

FUNDAMENTALS OF FINANCE

Session 4:

Project Evaluation

Project Valuation

Agenda

Recap of previous class

Solution to problem set

Project Evaluation/ Investment Criteria (Chapter 8)

Discounted Cash-flow Valuation (Chapter 9)

Recap and preview next class

Recap

- 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?

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Problem Set

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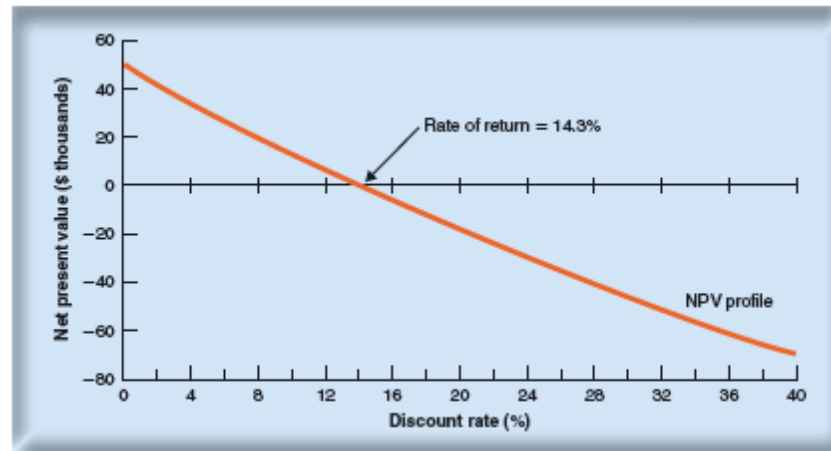
Recap and preview next class

So why $NPV > 0$ is not sufficient to choose among projects?

- Is it the same to invest \$1 million and get \$100 in NPV than invest \$100 and get \$100 in NPV?
- Is it the same to invest \$1 million for 5 years and get \$100 in NPV than invest the same amount for 100 years and get \$100 NPV?
- Time horizon of cash-flows?
- Risk?
- Re-investment?

Internal Rate of Return

- The internal rate of return is the discount rate that makes the NPV equal to zero.
- Very simple to calculate for one period project, not so simple for multi-period. You have to use Excel or financial calculator.
- As the discount rate increases, the NPV of the project decreases. So most calculations iterate over different discount rates to find the IRR



Internal Rate of Return

- The decision rule for IRR is: Invest in projects that have an IRR greater or equal than the discount rate.
- This is equivalent to: Invest in projects with positive NPV.
- But, this doesn't really add much benefits over the NPV decision rule, and adds additional problems:
 - Greater IRR doesn't mean greater value creation
 - Projects NPV might be negatively correlated to discount rate
 - Multiple IRR when there are negative cash-flows in the future

IRR Drawback (1)

- Project 1: 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 opportunity cost of capital is 7%
- Project 2: 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

Year:	0	1	2	3	IRR	NPV at 7%
Initial proposal	-350,000	+400,000			14.29%	+\$23,832
Revised proposal	-375,000	+25,000	+25,000	+475,000	12.56%	+\$57,942

IRR Drawback (2)

Project	Cash Flows (dollars)		IRR, %	NPV at 10%
	C_0	C_1		
A	-100	+150	+50	+\$36.4
B	+100	-150	+50	- 36.4

