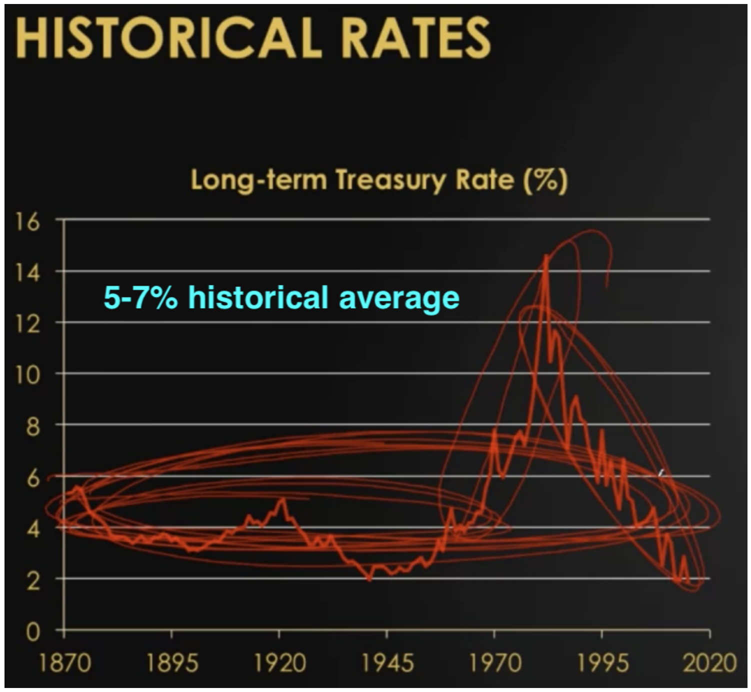


Figure 66: Let's take a look at historical rates and think about what risk free rates often look like. In the U.S., from roughly 1870 to 1970, if we look at this graph, we can see that U.S. Treasury rates on long term bonds, 10-year constant maturity treasuries, were around 5% or 6%. Then they went way up in the inflation that we had in the '70s and early '80s. And now they've come way back down as the Fed has tried to tame that inflation. If we give a long run historical average, interest rates are around 5% or 6%, maybe up to 7%. What's interesting is, if we go back another 100 years and look at Treasury rates in England, those rates are also around 5% to 7%. And if we go back to medieval Europe, where the Italian city-states were lending money to each other, those interest rates were also around 6% to 7%. Same for the Romans. It's interesting that 5% to 7% seems to be about right for what people, at least during peace time, seem to like as a reasonable rate of return. Going back to the lessons that we did in Section 1, where we said interest rates have to compensate us for wanting to be patient – remember, I don't really want to be patient. But if you compensate me, I'm willing to do so. It seems all throughout the course of human history that 5% to 7%, that sort of neighborhood seems right. At 3%, I'm not really willing to do it. And then 10% seems like too good to be true. So that 5% to 7% seems like sort of a fundamental. That's how willing we are to trade off consumption today for a promise of more money the future.

Figure 67: So the risk free rate also has what financial economists call a *yield curve*. That means the longer maturity, the higher the rate. That makes sense from a risk perspective. Rates may arise in the future, and there's more liquidity risk. I'm not sure I'm going to be able to sell something five years, ten years down the line. What's going to happen 20 years from now? The further you look out into the future, the more that cone of uncertainty sort of expands. And the more that cone of uncertainty expands, the more I'm going to charge you to be patient. So the yield curve on average tells us that the farther out the maturity, the higher the rate I'm going to take to bear that risk.

Figure 68: To sum up risk free rates, the risk free rate sets the floor. Anything riskier than that has to earn some premium over the risk free rate. Our risk free rate is the U.S. Treasury. That's going to be our benchmark for thinking about the bottom, the baseline, the foundation rate of return. And those rates tend to rise the farther the maturity of the debt.

4.3 Historical Risk and Return

Let's look at historical rates of return for multiple options, comparing debt and equity.

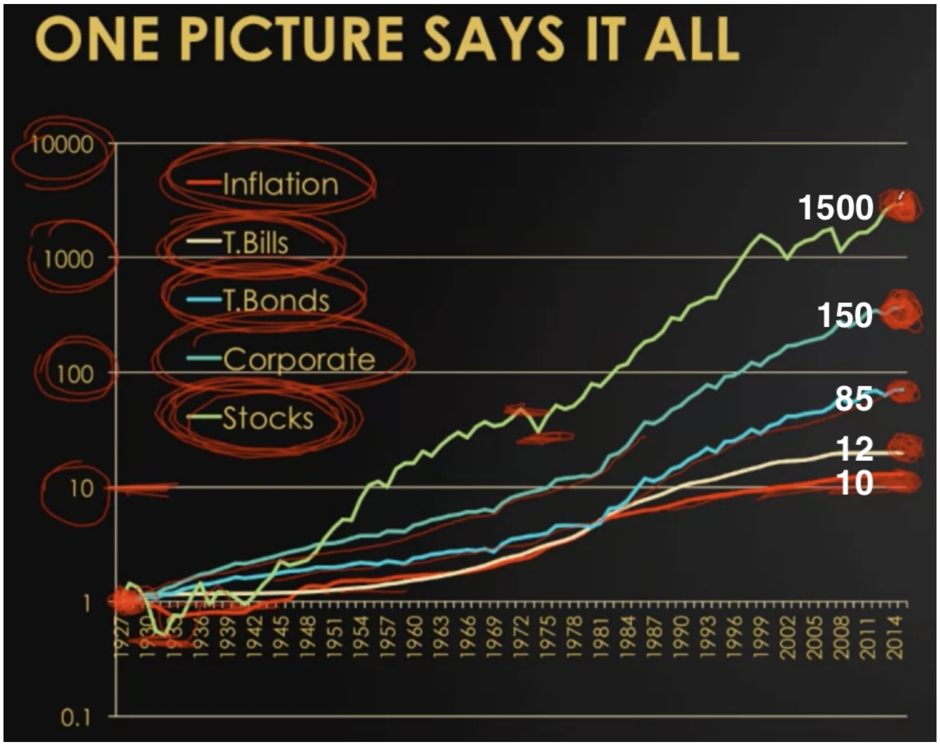


Figure 69: Alright, so this picture basically sums it all up. If we look at what we've graphed here on these five different lines, we have five different asset classes. And so if we go all the way back to 1927, which is where we're starting the analysis for the United States, what we're doing is taking a single dollar bill and then tracking that bill across those asset classes. So let's allow that dollar bill to rise at the general rate of goods and services, like say a basket of goods and services – which is inflation – and see how much prices tend to go up in the economy. That's the red line, and it ends somewhere right around \$10. OK. So prices have gone up about 10 times over the last hundred years. The next thing that we could do is take that dollar and put it in short-term treasury bills. That's the light yellow line, and if we track that, that's also a relatively smooth line. And that line winds up, after about a hundred years, at around \$12. So if we put our money in short-term treasuries, we'd have \$12 or \$13 at the end of that roughly hundred years. So let's do that again, but this time for long-term (10 year maturity) treasury bonds. If we do that, we wind up with about \$85, a hundred years later. Now if we put that dollar bill into corporate bonds, BAA constant maturity bonds, the line gets a little more wiggly, and it winds up at around \$150, again a hundred years later. Now finally, let's take that \$1 and put it in the stock market. We're taking the general S&P 500 here. Wow, this line is a lot wigglier! But overall, over the long run, this goes way up to \$1,500 by the time that hundred years is finished. So what do we learn from this graph? *As we increase the risk of what we put our money into, we wind up with more money later.* In other words, the riskier asset we buy, the greater the return.

Now one of the amazing things about just looking at this graph of the U.S. economy over the last hundred years, is that nobody made it be that way. The Federal Reserve didn't make this graph look like this. The government didn't make this graph look like this. All these assets – stocks, bonds, corporate bonds, general goods and services in the economy – are being traded by private individuals in a free market. What happens is that, at least in the U.S. over the last hundred years, as people buy and sell those different assets, they buy and sell them through discounting so that the assets reflect a return to their investors based on the prices that they paid. It lines up almost exactly with risk. So the more risk we take, the more return we get. Nothing made it that way. It just worked out that way. It should, right? In the capital markets, the whole idea of capitalism, is that capital markets direct capital from bad companies to good companies. If that works out right, then investors ought to be compensated for taking more risk.

HISTORICAL RATES OF RETURN

	Inflation	T.Bills	T.Bonds	C. Bonds	Stocks
Mean	3.0%	3.5%	5.2%	7.2%	11.4%
Standard Dev.	4.2%	3.1%	7.8%	7.8%	19.8%
Minimum	-10.1%	0.0%	-11.1%	-8.9%	-43.8%
25th percentile	1.2%	1.0%	1.2%	2.9%	-1.2%
Median	2.7%	3.1%	3.5%	5.2%	13.9%
75th percentile	4.2%	5.2%	8.5%	10.8%	25.3%
Maximum	18.1%	14.3%	32.8%	35.5%	52.6%

Figure 70: Let's take this graph and get some statistics from it. Average inflation was around 3%, plus or minus 4.2%. At one point, we had deflation of 10%, but most of the time, inflation was up, with a maximum inflation rate of 18%. That was around 1980. Treasury bills, short-term treasuries of less than a year maturity, offered around 3.5%, and treasury bonds, 5.2%. Corporate bonds were 7.2%, and stocks around 11.4%. Stocks seem great! Why not just put all of our money into stocks? After all, that's going to give us the best return! Well, the answer is in the standard deviation of these assets. Treasury bills, plus or minus 3%; bonds, plus or minus 8%; stocks, plus or minus 20%. Wow, stocks have a huge variation! That's a lot of risk. In fact, in one year, the stock market went down minus 43%! That was at the start of World War II. And 25% of the time, the stock market is down for the year. Going back to the graph, that stock market line really does wiggle an awful lot. So if we think about the trade off between risk and return, stocks have an awful lot more risk compared to treasury bonds, and that risk means a higher discount rate.

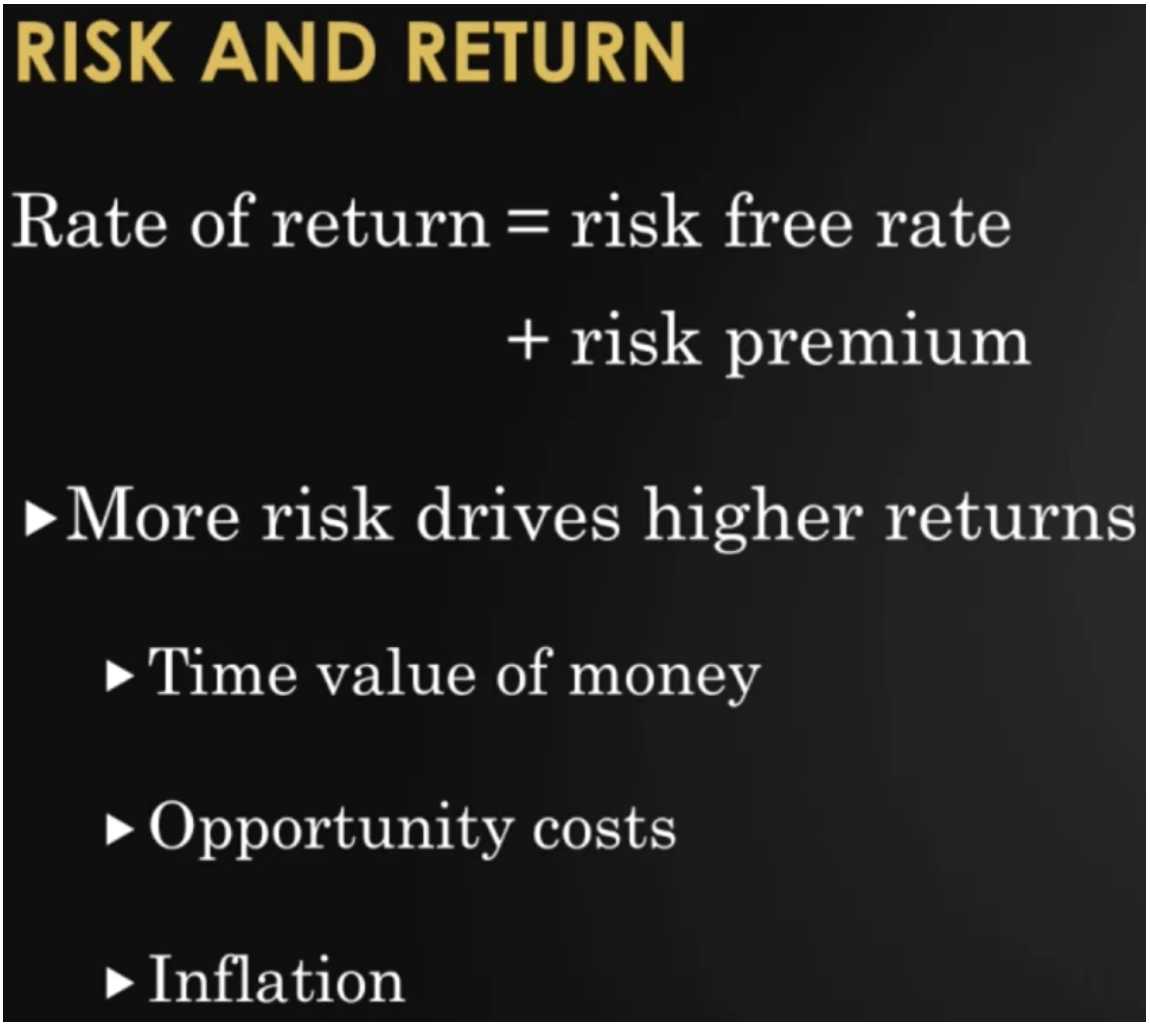


Figure 71: Remember that the risk of return of any asset is the risk free rate plus some risk premium. And so what we need to think about is the fact that more risk is going to drive higher returns because of the time value of money, opportunity costs, and inflation. Those same three things that we talked about when we first started talking about compounding! What we need to think about now is how to put a risk premium on those assets that incorporates those 3 metrics.

4.4 The Equity Risk Premium

So let's use what we talked about in Section 4.3 to talk about the equity risk premium. What is it? And roughly what ballpark numbers sound good?

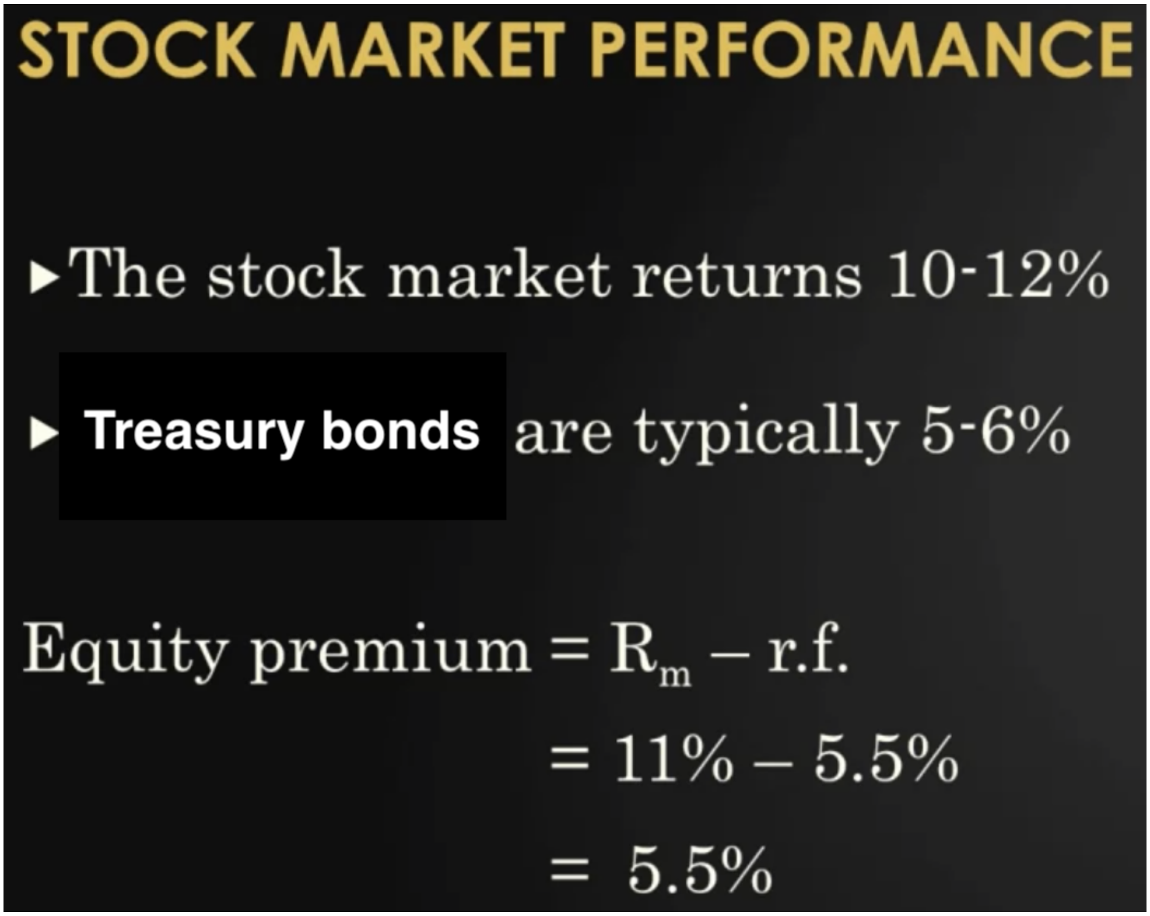


Figure 72: When we looked at the data in the last lesson, stock markets went up (AKA the return was) around 10% to 12% per year on average over the last say, roughly 100 years. And if we go back even further using some longer historical data, those numbers don't flop around too much. Also, we said that Treasury interest rates were usually around 5% or 6%. So if stock markets on average tend to earn around 10% to 12%, and interest rates tend to be around 5% or 6%, that tells us that the wedge between risk free rates and stock market returns gives us what we call the *equity risk premium*, which is the return on the market less the risk free rate. It's that 10% to 12% minus that 5% or 6%, which means that on average, the equity risk premium is around 5.5%. That's an important number! What that number tells us is how much extra we should require for putting our money into stocks, in general, above the risk free rate. In other words, what's the price of stock market risk as a whole? It's 5.5%, plus or minus. It's not a precise number, but that's how much does an investors require to put their money in the stock market instead of a Treasury bond.

