FUNDAMENTALS OF FINANCE

Session 3:

Time Value of Money

Discounted Cash-flow Valuation

Agenda

Recap of previous class

Solution to problem set

DuPont System (Chapter 4)

Time Value of Money (Chapter 5)

Discounted Cash-flow Valuation (Chapter 8)

Recap and preview next class

Recap

- Which are the 3 main financial statements?
- Tell us 3 things about:
  - Balance Sheet
  - Income Statement
  - Statement of Cash-flows
- Why do we use ratios?

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Problem Set

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Du Pont System

- It's just a sequential decomposition of one key ratio into many.
- The idea behind it is to isolate the "drivers" of profitability.
- Why?
  - As profit it's just one number, it doesn't provide an explanation about the source of profit. By "double clicking" in the ratio, we can get more insights.
- There are infinite decompositions, as we could invent as many as we wanted, however, these are the most frequently used:

$$\text{Return on assets} = \frac{\text{after-tax operating income}}{\text{assets}}$$

$$= \underbrace{\frac{\text{sales}}{\text{assets}}}_{\text{asset turnover}} \times \underbrace{\frac{\text{after-tax operating income}}{\text{sales}}}_{\text{operating profit margin}}$$

Du Pont System

$$ROE = \frac{Net\ income + after\ tax\ interest}{Equity}$$

$$ROE = \frac{Net\ income + after\ tax\ interest}{Assets} x \frac{Assets}{Equity}$$

$$ROE = ROA\ x\ measure\ of\ leverage$$

$$ROE = \frac{Net\ income + after\ tax\ interest}{Sales} x \frac{Sales}{Assets} x \frac{Assets}{Equity}$$

ROE= Operating profit margin x Asset turnover x measure of leverage

Du Pont Example

- Recall ROE from Problem set 2:
- $ROE = \frac{Net\ income + after\ tax\ interest}{Sales} x \frac{Sales}{Assets} x \frac{Assets}{Equity}$
- ROE= Operating profit margin x Asset turnover x measure of leverage
- To increase ROE the company can:
  - Increase profit margin (operational improvement)
  - Increase efficiency (sell more with the same assets or reduce assets and maintain level of sales)
  - Increase leverage (reduce equity/increase debt)

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Time Value of Money

- While in our first class we discussed many reasons why common sense and human nature lead us to convey more value to things in the present than things in the future, in finance we bypass all of those reasons.

- In finance, the reason why a dollar today is worth more than a dollar tomorrow is because we ASSUME that you could invest a dollar today RISK-FREE and receive more than a dollar tomorrow.

Future Value

- Interest (interest rate)
  - Amount (or rate) that you earn on an investment over a period of time. Usually one year
  - Most of the time, we'll use interest rates (%)

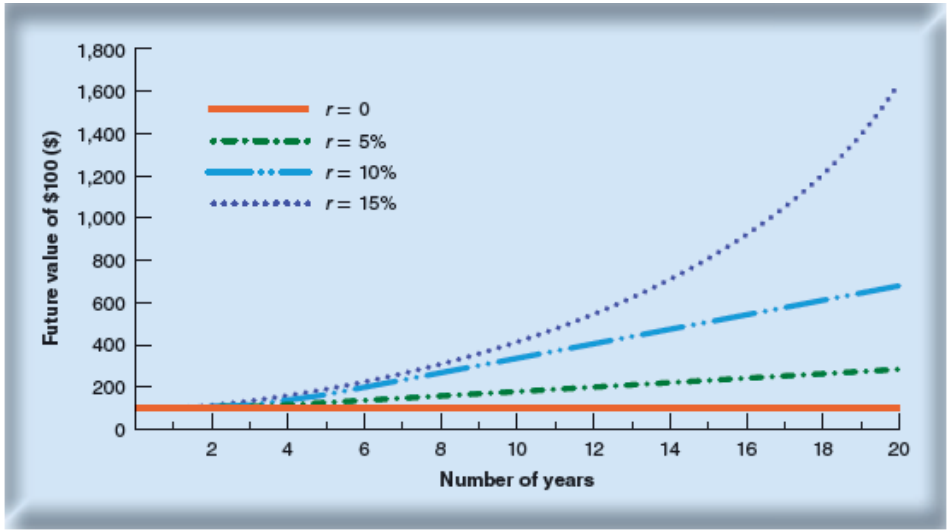
- Simple interest rate
  - Assumes you don't earn interest on the interest payments you received (you withdraw each interest payment)

- Compounded interest rate
  - Assumes you earn interest on the interest payment you received (you re-invest interests)

- Future Value
  - Amount that will be received in the future, for a given investment today
  - It always uses compounded interest (why?)
  - Investment x (1+ interest rate)$^{\#\ \text{of periods}}$

Future Value Examples

- Calculate the future value of $100 at an annual rate of 5%
  - In 5 years
  - 10 years
  - 30 years



- Calculate the future value of $100 at an annual rate of 15%
  - In 5 years
  - 10 years
  - 30 years

Present Value

- Present Value:
  - Value as of today, of a cash-flow received in the future
  - Equivalently, how much should I invest today, to receive certain future value
  - Using the same equation, but “solving” for initial investment

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

- Since future values are “worth” less today, we call this process “discounting” future values

- The rate at which we discount future values is called…

  …discount rate

- Discounted Cash-flow valuation
  - Method of calculating present value by discounting future cash-flows.