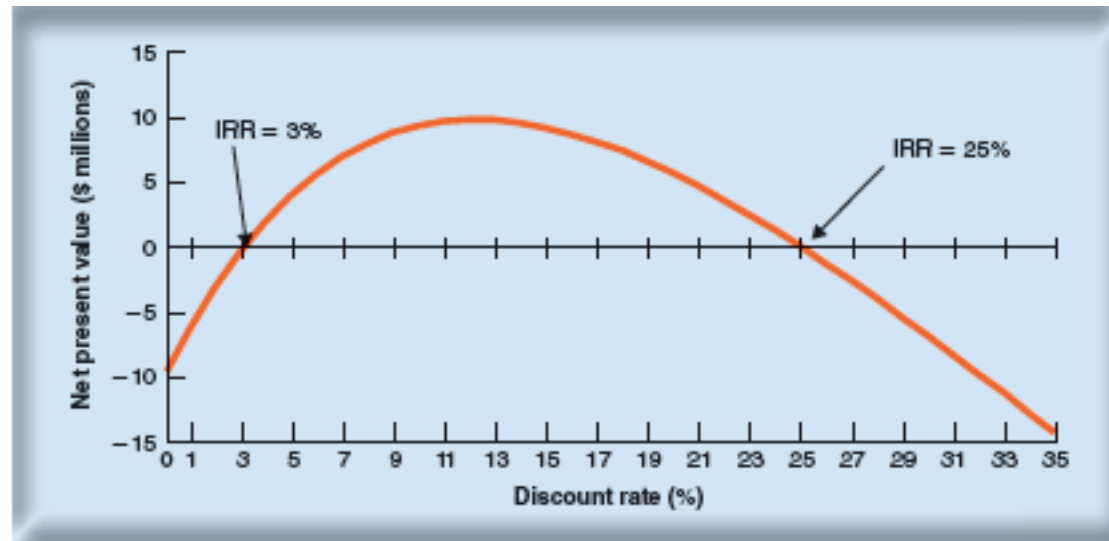
Each project has an IRR of 50%. In other words, if you discount the cash flows at 50%, both projects would have zero NPV.

IRR Drawback (3)

$$NPV = -210 + \frac{\$125}{1.03} + \frac{125}{1.03^2} + \frac{175}{1.03^3} + \frac{175}{1.03^4} - \frac{400}{1.03^5} = 0$$

and

$$NPV = -210 + \frac{\$125}{1.25} + \frac{125}{1.25^2} + \frac{175}{1.25^3} + \frac{175}{1.25^4} - \frac{400}{1.25^5} = 0$$



Internal Rate of Return Conclusions

- Personally, I hate IRR. It only confuses people with additional rules to remember and adds very little. Yet text books still include it.
- Never use it in isolation. You must combine it with other measures.

Profitability Index

- Measures the net present value created per dollar of investment. Also known as the benefit-cost ratio

$$\text{Profitability Index} = \frac{\text{Net Present Value}}{\text{Initial Investment}}$$

- If the NPV is positive, the PI will also be positive, so they provide the same directional result. However, the PI adds a new dimension (Initial Investment)
- If you can only invest \$10, how would you allocate that capital?

Project	Cash Flows (\$ millions)			NPV at 10%	Profitability Index
	C ₀	C ₁	C ₂		
C	-10	+30	+5	21	21/10 = 2.1
D	-5	+5	+20	16	16/5 = 3.2
E	-5	+5	+15	12	12/5 = 2.4

- Always prioritize projects that give you the highest return on your money
- If you can only invest in 1 project?

Pay back rule

- Payback period: Time until cash flows compensate the initial investment in the project.
- Payback rule: Accept projects that have a payback lower than x periods
- Drawbacks:
 - It doesn't consider the time value of money (but this is an easy fix... discounted payback)
 - It doesn't consider cash-flows after the payback period

Project	Cash Flows (dollars)				Payback Period, Years	NPV at 10%
	C ₀	C ₁	C ₂	C ₃		
F	-2,000	+1,000	+1,000	+10,000	2	\$7,249
G	-2,000	+1,000	+1,000	0	2	-264
H	-2,000	0	+2,000	0	2	-347

Why does the book include measures that are not very useful?

- Because companies use them!!!!