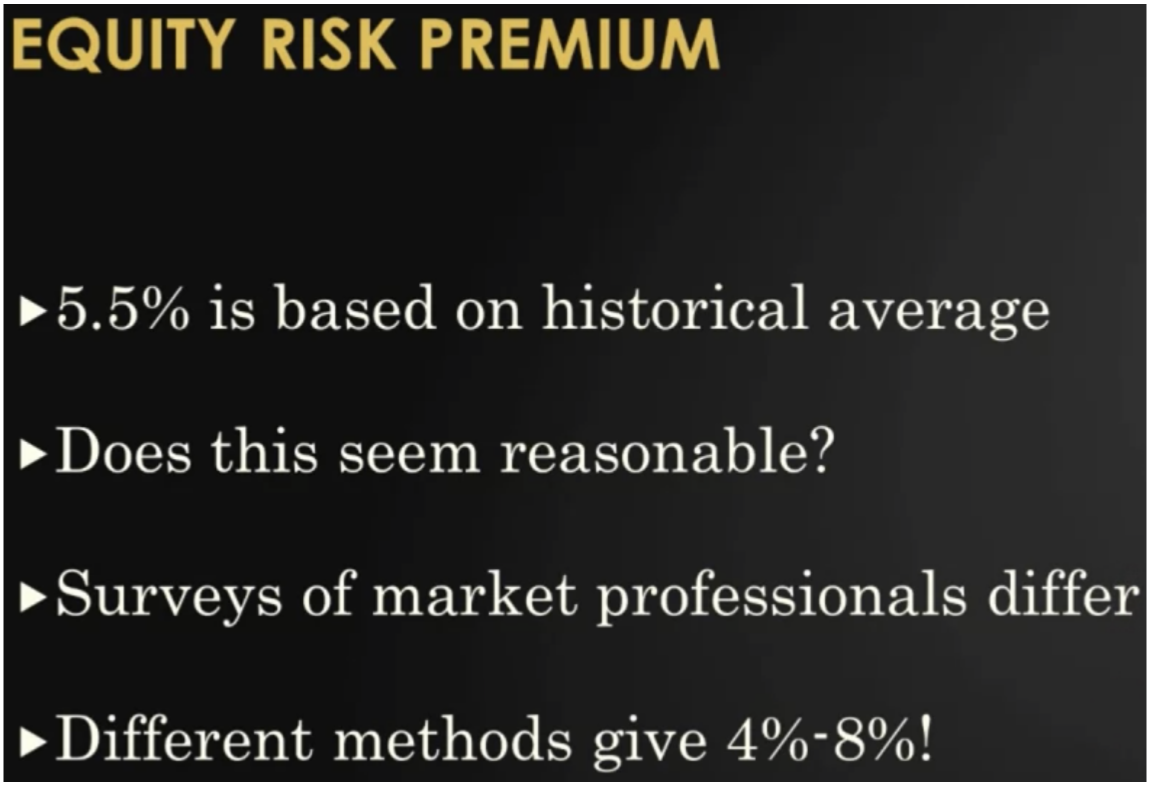


Figure 73: So that's a long-run historical average. Does that seem like a reasonable rate? It should, because over the long run, investors seem to think a reasonable rate on average is around doubling the risk free rate. So if the risk free rates are around 5% to 6%, we would require at least double that to earn 10% or 12% in the stock market. Now if you survey market professionals, or analysts, portfolio managers – people that manage money and put their money into the stock market professionally – they actually come up with different equity premiums. Different methods, and different historical averaging, give a range from 4% to 8% as the equity premium. Our historical rate was around 5.5%, so even with all of the variation, it's a relatively tight range, 4% to 8%.

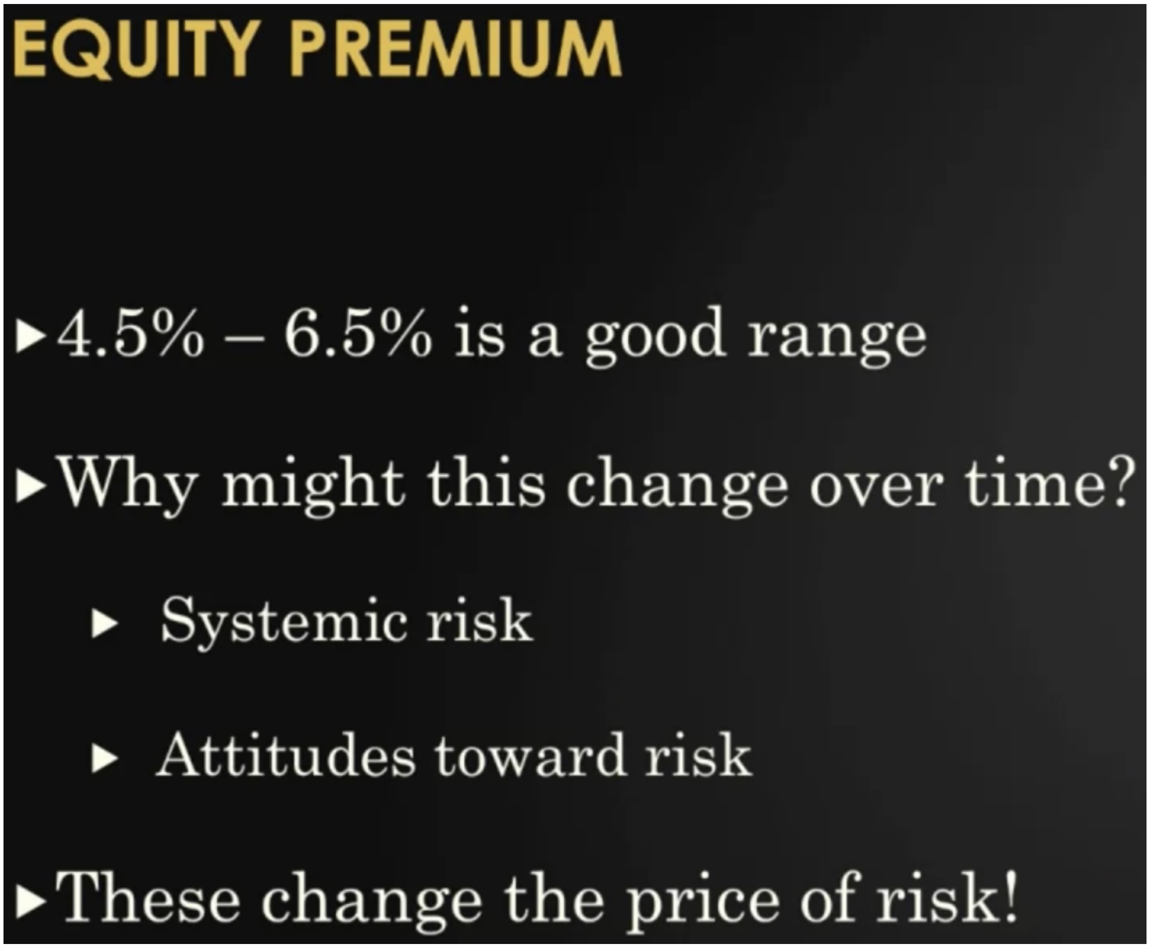


Figure 74: So to be safe, 4.5% to 6% is a good range for the equity premium. 8% is usually a little extreme. Since it's not always the same, what might make that premium change? The market itself has changing risk, and if we just went through a financial crisis, everyone's attitude towards risk might be a little bit more shy. We might be a little bit more reluctant. We might not feel as comfortable putting our money into the stock market after some really big, bad event – the equity premium seems to go up after oil crises, and it seemed to go up after World War II and after the financial crisis in 2008. Attitudes towards risk, as they shift around, shift the equity premiums as well. So the equity risk changes from the lower part of the range, 4.5%, all the way up to that higher part of the range, maybe 6% or even above.

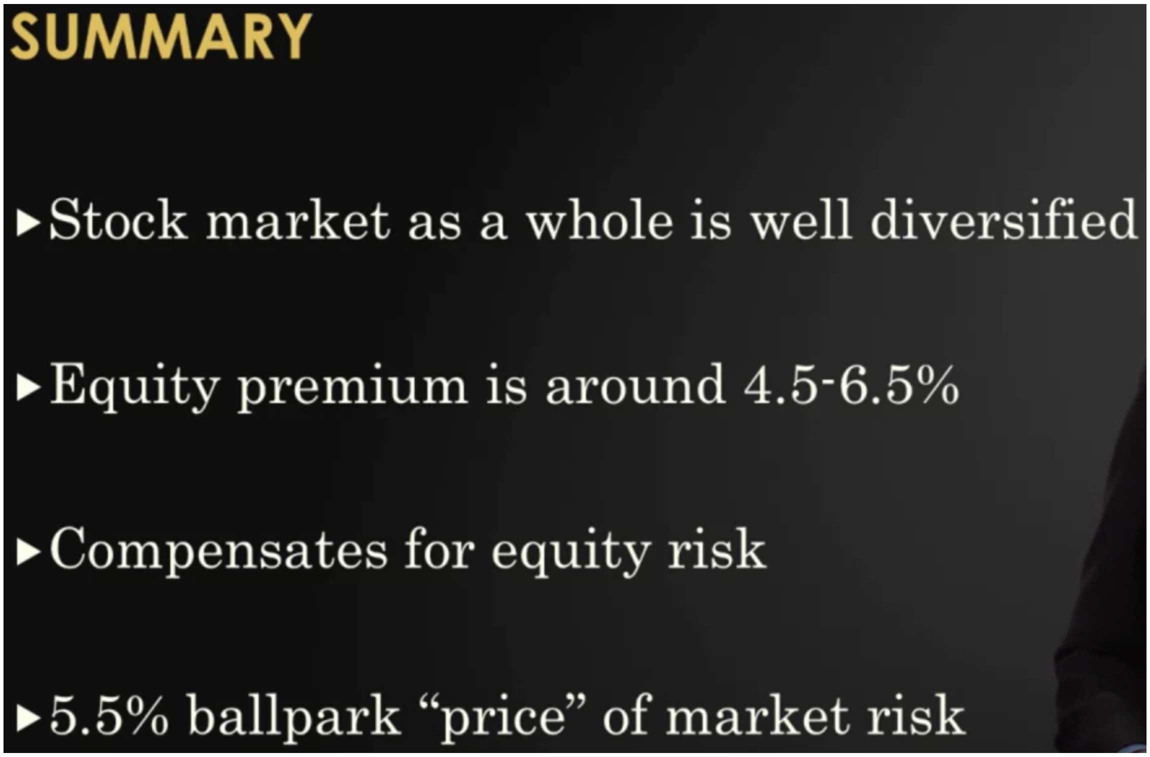


Figure 75: So to sum up, we're talking about the stock market as a whole, with a well-diversified portfolio. That risk – putting the money into the stock market overall – is around 4.5% to 6.5% above the risk free rate. So the equity premium compensates for the equity risk. It could wiggle around, plus or minus 1% or 2%, but 5.5% is what we'll call the equity premium that compensates us for taking general stock market risk.

4.5 Beta and the Cost of Equity

Now, let's talk about individual company betas and their own cost of equity.

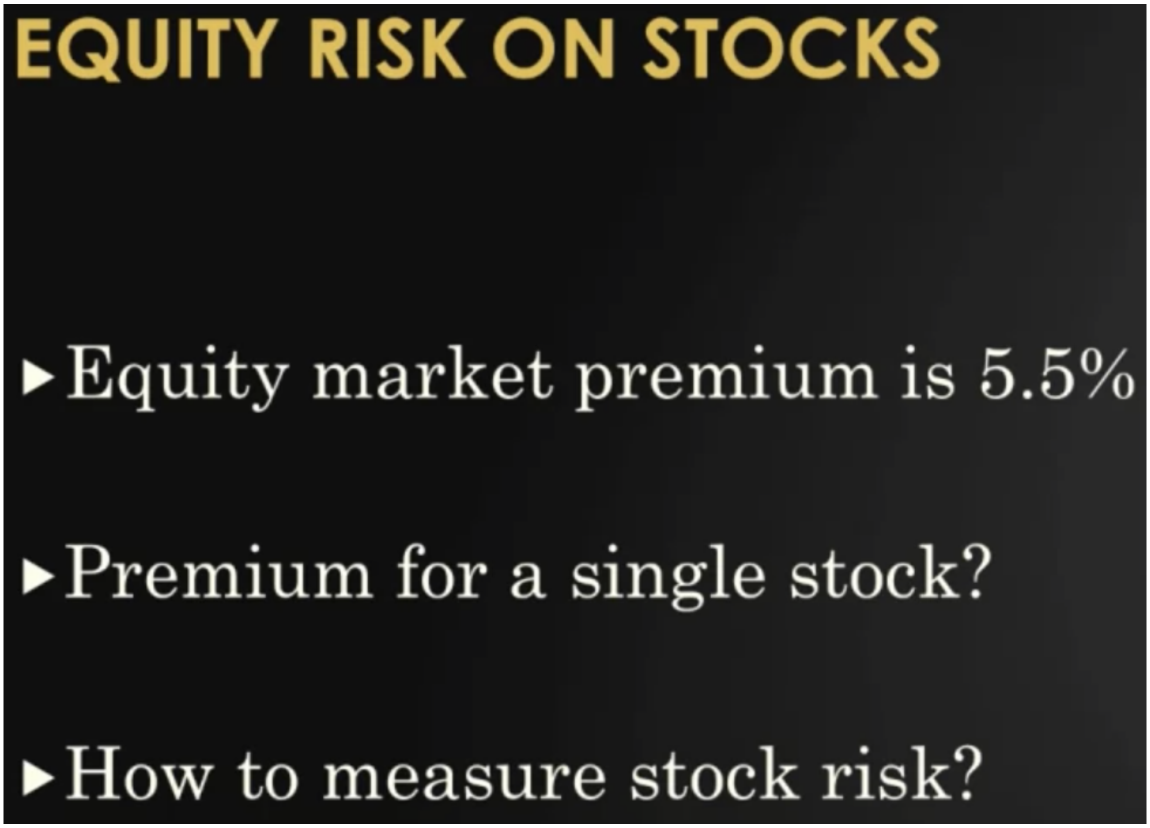


Figure 76: Okay, so the equity premium we said was around 5.5%, and that compensated us for putting our money into the stock market overall. But what if we wanted to put our money into a single stock? What kind of a return should we expect? Well, that definitely seems riskier than putting our money into the stock market overall. So what would the premium for that be? If the overall stock market should return 5.5% over the risk free rate, how much extra risk premium should we get for putting our money into one specific stock? In other words, how would we measure how risky that stock is?