Implicit discount rate

- Just as we “solved” for PV, we can solve for the discount rate

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

- A little more complicated, but just a little.

$$r = \left(\frac{FV}{PV}\right)^{1/t} - 1$$

Discount rates and Discount factors

- Sometimes, books talk about discount factors. They are equivalent to discount rates, but supposedly easier to interpret.

- Calculate the present value of 100 received in 10 years, at a discount rate of 10%

- Usual formula:

- Transform the division into a multiplication

- That is the discount “factor”

What if there are many cash-flows

- Discount each cash-flow according to the number of years in the future
- Calculate the present value of the following cash-flow, using a discount rate of 10%

  Year 1= 200

  Year 2= 300

  Year 3 = 400

  PV=?

- Note: The discount rate doesn't have to be the same each year, but for 99.99% of the cases you will assume it is.

Perpetuities

- Perpetuity: a cash-flow that pays the same amount each year, forever

- If we assume the first cash flow is received in one year from now, the formula for the present value of a perpetuity is:

$$PV = CF/r$$

- If we assume the first cash-flow is received today (perpetuity due), the formula for the present value of a perpetuity changes to:

$$PV = \frac{CF}{r} + CF * r$$

Annuities

- Annuity: a cash-flow that pays the same amount each year, for a certain number of years

- If we assume the first cash flow is received in one year from now, the formula for the present value of an annuity is:

$$Present\ Value\ of\ t-year\ annuity = C\left[\frac{1}{r} - \frac{1}{r\ (1+r)^t}\right]$$

	Cash Flow						
Year:	1	2	3	4	5	6 . . .	Present Value
1. Perpetuity A	$1	$1	$1	$1	$1	$1 . . .	$\frac{1}{r}$
2. Perpetuity B				$1	$1	$1 . . .	$\frac{1}{r(1+r)^3}$
3. Three-year annuity	$1	$1	$1				$\frac{1}{r} - \frac{1}{r(1+r)^3}$

Annuities

- If we assume the first cash-flow is received today (annuity due), the formula for the present value of an annuity changes to:

Present value of annuity due= Present Value of Annuity * (1 + r)

- Why?

Problems:

- A British government perpetuity pays £4 a year forever and is selling for £48. What is the interest rate?

- In May 2013 an 84-year-old Florida woman invested $10 in five Powerball lottery tickets and won a record $590.5 million. That sum was to be paid in 30 equal annual installments of $19.683 million each. Assuming that the first payment occurred at the end of 1 year, what was the present value of the prize? The interest rate at the time was 3.6%.

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Do companies generate the same cash-flow each year?

- To value a company, we use discounted cash-flows to get its present value
- Net present value: Present value of cash-flows minus the present value of investment
- Calculate the present value of the following cash-flow, using a discount rate of 10%
  - Year 1= 200
  - Year 2= 300
  - Year 3 = 400
  - Year 0 = - 700
  - PV=?
- This is probably the most used calculation in finance. Its complexity clearly explains why investment analysts get $100k a year

New vocabulary, but similar concepts

- Discount rate, now called opportunity cost of capital:
  - Expected rate of return given up by investing in a project. The project has to have the same level of risk
  - We could still compare projects of different risk, adjusting the discount rate (or cost of capital). You will learn about this with Prof. Shen.
- If a project has a positive net present value, it means that the present value of its cash-flows is greater than the investment required
- If you are a CEO/CFO, you want to invest in positive NPV projects and avoid negative NPV projects

Basic example

- Suppose that you are in the real estate business. You are considering construction of an office block. The land would cost $50,000, and construction would cost a further $300,000. You foresee a shortage of office space and predict that a year from now you will be able to sell the building for $400,000.
- Suppose the project is riskless, and the opportunity cost of capital is 7% (other projects with the same level of risk offer 7% return)
- Should you take this project?
- What if the opportunity cost of capital is 12%?
- How much can the construction cost increase and still remain a positive NPV project?

Little more difficult example

- For example, suppose that you are approached by a possible tenant who is prepared to rent your office block for 3 years at a fixed annual rent of $25,000. You would need to expand the reception area and add some other tailor-made features. This would increase the initial investment to $375,000, but you forecast that after you have collected the third year's rent the building could be sold for $450,000. The opportunity cost of capital is r = 7%

- Should you take this project or stay with the previous?

Much more difficult examples?

- How could we make this more difficult?
  - More periods
    => repeat the same process
  - Different discount rates
    => still same process
  - Different cash-flows
    => same process

- I won't use DCFs with more than 4 periods, there is no additional learning for you. It only increases the probability of mistakes

What if 2 projects have same NPV but different risk, duration, investment, etc.?

Next class

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Recap of today

- What is the DuPont system?
- Why is a dollar today worth more than a dollar tomorrow?
- What is a Present Value?
- What is a Future Value?
- What is the difference between discount rate and discount factor?
- What is a discounted cash flow?

Preview

- Less reading. Chapters 8 and 9

- Problem set due at the beginning of the class
  - Available tomorrow afternoon on Canvas. Will be longer than today's.
  - Use the same calculator you will use in the exam

- Next class:
  - Net Present Value and Investment Decision Criteria
  - Applied DCF => Corporate Finance Analyst main job
  - Last class of part 1