Investment Criterion	Percentage of Firms That Always or Almost Always Use Criterion	Average Score on 0–4 Scale (0 = never use; 4 = always use)		
		All Firms	Small Firms	Large Firms
Internal rate of return	76	3.1	2.9	3.4
Net present value	75	3.1	2.8	3.4
Payback period	57	2.5	2.7	2.3
Profitability index	12	0.8	0.9	0.8

How does timing play a role? (1)

- So far, we have discussed projects that start at the same point in time (but may have different duration)
 - This affects the payback ratio
- What if they start at different points in time?
 - NPV to today (or the same point in time)
- What if it's the same project that can start at different times?
 - If nothing changes (same investment and same profits)=> Sooner is better
 - If something changes (either investment, profits or both) = > NPV to the same point in time

Year of Purchase	Cost of Computer	PV Savings	NPV at Year of Purchase ($r = 10\%$)	NPV Today	
0	\$50	\$70	\$20	\$20.0	
1	45	70	25	22.7	
2	40	70	30	24.8	
3	36	70	34	25.5	← optimal purchase date
4	33	70	37	25.3	
5	31	70	39	24.2	

How does timing play a role? (2)

- What about sequential projects that have different duration?
 - Project A lasts 3 years (and after it's over you start again)
 - Project B lasts 2 years (and after it's over you start again)
- Create a “joint project” with the same duration and calculate NPV
 - Project A2: Project A twice
 - Project B3: Project B three times
 - Choose higher NPV
- Calculate equivalent annual annuity
 - Transform NPV of project A to a 3 year annuity
 - Transform NPV of project B to a 2 year annuity
 - Choose higher equivalent annuity
- Be careful!!! In the text book, examples usually involve NPV negative projects (they compare costs, not profits). If you have negative NPV, you want the least negative.

In class exercise

1. If the opportunity cost of capital is 11%, which of these projects is worth pursuing?
2. Suppose that you can choose only one of these projects. Which would you choose? The discount rate is still 11%.
3. Which project would you choose if the opportunity cost of capital were 16%?
4. What are the internal rates of return on projects A and B
5. In light of your answers to Problems 2–4, is there any reason to believe that the project with the higher IRR is the better project?
6. What is the profitability index for each project? Is the project with the highest profitability index also the one with the highest NPV? Which criterion should you use? (use both 11% and 16% as discount rates)
7. What is the payback period of each project? Is the project with the shortest payback period also the one with the highest NPV? Which criterion should you use? (use both 11% and 16% as discount rates)

Year	Project A	Project B
0	-\$200	-\$200
1	80	100
2	80	100
3	80	100
4	80	

In class exercise solutions (1)

1. If the opportunity cost of capital is 11%, which of these projects is worth pursuing?
A \$48.19, B = \$44.37, Both have positive NPV, so both
2. Suppose that you can choose only one of these projects. Which would you choose? The discount rate is still 11%.
Project A has the highest NPV
3. Which project would you choose if the opportunity cost of capital were 16%?
A \$23.85, B = \$24.58, so now choose B
4. What are the internal rates of return on projects A and B
A=21.86% B=23.38%
5. In light of your answers to Problems 2–4, is there any reason to believe that the project with the higher IRR is the better project?
No, because it will depend among other things, on the discount rate of the project

In class exercise solutions (2)

6. What is the profitability index for each project? Is the project with the highest profitability index also the one with the highest NPV? Which criterion should you use? (use both 11% and 16% as discount rates)

@ 11%: Project A = 0.240 ; Project B = 0.222

@16%: Project A = 0.119 ; Project B = 0.123

If the discount rate is 11%, Project A has a higher NPV and higher PI. Both measures lead to the same optimal conclusion

If the discount rate is 16%, Project B has a higher NPV and higher PI. Both measures lead to the same optimal conclusion

7. What is the payback period of each project? Is the project with the shortest payback period also the one with the highest NPV? Which criterion should you use?

A=2.5 years B=2 years

If the discount rate is 11%, Project A has a higher NPV but longer payback. If the decision is based on payback, then we would choose A (but loose out on NPV)

If the discount rate is 16%, Project B has a higher NPV and a shorter payback. Both measures lead to the same optimal conclusion

What is the takeaway here?