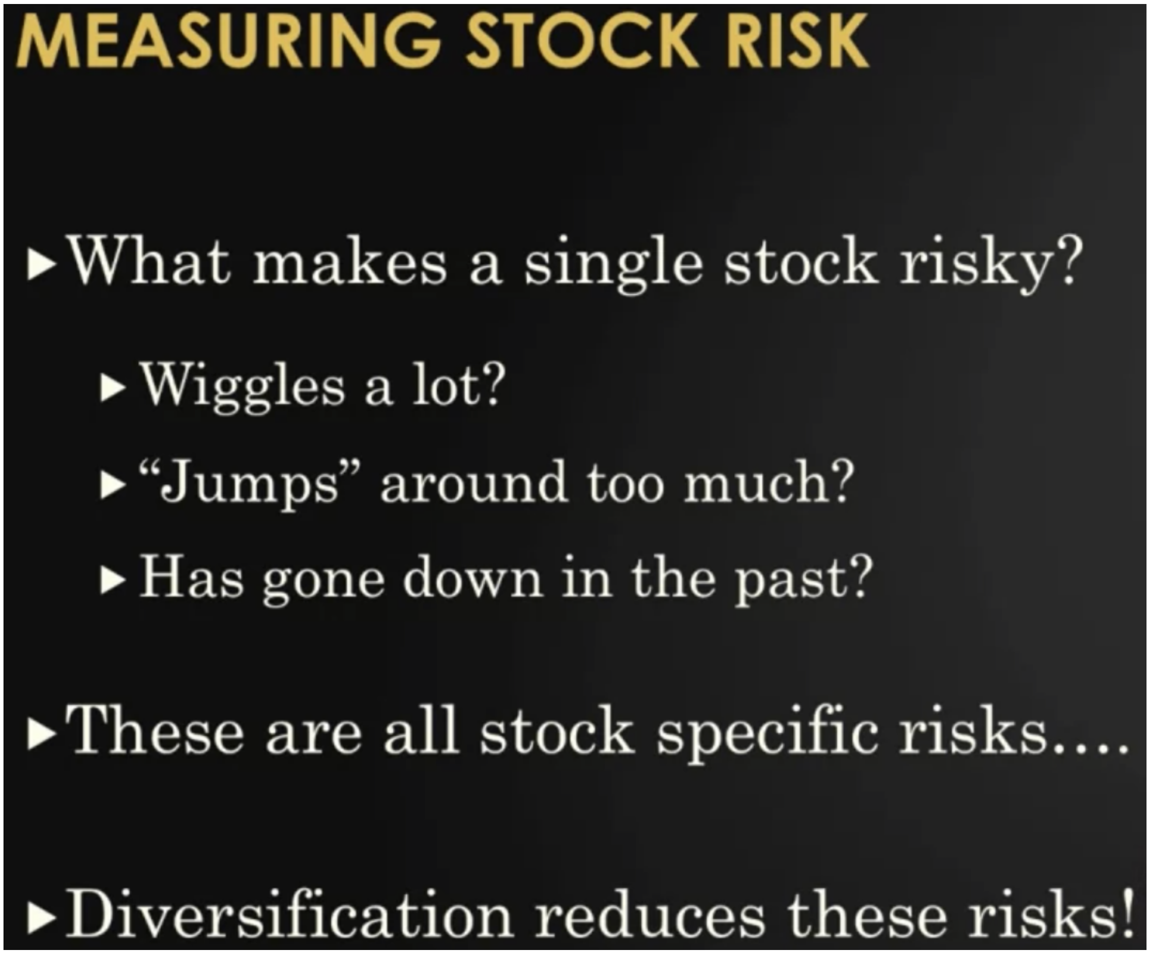


Figure 77: OK, so let's think about what makes a stock risky. Well, it wiggles round a lot, right? That's probably the most intuitive measure, the fact that it moves and jumps around a whole bunch. We just never know what's going to happen to it. Maybe it's up 10%, and then a few days later, it goes down 30%. So how has it done in the past? Has it been going down over time? Those are all what we call *stock specific* risks. Okay, but we don't have to buy just one specific stock, we could buy lots of different stocks. And as we buy lots of different stocks, that diversification might reduce my risk. In other words, if we required 20% to hold a stock that risky, but some other investor says, well, I'm not going to charge you 20% extra return, because I'm going to put you in a diversified portfolio, the company's going to raise money from that investor. So we have to think about diversification and how that diversification sort of plays into the risk of individual stock.

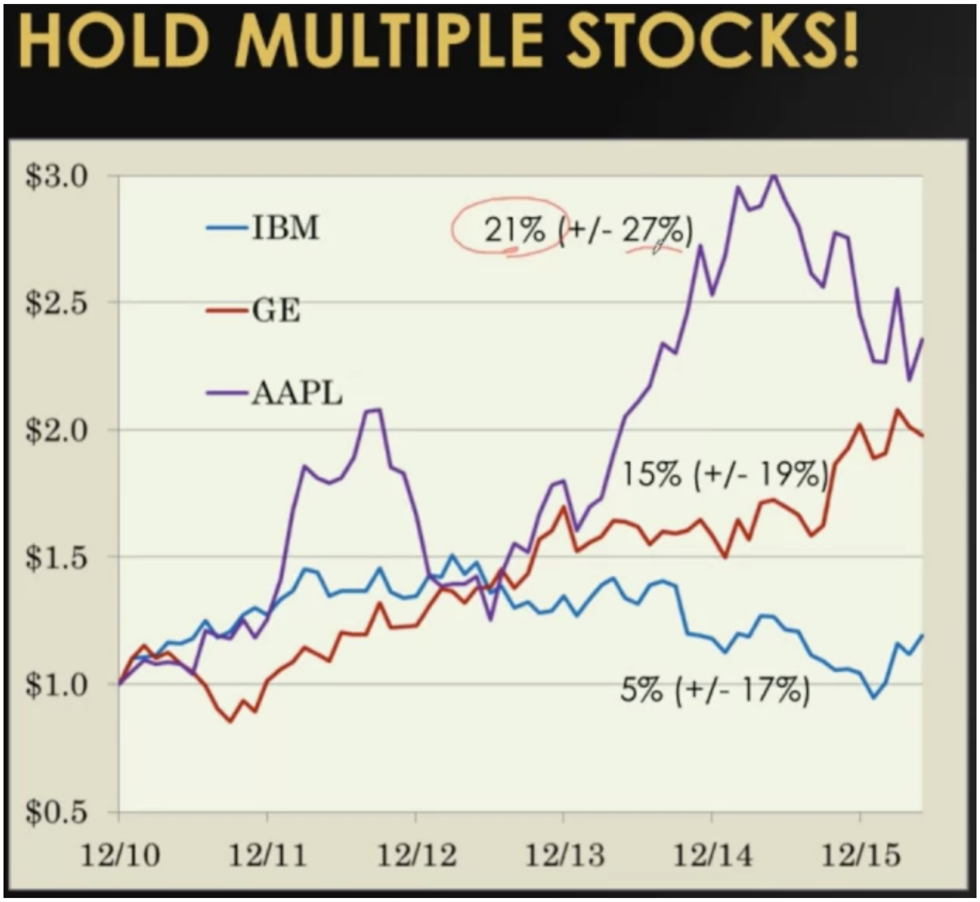


Figure 78: Let's put this through an example. We have a graph here showing the historical returns for five years on three stocks, IBM, General Electric, and Apple. Apple is the purple line that goes up the most. It goes up at around 21% a year, plus or minus 27% – now that's a lot of volatility! General Electric is the red line in the middle, and it goes up on average 15% a year over those five years, plus or minus around 19%. So it wiggles a little bit less. And then IBM is the blue line that's done kind of meh over the five year period. It's gone up on average 5%, plus or minus around 17%. So in terms of risk premiums, you could say, well we should charge Apple the most, and then GE somewhere in the middle, and then charge IBM the lowest.

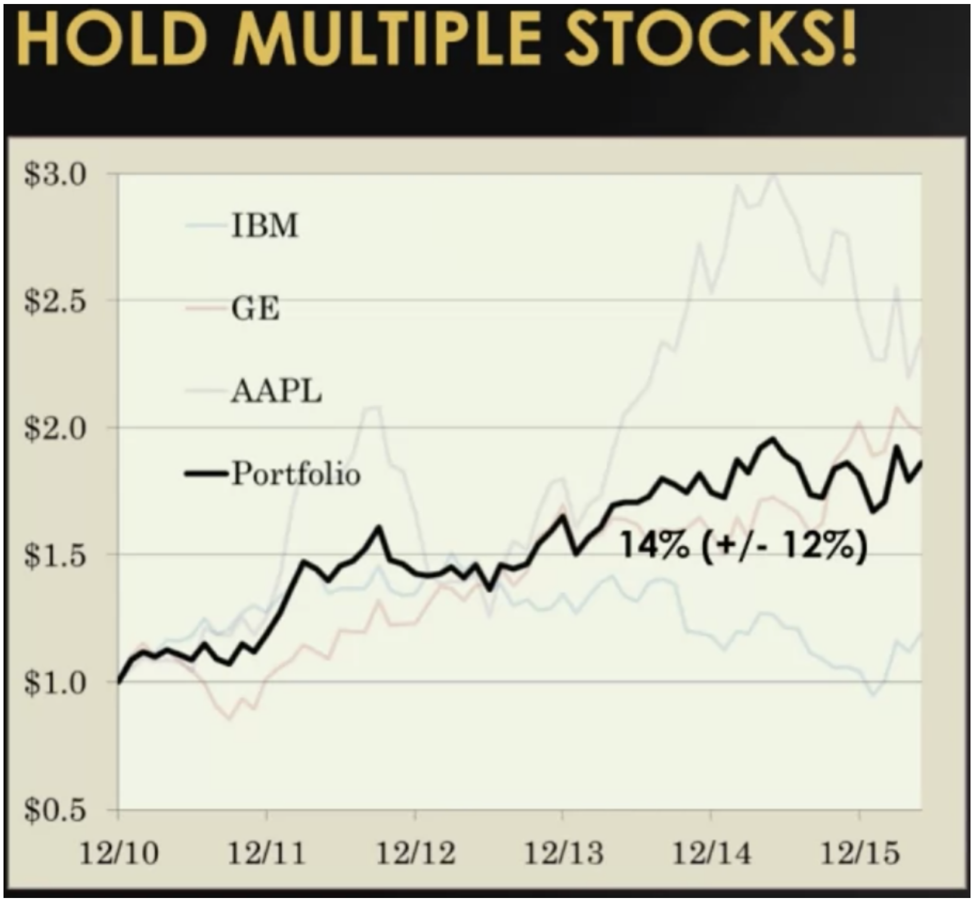


Figure 79: But what if we could put all three stocks into a diversify portfolio – on average, what would we charge that for portfolio? That's that black line, and if we did that, that's now a much smoother line. It's a lot more steady, going up at around 14%, plus or minus only 12% . In other words, the individual stock fluctuations approximately canceled each other out, and from an investor's perspective, that's what I'd love. I would love to just sit back and smoothly earn 5.5%, 6%, 7%, and not have to worry about the ups and downs of the market. The more I diversify, the more comfortable I can get about putting my money into risky securities like stocks. So the more we can get those variations to cancel each other out, the more comfortable we can feel, and the lower the return we're going to require for an individual stock. Therefore, what we want is a measure of how much each stock makes that black line, the entire portfolio line, wiggle. AKA, if we put that stock into our portfolio, does it make that portfolio line wiggle more or wiggle less? What that means is that it's going to depend not really on how much that sole stock wiggles, but really how it wiggles in relation to the other stocks in my portfolio. That's a key concept! The risk of a stock is coming not just from how much it wiggles around, but how much it wiggles around with the other stocks in our portfolio.

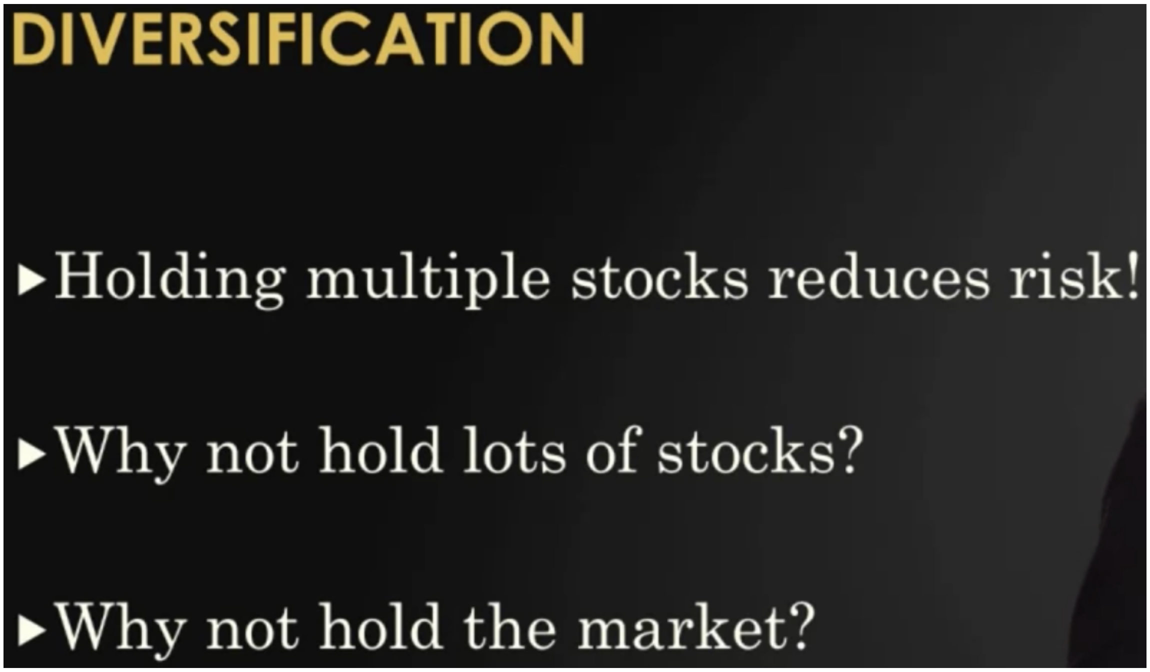


Figure 80: That means holding multiple stocks can reduce my risk. Why not hold lots of stocks? Why not hold the whole market?

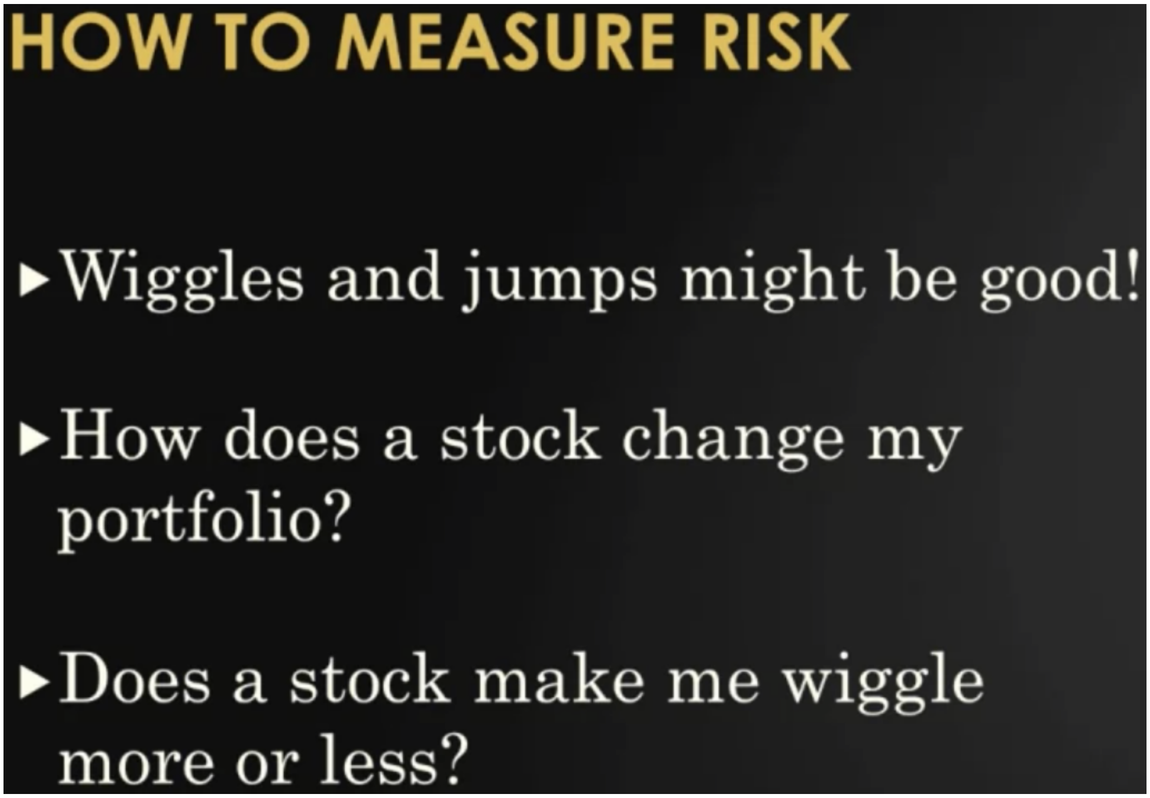


Figure 81: Wiggles and jumps might be good! If that stock wiggles and jumps independently of all of the other stocks in my portfolio, maybe it's actually a hedge against other stocks. So what we want to measure is, how does the stock change the risk of my portfolio? How does the stock make my portfolio wiggle more or wiggle less?

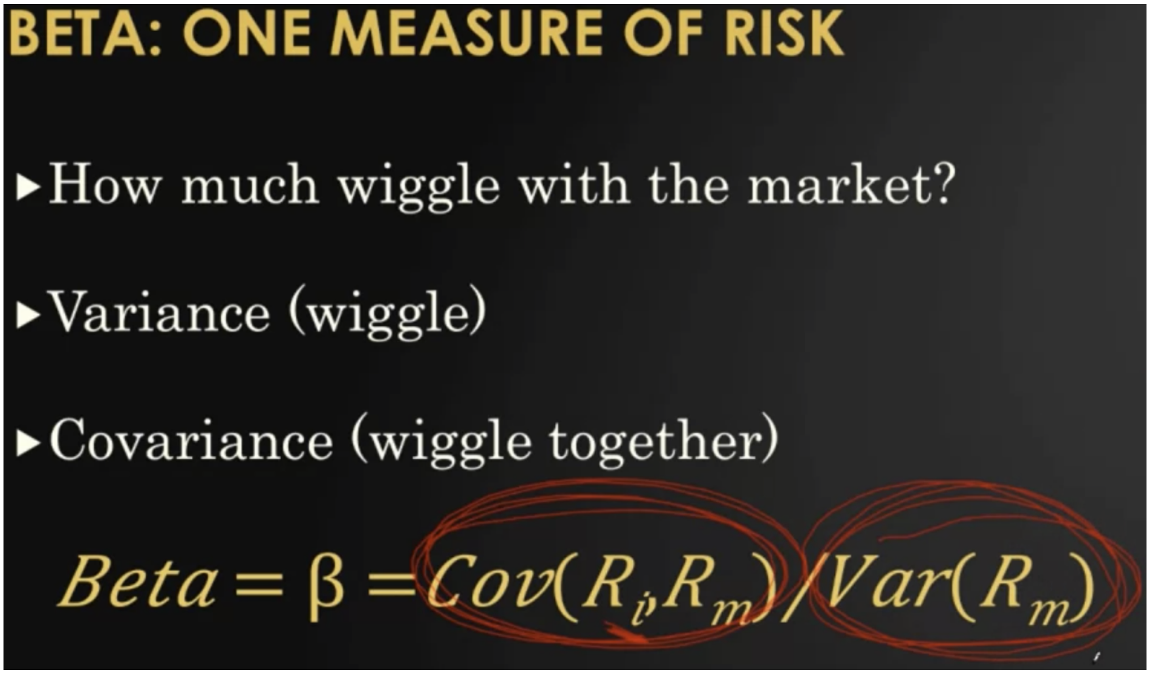


Figure 82: That's going to get us to our measure of *beta*. Beta is going to tell us how much the stock wiggles with the market. To do that, we're going to think about the variance of the market, and we're also going to think about the covariance, how the market and the individual stock wiggle together. If they move together, then they have a high covariance. But if they're independent, where the movement of one doesn't affect the other, then there's no covariance between them. So covariance is the physical measure of how things move together, and variance is the measure of how something moves relative to itself. OK, so the beta is a ratio of those two things. How much does our stock, the stock that we're looking at, move with the market? So that's the covariance between our *Ri*, our individual stock, and the market, *Rm*. And then we're going to take that and scale it by how much market moves overall. That beta is a measure of how risky our stock is in a portfolio.

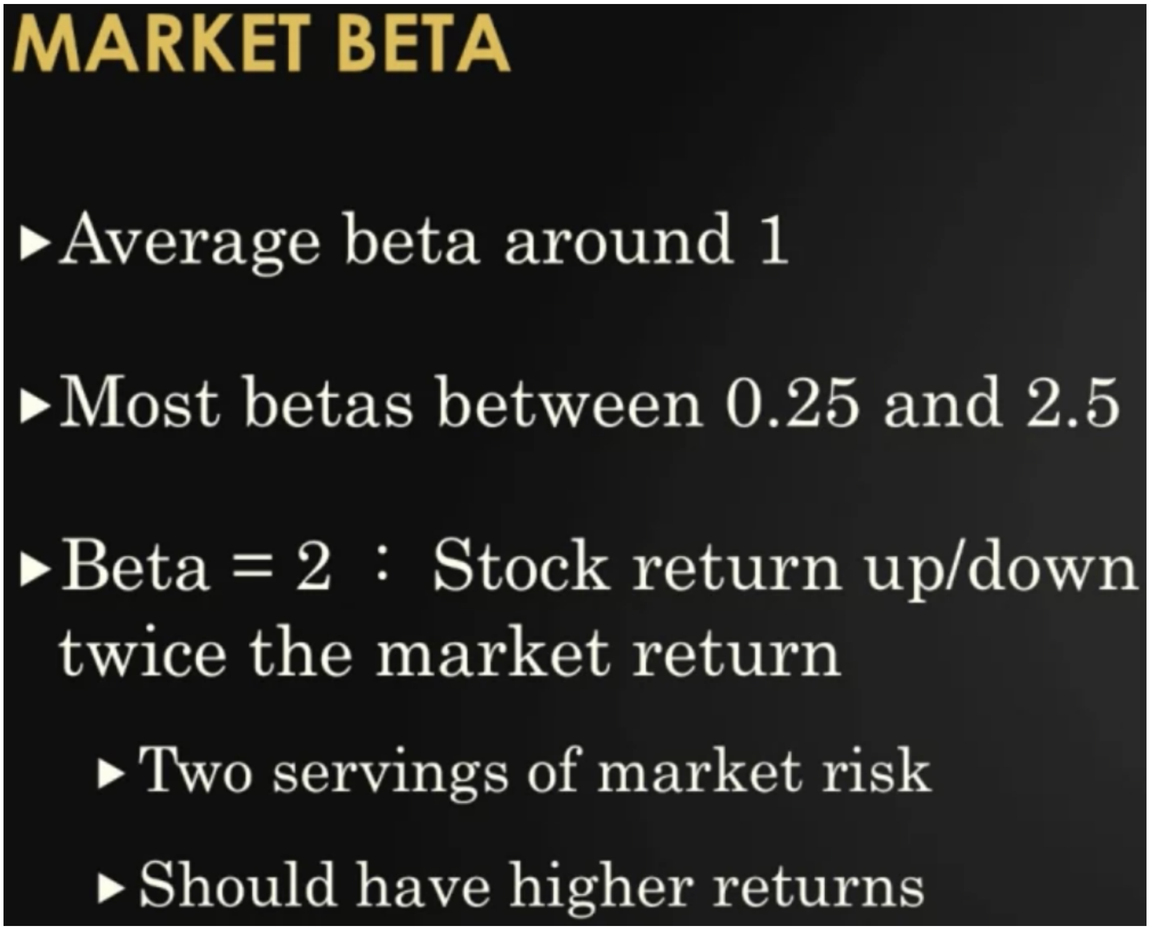


Figure 83: Betas are usually around one, but they can go as low as around 0.25 and sometimes even as high as 2.5. And that beta tells us how much market risk we're taking when we buy that stock. For example, if a stock has a beta of two, then that stock wiggles around twice as much as the market. So if the overall market risk is around 5.5%, then we would require two servings of market premium in order to buy that stock, because that stock is twice as risky as the market return. That means two servings of market risk should a return that's twice as high.

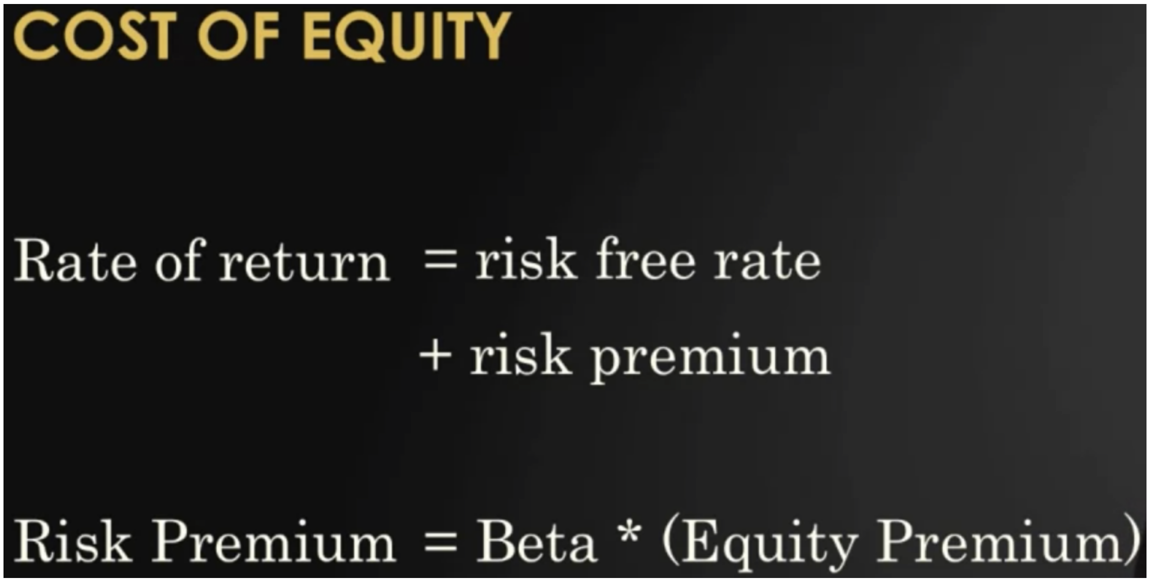


Figure 84: When we think about the cost of equity, that rate of return was the risk free rate plus some risk premium. We now have a way to think about what that risk premium is. That risk premium should be beta, how much the risk of an individual stock is when compared to the overall market, times the overall market equity premium, that 5.5%, which is one serving of market risk. Beta is basically how many servings of market risk that we have, and the equity premium is one serving of market risk.

Figure 85: We can now put that together to come up with what we call the Capital Asset Pricing Model (or in finance, CAPM), which tells us that the risk of return of any asset is the "risk free rate + (Beta times the Equity Premium)". And that simple formula gives us a way to measure the risk on any stock because every stock is going to have a different beta, which we can calculate individually or just look up on Yahoo. So that *Re*, that discount rate for equity, is the "risk free rate + (Beta times the Equity Premium)" – or, our Capital Asset Pricing Model.

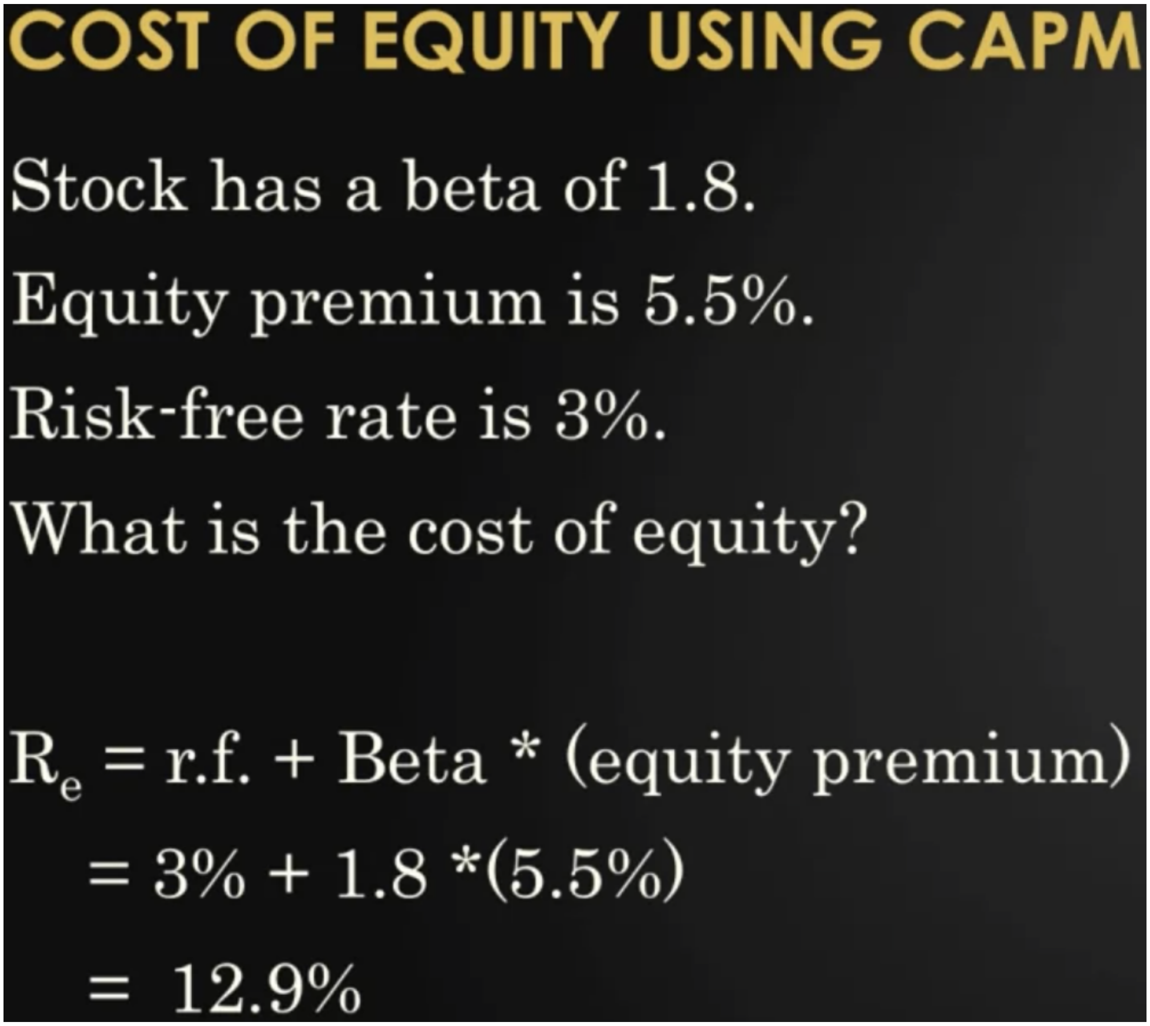


Figure 86: So for example, if a stock has a beta of 1.8, the equity premium is around 5.5%, and the risk free rate is 3%, what would be the cost of equity for that stock? It would be the risk free rate, plus beta times the equity premium. In this case, that would be 3% + (the beta of 1.8 times the 5.5% equity premium), for a total of 12.9%. Now we have a number, now we have a discount rate that we can use to discount what, we think, are going to be future cash flows to the equity holders. Another way to think about that is if we buy that stock, how much do we expect to earn for taking that much risk? We expect to earn about 13% for a stock with a beta of around 1.8.

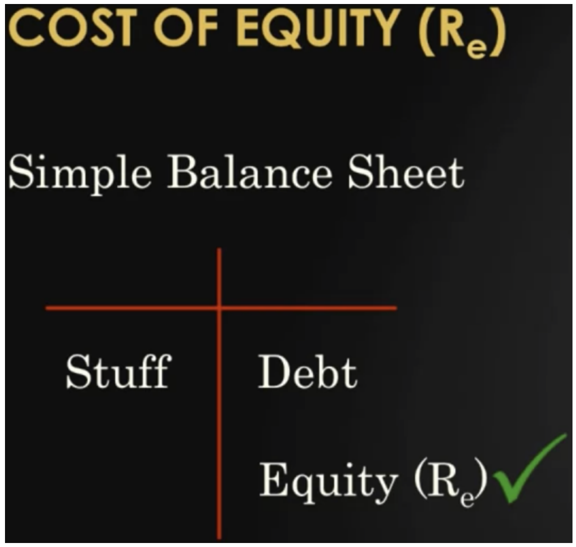


Figure 87: Okay, so let's go back to that simple balance sheet from Section 4.1 where we said we had stuff on the left-hand side and then debt and equity on the right-hand side. Well, now we have a way to discount the cashflows to equity. That's our capital asset pricing model.