- You can't rely on one measure.
 - If there is a capital constraint, include the profitability index.
 - If there is a time constraint, include payback
 - IRR???
 - If you find out why should we use IRR, please let me know

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Recap and preview next class

Project Valuation

- In this chapter will apply DCF valuation to a company. The main difference is:
 - None
 - It's the same thing...
- Maybe more detail, but the same same same thing:
 1. Get cash-flows (from a financial statement)
 2. Get discount rate (this starts next week, for now, you will be given a discount rate)
 3. Discount cash-flows
 4. Deduct investment if any
 5. Done

Project Valuation (1)

- Why should we use cash-flows instead of profits?
- What are the most common adjustments for non-cash items in the income statement?
- How do we get the cash-flow from the income statement?
 - **Adjust for Net working Capital**
 - Adjust for accounts receivables (sales not paid yet)
 - Adjust for inventories (paid inventory not sold yet)
 - Adjust for accounts payables (suppliers not paid yet)
 - Adjust for changes in fixed assets
 - Capital expenditures (purchase of new assets)
 - Sales of old assets (if the project is an upgrade)
 - Recover terminal value at the end of the project
 - Adjust for depreciation
 - Adjust for after tax interest payment

Project Valuation (2)

- Consider incremental cash-flows:
 - One option is to do 2 cashflows, 2 NPVs and choose highest NPV
 - Shortcut: use incremental cash-flows to get incremental NPV. If incremental NPV is positive, go ahead with project
 - Incremental cash-flows: Change in cash-flow
 - Incremental operating cash-flow (easy, incremental sales, incremental costs, incremental dep, inc taxes)
 - Add back depreciation
 - Include net working capital
 - Include investments
 - Include “terminal cash-flows” (Get net working capital back at the end of the project, any residual value from assets)
- Corollary:
 - Don't consider non-incremental cash-flows (those that don't change)
 - Sunk costs

Short example for operational cash-flow

- A project generates revenues of \$1,000, cash expenses of \$600, and depreciation charges of \$200 in a particular year. The firm's tax bracket is 35%.

- Step 1: Get net income

Revenues	1,000
– Cash expenses	600
– Depreciation expense	200
= Profit before tax	200
– Tax at 35%	70
= Net profit	130

- Method 1: revenues – cash expenses – taxes = $1000 - 600 - 70 = 330$
- Method 2: net profit + depreciation = $130 + 200 = 330$
- Method 3: $(\text{revenues} - \text{cash expense}) \cdot (1 - \text{tax rate}) + (\text{Depreciation} \cdot \text{tax rate})$
 $= (1,000 - 600) \cdot (1 - 35\%) + (200 \cdot 35\%) = 330$

Long example

- A bicycle manufacturer currently produces 250,000 units a year and expects output levels to remain steady in the future. It buys chains from an outside supplier at a price of \$3 a chain. The plant manager believes that it would be cheaper to make these chains rather than buy them. Direct in-house production costs are estimated to be only \$1.50 per chain. The necessary machinery would cost \$250,000 and would be obsolete after 5 years. This investment could be depreciated to zero for tax purposes using a 5-year straight-line depreciation schedule. The plant manager estimates that the operation would require additional working capital of \$50,000 but argues that this sum can be ignored since it is recoverable at the end of the 5 years. Expected proceeds from scrapping the machinery after 5 years are \$20,000.

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Recap of today

- What is IRR and its drawbacks?
- What is Profitability Index and its drawbacks?
- What is Payback rule and its drawbacks?
- What is equivalent annual annuity?
- What is the best rule to compare investments?
- Should you use profit of cash-flow to value/evaluate a project?
- How would you construct incremental cash-flows?

Recap of session 01

- What is the role of a financial manager?
- What is the agency problem?
- Who are the players in the financial market?

Recap of session 02

- 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?

Recap of session 03

- 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?

Recap of session 04

- What is IRR and its drawbacks?
- What is Profitability Index and its drawbacks?
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- What is equivalent annual annuity?
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- How would you construct incremental cash-flows?

Preview

- Last problem set due at the beginning of exam
 - The problem set will be very similar to the exam, in content, structure and difficulty
 - Will have the same formulas as the exam
- Bring a calculator. Requirements:
 - You must know how to use it
- Exam:
 - Starts at 6 pm
 - Ends at 9 pm
 - You should take about 90 minutes to finish
 - Score will be available Monday 11th