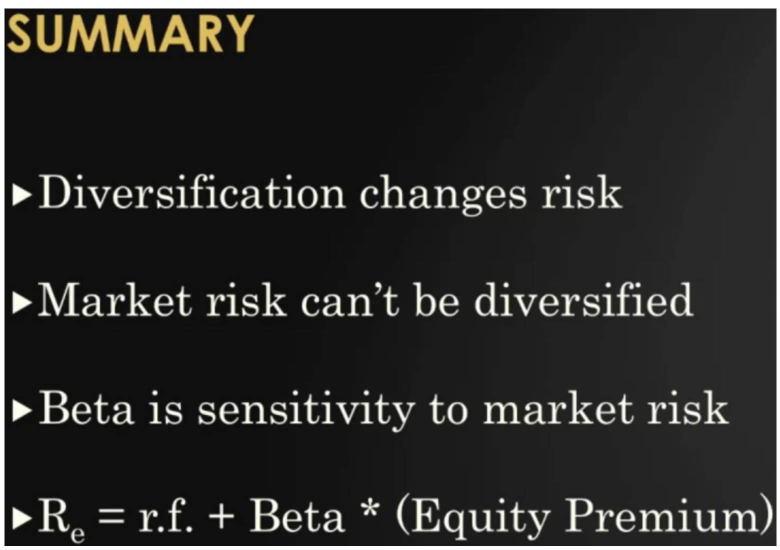


Figure 88: So diversification changes risk, and market risk can't be diversified away; that was that 5.5%. Beta measures our sensitivity to that market risk, and when we put those two things together, risk-free rate + (Beta times the Equity Premium), we have a way to discount the risk of owning individual stocks.

4.6 Credit Ratings and Quality Spreads

Now, let's turn to the cost of debt. And to give us a basis for that, let's talk about credit ratings and quality spreads.

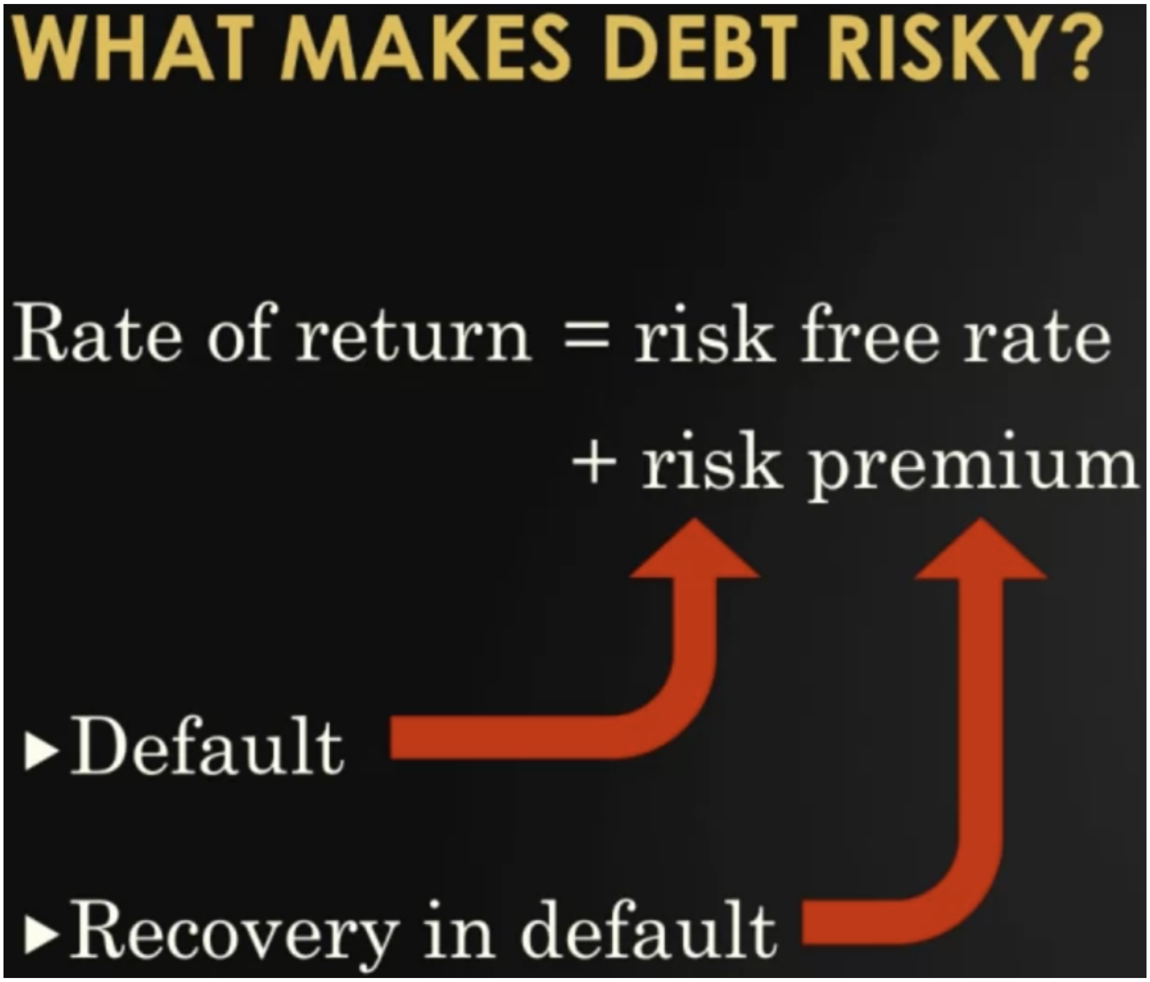


Figure 89: OK, so what makes debt risky? Well, when we thought about a rate of return, any rate of return, that was the risk free rate plus some risk premium. What should the risk premium be when we think about debt, when we think about bonds, or bank loans, lines of credit? Well, the main thing that I'm worried about is will the firm default, or just not pay anything back, right? Because I'm not going to get any extra money if the firm does really well. So that's going to earn a risk premium. The other thing I'm worried about is: if the firm defaults, how much can I get back? What's my recovery rate going to be in default? Those two things, default and recovery in default, are how we put risk premium on debt.

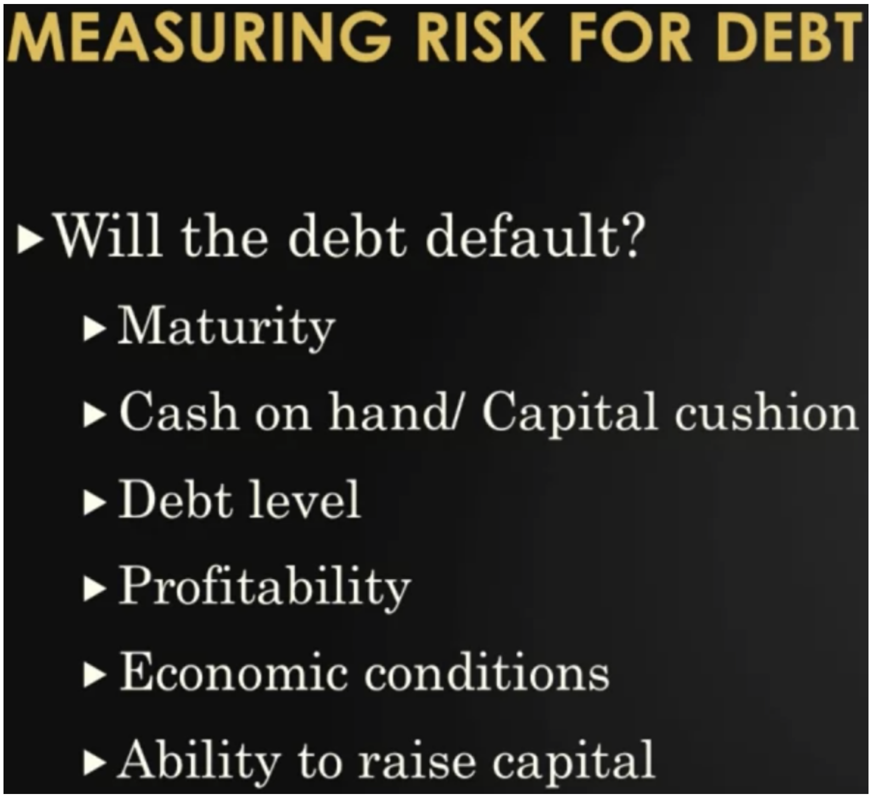


Figure 90: So will a firm default on its debt? Well, the longer the maturity of the debt, the more worried we are about the firm defaulting. The cash that it has on hand, its capital cushion, the lower that is, the more worried we are about default. How much debt it has overall – the more indebted the firm is – the more worried we are about default. Is the firm profitable? The better the profitability, the less worried we are about debt. And what are general economic conditions? Are in a recovery? Are we in an expansion? Are we in a recession? That's going to make us worry more or worry less about whether or not the firm is going to default. So those are the main things that make us worry about default, when we think about the *credit worthiness* of the firm. All of those things affect the firm's ability to raise capital. All of those are going to go into the cost of debt. You can imagine a firm that comes in and wants to borrow a whole bunch of money for a long time, but that doesn't have any cash. They already have a ton of debt. They're not making any money, and we're in the middle of a recession. A bank is going to either not want to lend money at all, or is going to charge them a really high interest rate. On the other hand, if it's a big, diversified industrial conglomerate, and they want to raise money for the next 60 days, and they have tons of money, little debt, and they're making lots of money in an expansion period, you almost might give them the money for free! You might charge them a 1% or 2% rate, right? All of those things together are going to make the banks or the credit markets more or less willing to lend at any given rate and affect the risk premium.

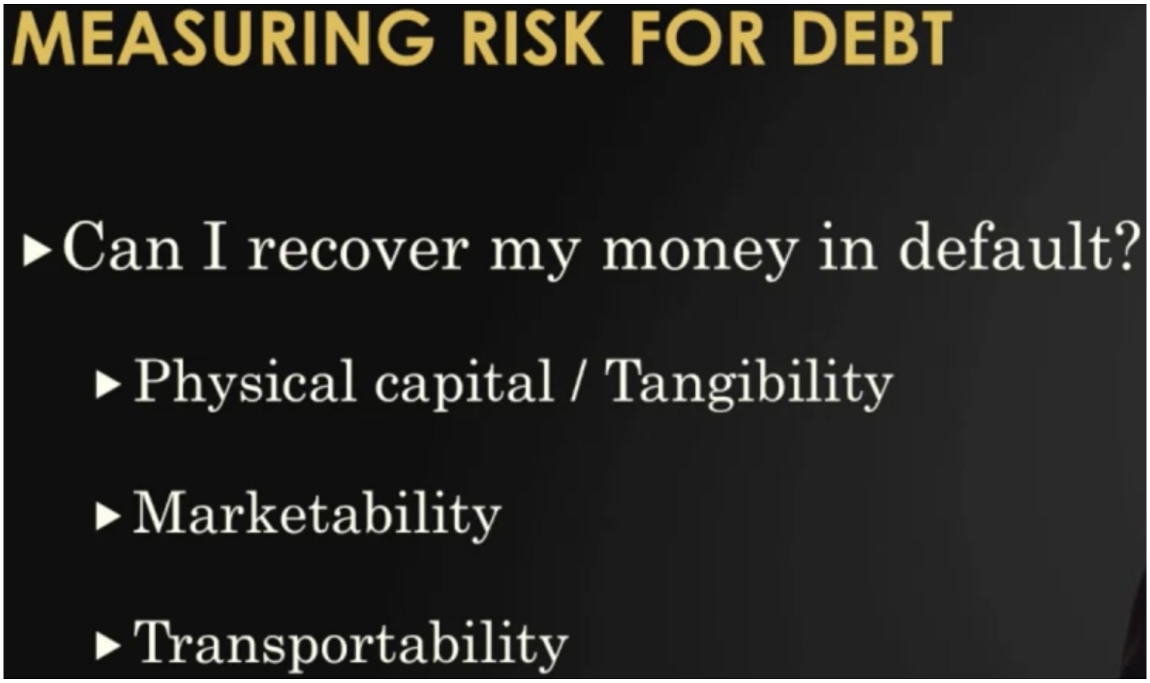
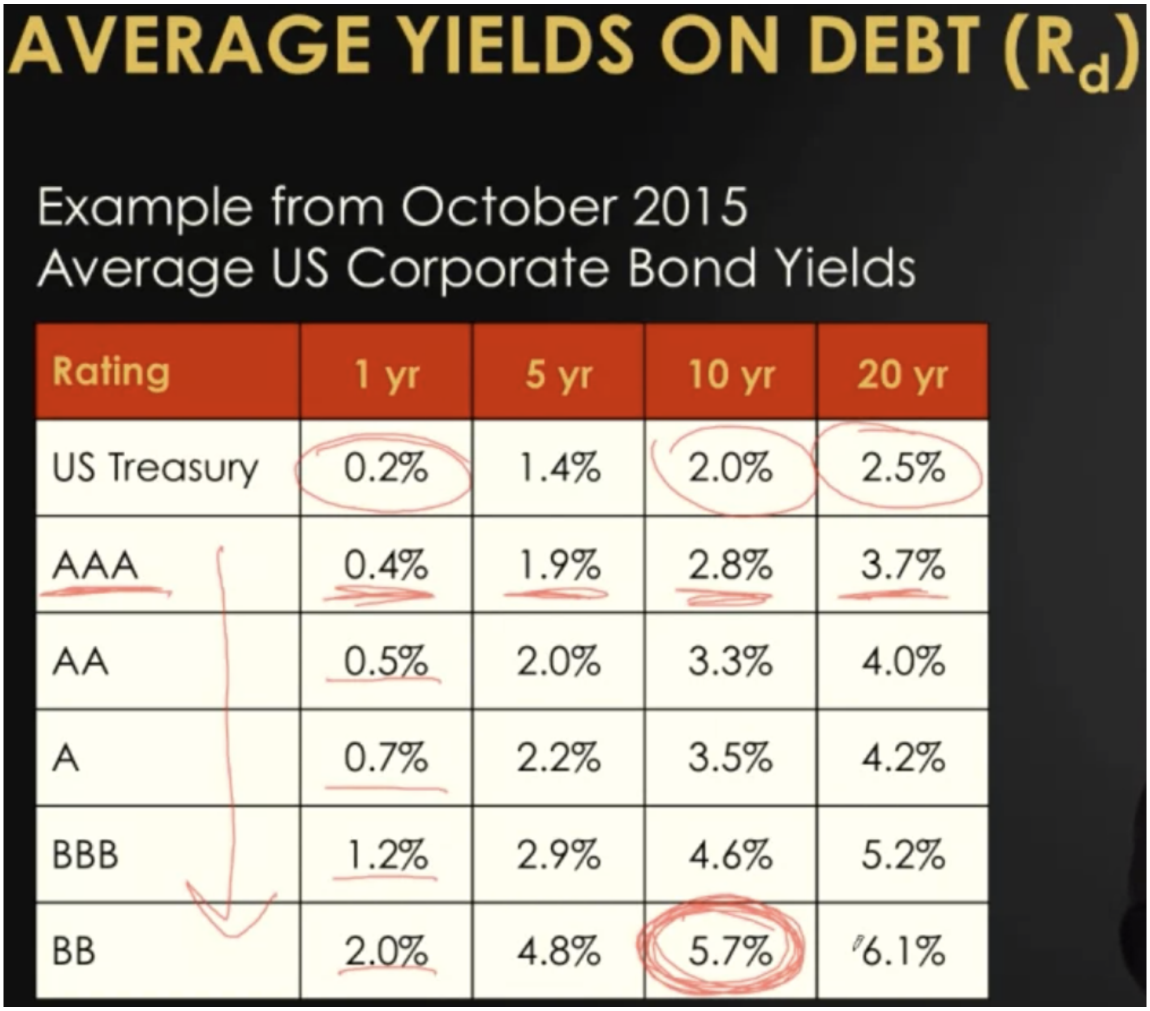


Figure 91: So how much can we recover in the state of default? A lot of that depends on physical capital, if there are actual physical assets that we can come and take – like airplanes for example. Airline companies borrow lots and lots of money. But from the bank's perspective, that's OK because they've got it collateralized with airplanes. And airplanes we can just pick up and move someplace else. They're easy. They're physical, they're transportable, and they're marketable. we can sell them. For something like tooling and die, machine that's drilled into the ground and bolted into the factory floor, that might be harder to market and transport, even though it's still physical capital. So the easier it is to recover and sell that collateral, the safer it is to a bondholder.

Figure 92: Luckily, banks and credit rating agencies do a lot of the work for us. They estimate these default and recovery rates and assign classifications. If you've ever tried to get credit on your own, you know that you have a credit score. Credit scores work for firms as well, and larger, public firms and companies have *credit ratings* from places like Moody's or Fitch. It's a lot like being in class. You get a rating of A, B, or C depending on your credit worthiness, which determines what your likelihood of default is and what your likelihood of recovery is in the state of default. We can then use those credit ratings to assign a cost of debt, which is going to give us a risk premium to put on top of the risk free rate to assign a cost of debt.



AVERAGE YIELDS ON DEBT (R_d)

Example from October 2015
Average US Corporate Bond Yields

Rating	1 yr	5 yr	10 yr	20 yr
US Treasury	0.2%	1.4%	2.0%	2.5%
AAA	0.4%	1.9%	2.8%	3.7%
AA	0.5%	2.0%	3.3%	4.0%
A	0.7%	2.2%	3.5%	4.2%
BBB	1.2%	2.9%	4.6%	5.2%
BB	2.0%	4.8%	5.7%	6.1%

Figure 93: Let's look at some data on the average yields of debt from 2015. We can see that U.S. Treasury rates are very low here, with a one year rate around 0.2%, or 20 basis points (1 basis point is 1/100 of 1%, or 0.01%). Continuing along, we can see that the 10 year rate is around 2%, and the 20 year rate is around 2.5%. There's that relationship – the longer the maturity, the higher the discount rate, and if we look at AAA-rated debt, which is the highest and most credit worthy debt – those still trade at a premium to treasuries. That's what we call the *quality spread*, which is the discount rate increase when the only difference between two debt options is the credit worthiness of the firms. As we go down in credit quality, from AAA to A, from BBB to BB, the yields on that debt go up. So on the flip side, if we were a firm, and we wanted to issue 10 year debt, and we were rated at BB, we would expect to pay around 5.7%. Therefore, we can look at charts like these and ballpark how much we would pay if we wanted to go out and raise debt capital today.

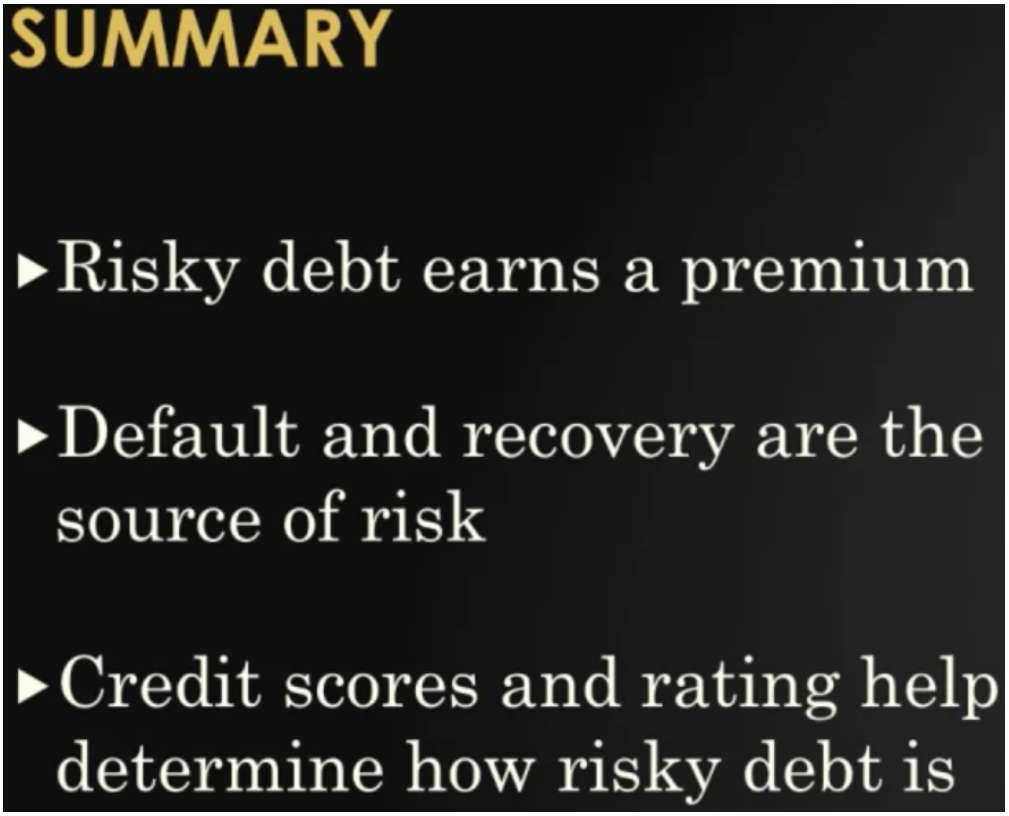


Figure 94: OK, so to sum up, risky debt has to earn some kind of premium, because otherwise, why wouldn't we just put money in treasuries? Default and recovery in default are the main sources of risk that go into putting that risk premium on top of treasury rates. And credit scores and credit ratings help us determine how risky that debt is.

4.7 Estimating the Cost of Debt

So if we were going to do this ourselves, how would we estimate the cost of debt?

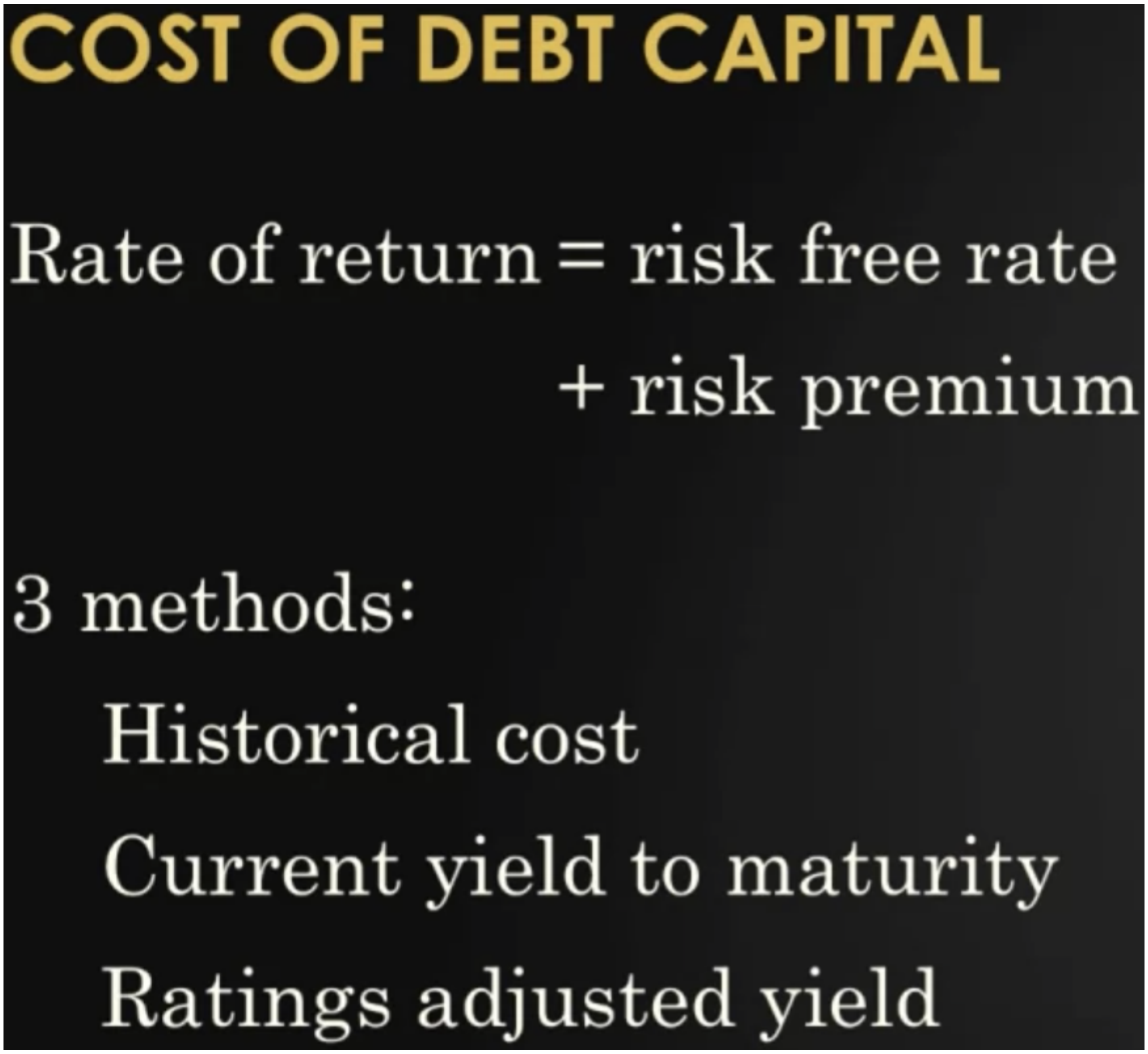


Figure 95: There are 3 basic ways to think about estimating the cost of debt – in other words, what's our risk premium on that debt on top of the risk free rate? First, we can look at the historical cost of debt to figure out a risk premium, or second, we can look at the current yield to maturity of already existing debt. But probably the most useful method is the third: looking at the ratings adjusted yield, playing off of Section 4.6 and thinking about credit ratings and quality spreads.

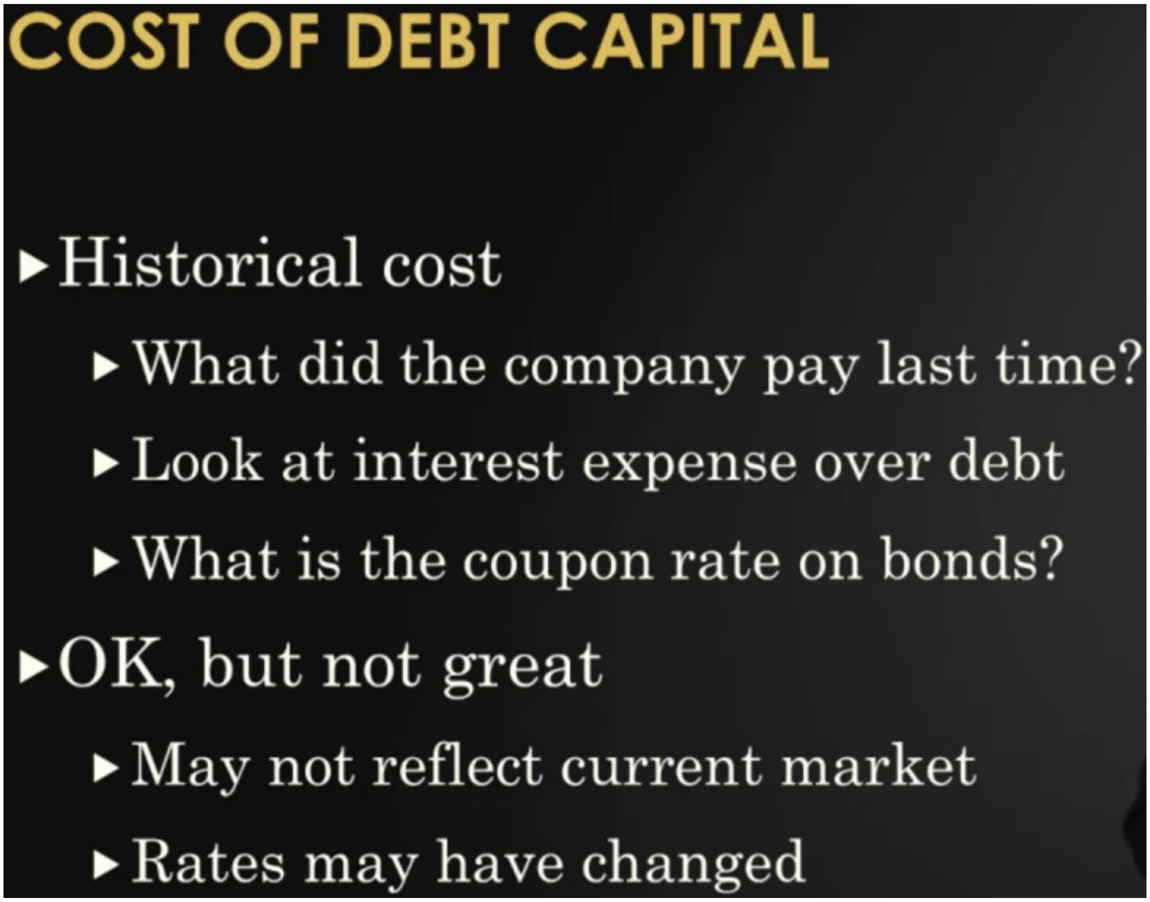


Figure 96: So let's start with the first, historical cost: what did the company pay the last time that it issued debt? Maybe 3 years ago, we paid 4.5%, so maybe that's the best guess for what we'd pay the next time around. That 4.5%, maybe that was the interest expense on our current outstanding debt, or maybe that was the coupon rate, or the interest rate, on our most recent bond issue. That works OK, but it's not a super great method for estimating the cost of debt – if we have nothing else to go on, that's what we can use. But that may not reflect current market rates: prices may have changed, interest rates may have go up, maybe the Fed comes out and does something. Maybe our credit worthiness changed in the meantime. Historical costs don't always reflect the going forward, or forecasting, of what our cost of debt might be, so that's something to be careful of. We need to be cautious about using it, and we need to understand that we're looking only backwards – we can't look forward using historical cost.

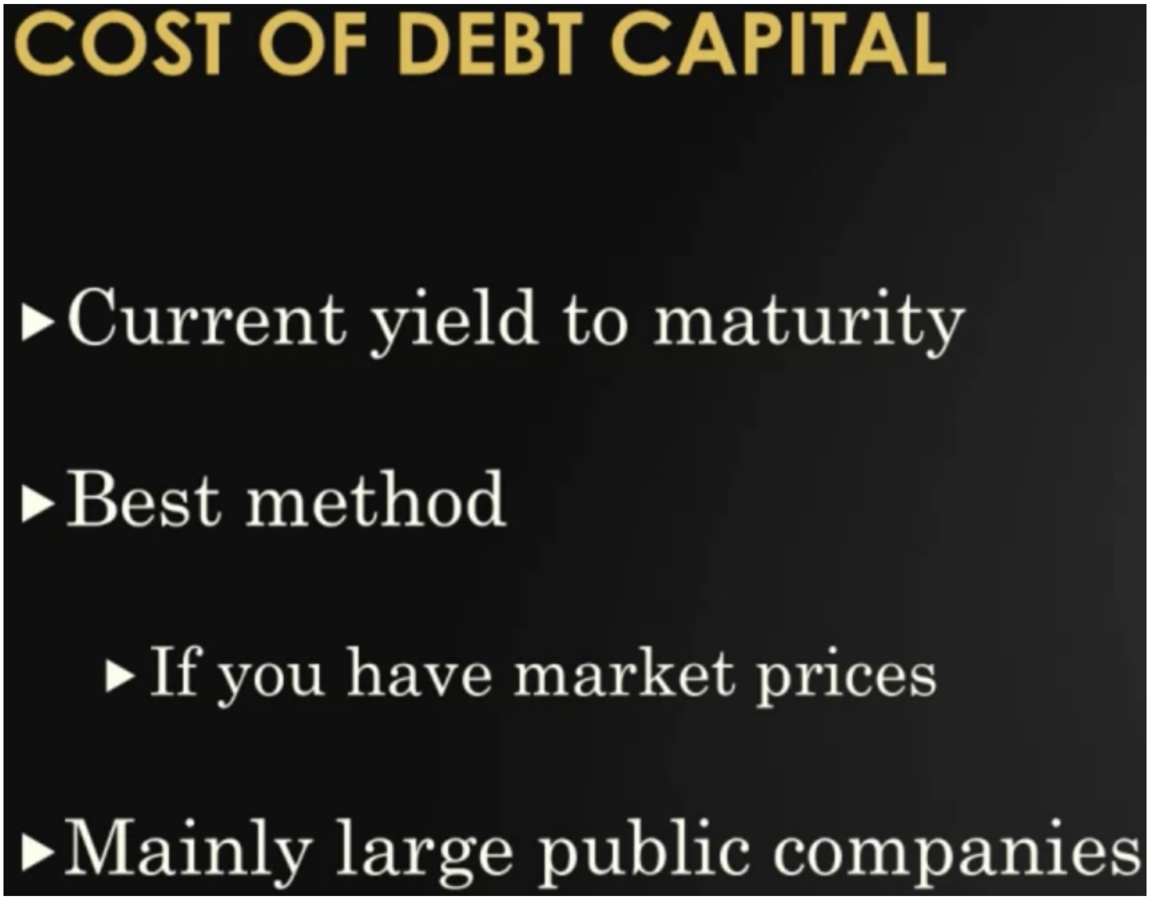


Figure 97: The ideal scenario is to use the current yield to maturity. If we have outstanding debt that is currently traded on the open market, then bingo. That's what we would issue if we were going to issue debt today. Trouble is, that only really works if there's a current market for the debt, which is really only going to be relevant for large public companies. So if we're thinking about putting a cost of debt on General Electric, we could go look at General Electric bonds that are trading most days. See what the yield to maturity is, see what the interest rate is currently being discounted on General Electric's bonds, and that's what we would pay if we issued debt today. But if we're not a large public company, if we don't have good market prices on our firm's debt, what are we going to do?

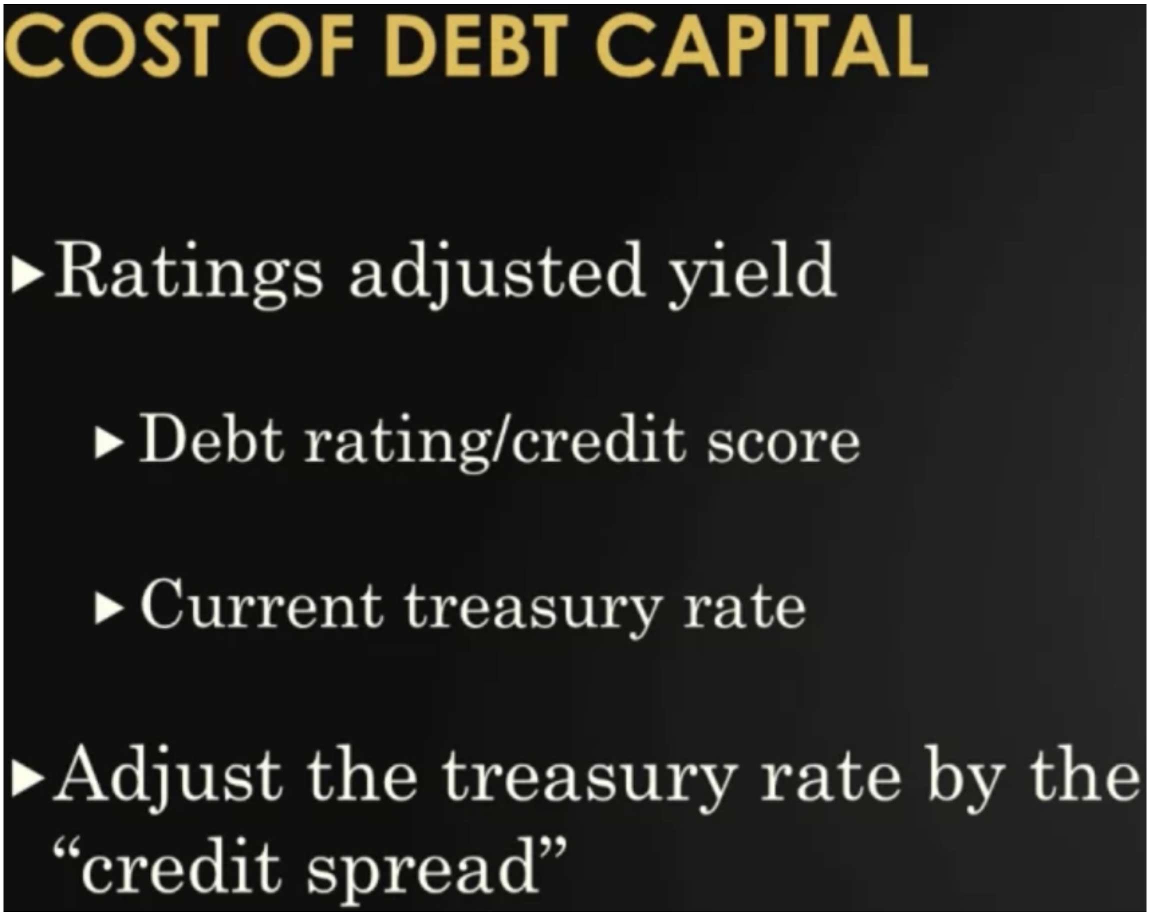


Figure 98: So let's do the usually most useful option and go back to Section 4.6, where we talked about a ratings adjusted yield. We can simply look at the credit rating of the firm and put our premium on top of the treasury rate based on that credit rating – this is because we can use other firms as comparables! See, it's hard to compare one stock to another, because they all have unique risks and challenges. But bond is a bond is a bond. If we promise to pay you this rate at this point in the future, whether that's been issued by General Electric or IBM – outside of minor variations in credit worthiness, which is what the quality spread (also called the credit spread) is going to tell us – as long as we stay within a credit score category, the bonds are pretty much interchangeable. So we can infer from other companies what our rate might be.

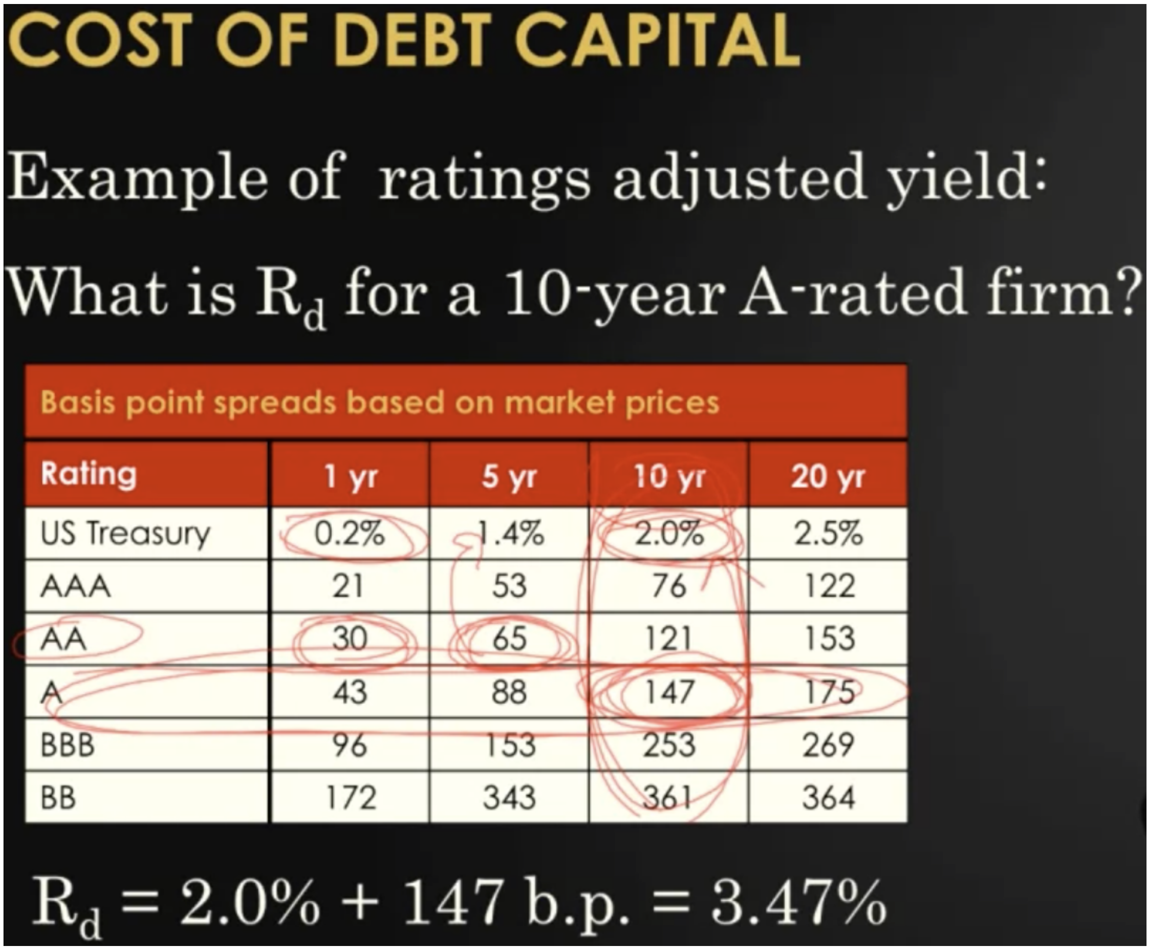


Figure 99: So let's do an example of a ratings adjusted yield. What would be our cost of debt if we were going to issue a 10 year maturity for an A-rated firm? Let's go right back to a similar table like that from Section 4.6, where we looked at different treasury rates for different credit ratings. These are coming from other firms, where we can see the bonds trading over time. Here, we need to know that the basis point spread is the risk premium – in other words, we still need to account for the risk free rate to find the full cost of capital for the debt, the *Rd*. So we need to add the 2% treasury rate + the 147 basis point, or 1.47%, premium, and that gives us a total cost of debt of 3.4%. A nice, simple, easy, back-of-the-envelope way to calculate cost of debt, and one that is much easier than the equity cost, where we had to calculate betas and covariances. Since a bond is a bond is a bond, we can just look at comps, figure out what the quality spread is, tack that onto the treasury rate, and call it a day.

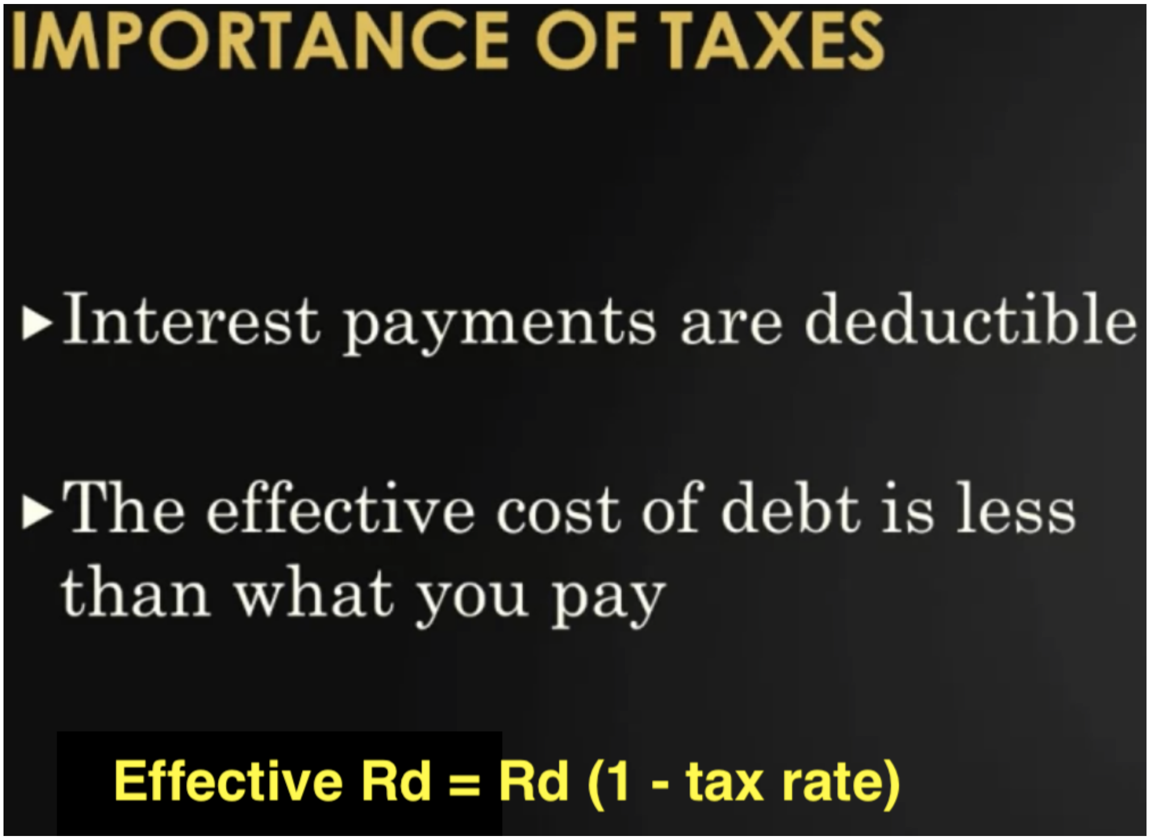


Figure 100: OK, so interest payments are tax deductible. It's important to remember this. The effective cost of debt *as a company* is less than what we actually pay to the bank. In fact, our effective cost of debt is going to be that Rd from before times (1 minus the tax rate).

Importance of Taxes on Making Debt Cheaper

Cost of Debt After Taxes

The after-tax cost of debt is the interest paid on debt less any income tax savings due to deductible interest expenses. To calculate the after-tax cost of debt, subtract a company's effective tax rate from 1, and multiply the difference by its cost of debt. The company's marginal tax rate is not used, rather, the company's state and the federal tax rate are added together to ascertain its effective tax rate.

For example, if a company's only debt is a bond it has issued with a 5% rate, its pre-tax cost of debt is 5%. If its tax rate is 40%, the difference between 100% and 40% is 60%, and 60% of the 5% is 3%. The after-tax cost of debt is 3%.

The rationale behind this calculation is based on the tax savings the company receives from claiming its interest as a business expense. To continue with the above example, imagine the company has issued $100,000 in bonds at a 5% rate. Its annual interest payments are $5,000. It claims this amount as an expense, and this lowers the company's income on paper by $5,000. As the company pays a 40% tax rate, it saves $2,000 in taxes by writing off its interest. As a result, the company only pays $3,000 on its debt. This equates to a 3% interest rate on its debt.

Figure 101: Great explanation on Investopedia that goes into more detail and provides a good example. URL link: https://www.investopedia.com/terms/c/costofdebt.asp

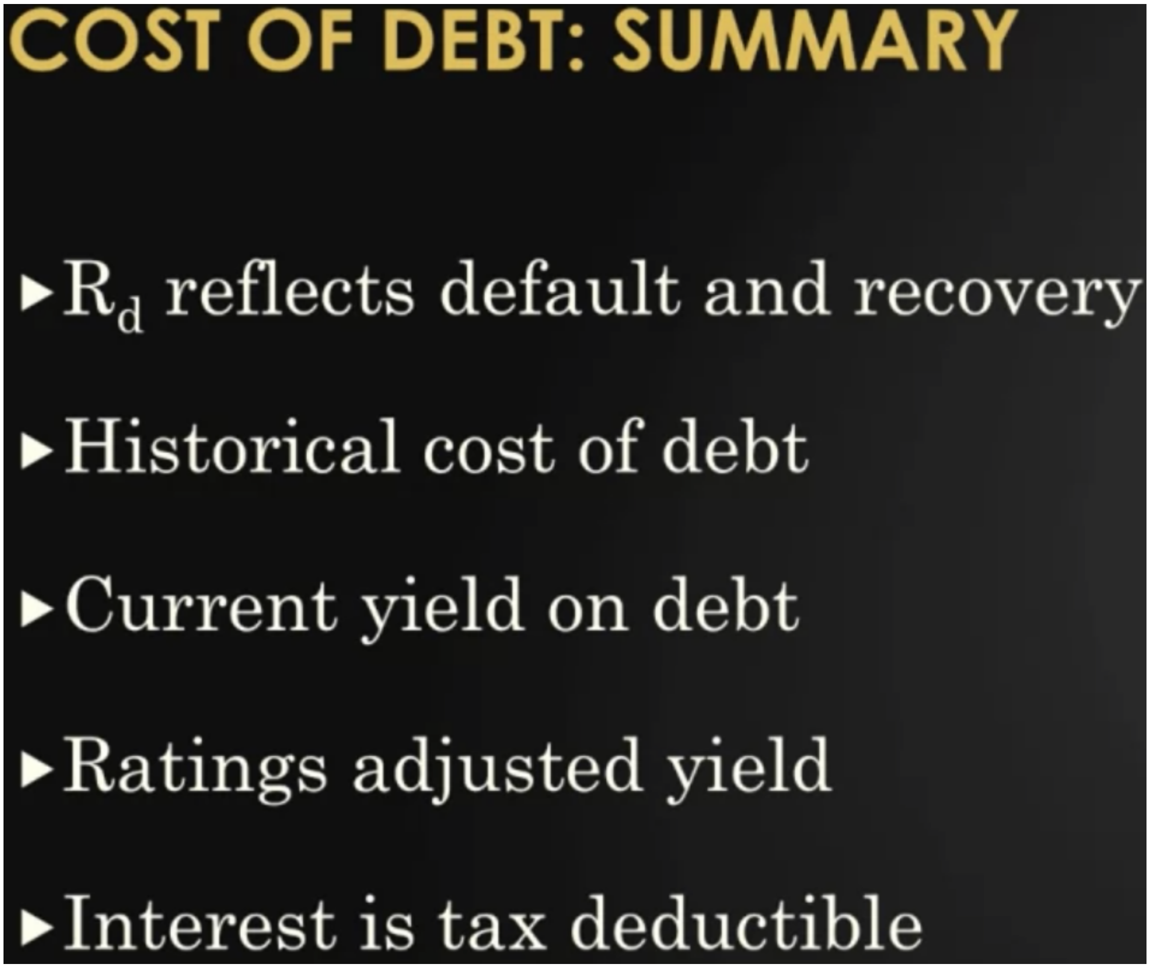


Figure 102: OK, so to sum up, the cost of debt reflects the premium of both defaulting and recovery in the event of a default. To calculate the cost of debt, that *Rd*, could use a firm's historical cost of debt, or it's current yield – only if we have some good market prices – or we can use the ratings adjusted yield, which is probably the most popular way of estimating the cost of debt. And always remember that the interest is tax deductible. Our effective interest rate is lower than what we're actually paying.

4.8 Putting it All Together as the WACC (Weighted Average Cost of Capital)

OK, so let's put together the cost equity and the cost of debt to come up with our weighted average cost of capital (WACC).

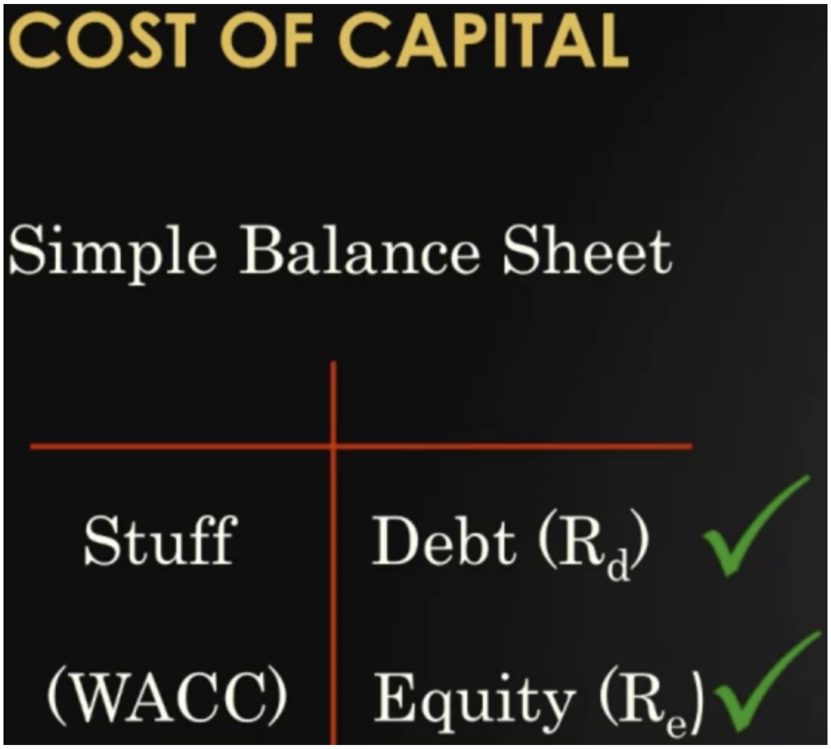


Figure 103: So if we go back to that very simple balance sheet from Section 4.1, we said that there is stuff over on the left-hand side of the balance sheet and debt and equity over on the right-hand side of the balance sheet. Well, now we've talked about the cost of debt and we've talked about the cost of equity. We said the cost of equity, AKA the capital asset pricing model, was the Risk Free Rate + (Beta times the Market Premium). That gave us the discount rate that we should use depending on the riskiness of an individual stock. For the cost of debt, we were going to use 1 of 3 options: historical cost, yield to maturity, or, more likely, the ratings adjusted yield to figure out what default and recovery premiums we should put on debt. That came out to be the Risk Free Rate + the Risk Premium.

So different firms have different capital structures. Some firms have no debt at all; they're all equity. Other kinds of firms, like an airline company, have lots of debt. So what their average cost of capital is depends on how much debt and how much equity is financing all the stuff on the left-hand side. And that's ultimately what we want: one unified discount rate to apply to the entire firm overall. So just as the balance sheet has to balance (assets = liabilities + equity), the balance sheet has to balance risk, too. And the way that's going to happen is to take a weighted average of the debt and the equity to make up the capital structure of the firm.

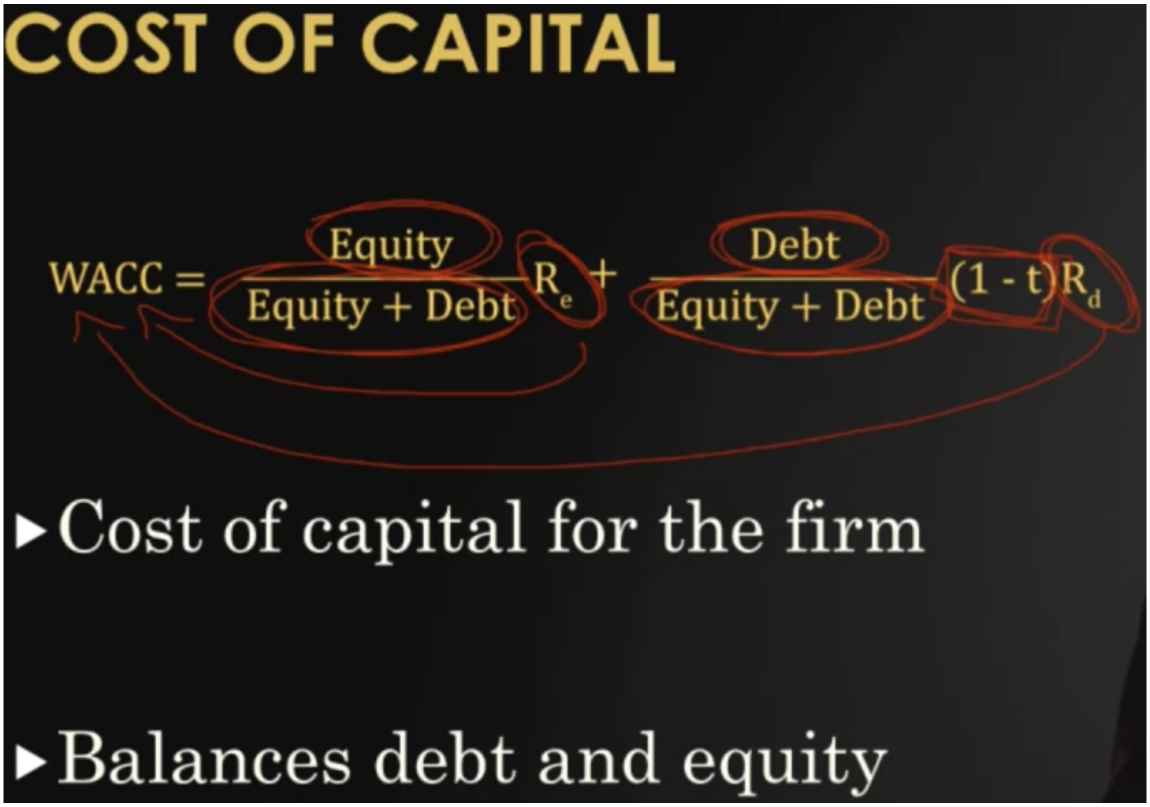


Figure 104: We're going to call that discount rate for the overall cost of capital the *weighted average cost of capital*, or WACC, and that formula is above. It's actually a pretty simple formula. It's just the proportion of the firm that's equity times the equity premium, added to the proportion of the firm that's debt times the debt premium, and with a tax offset factor included in the debt calculation to reflect the effective cost of debt. So when we put those things together and take a weighted average of *Re* and *Rd*, those weights come together to form the weighted average cost of capital. Just as a reminder, the two proportions add up to 1, solidifying the notion that this is a weighted average.

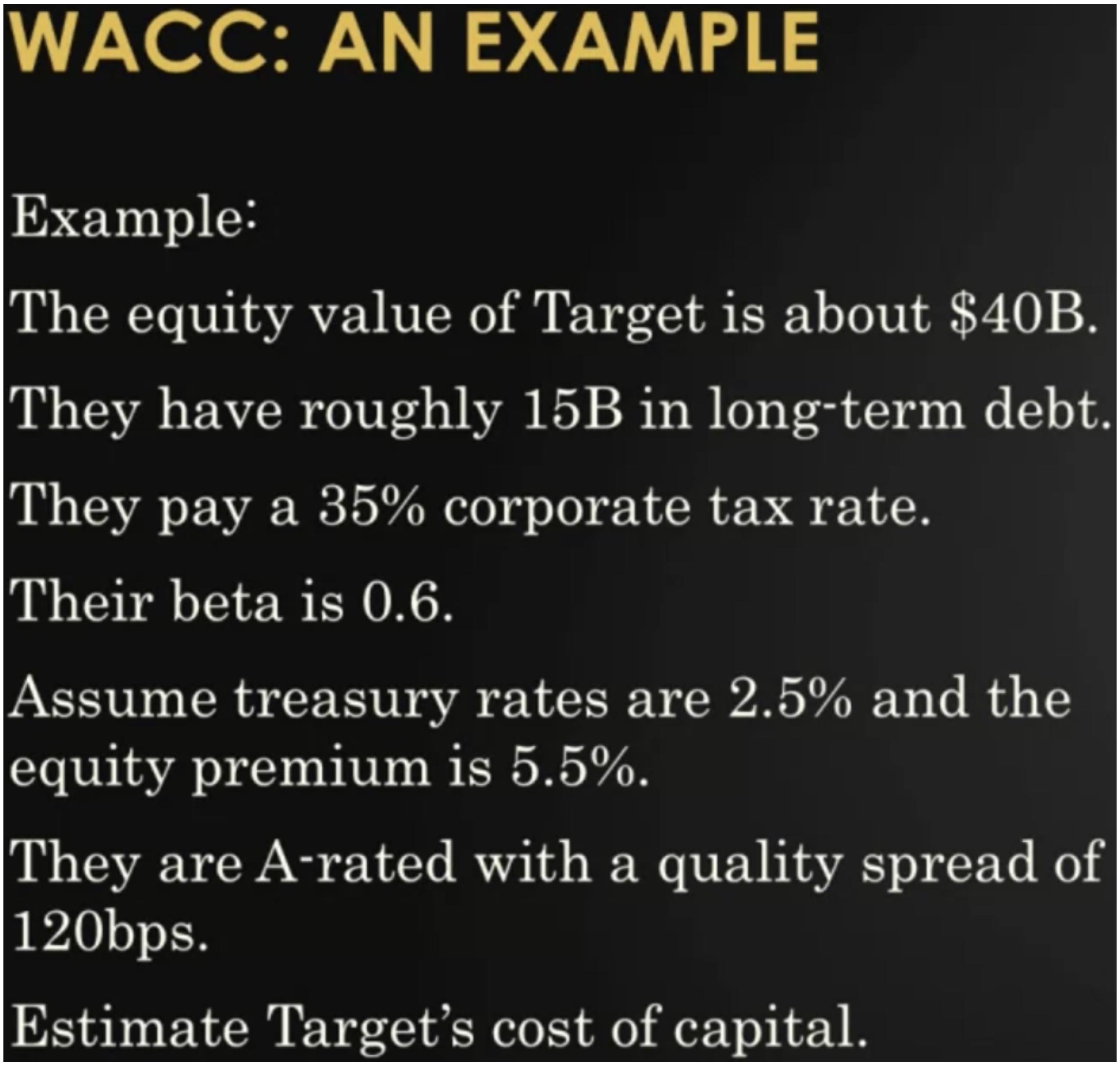


Figure 105: WACC Example for Target. The next page has the calculations.

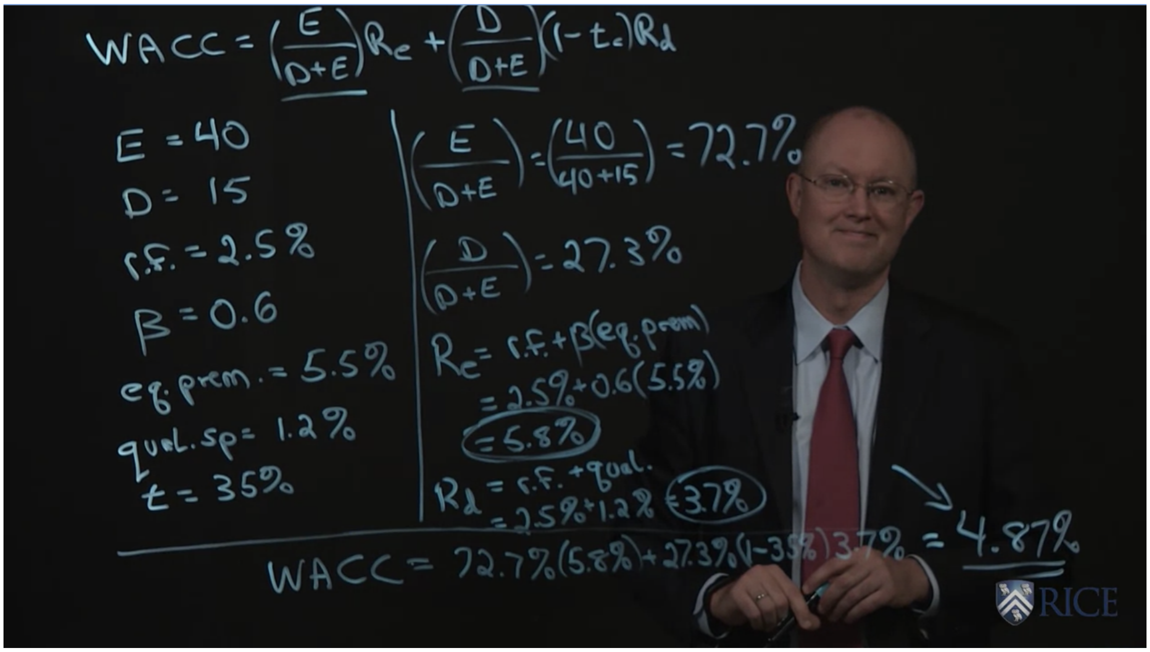


Figure 106: Solving for the WACC yields 4.87%, which is how much average investors in the Target Corporation would expect to earn. It's a balance between the 5.8% the equity investors would expect to earn, and 3.7% that the debt holders would expect to earn if we bought single A-rated debt for a 10-year maturity in Target Corporation. So 4.87% is the discount rate that we would use for all of the capital budgeting tools that we learned in Section 2 for both internal and external investors. That's the discount rate for all cash flows that Target should use internally when they're looking at project feasibility in computing NPV's, IRR's, and paybacks.

4.9 Conversations with a Practitioner

Section 4 has been all about estimating the cost of equity, cost of debt, estimating market betas, and putting them together into the weighted average cost of capital. So is that what we see in the field? Certainly, the cost of capital is certainly very important in the finance decision-making process, but it can be tricky to calculate. It's cumbersome. There can be assumptions, guesswork. So, we see that firms feel the tendency to just grab a ballpark estimate. "Why not just use 10 percent? Let's just use 10 percent." That kind of thing. So, that's something that's seen a lot with smaller businesses or firms, which is you that you can go through this calculation of a beta, estimate what the equity premium is, you put it together with where you think treasury rates are going, and it starts to get pretty complicated. So a lot of times, they simply say, "Well, we just threw in 10 percent as our cost of capital because it was close enough."

But the answer is that it really can make a lot of difference if you think about two different kinds of firms that have a very different kind of risk. If you think of maybe some of the safest businesses, like those in a heavily regulated industry like oil, there are large fixed assets, very easily controlled by the government. They're definitely not going to grow at 20 percent a year, right? At least in the U.S., it's much too mature of an industry. So for that kind of company, it might make a lot more sense to pick a conservative ballpark estimate and just throw that in. But for other, riskier, companies like smaller mom-and-pop oil field businesses – the guys who grew it from the bottom up and there's no telling where it's going to go tomorrow – if we think about it from an equity investor's perspective, if we're thinking about buying stock or lending money to either this large regulated public utility or this mom-and-pop drilling operation, are we as investors really going to want 10 percent for either company? Absolutely not.

So we even know that even heuristically, the investors are going to require different rates. So out in the field even when you see people say, "All right, let's just use 10 percent." oftentimes they also say, "But let's scooch it up a little bit because this is particularly risky or let's pull that back down a little bit because we have some history there." So when we talk about these different capital budgeting tools and using the capital asset pricing model or market betas or quality spreads, all we're trying to do is just put a little bit of conceptual framework around whether to take that 10 percent and scooch it up a little, or scooch it back down. And it can make a meaningful difference to the bottom line, since as we change the discount rate between a riskier and less risky project, it can drastically affect the results. For example, we could change the discount rate from five percent to something like 10 percent or 15 percent and the NPV could almost double.

Going back to the conversation about whether debt is really a cheaper source of capital, why shouldn't we just lever up? This debate really reflects the trade-off between the debt that generates some cash for us through the tax shield and the probability of distress during down times. So the capital structure that we choose has to reflect the trade-off between those forces.