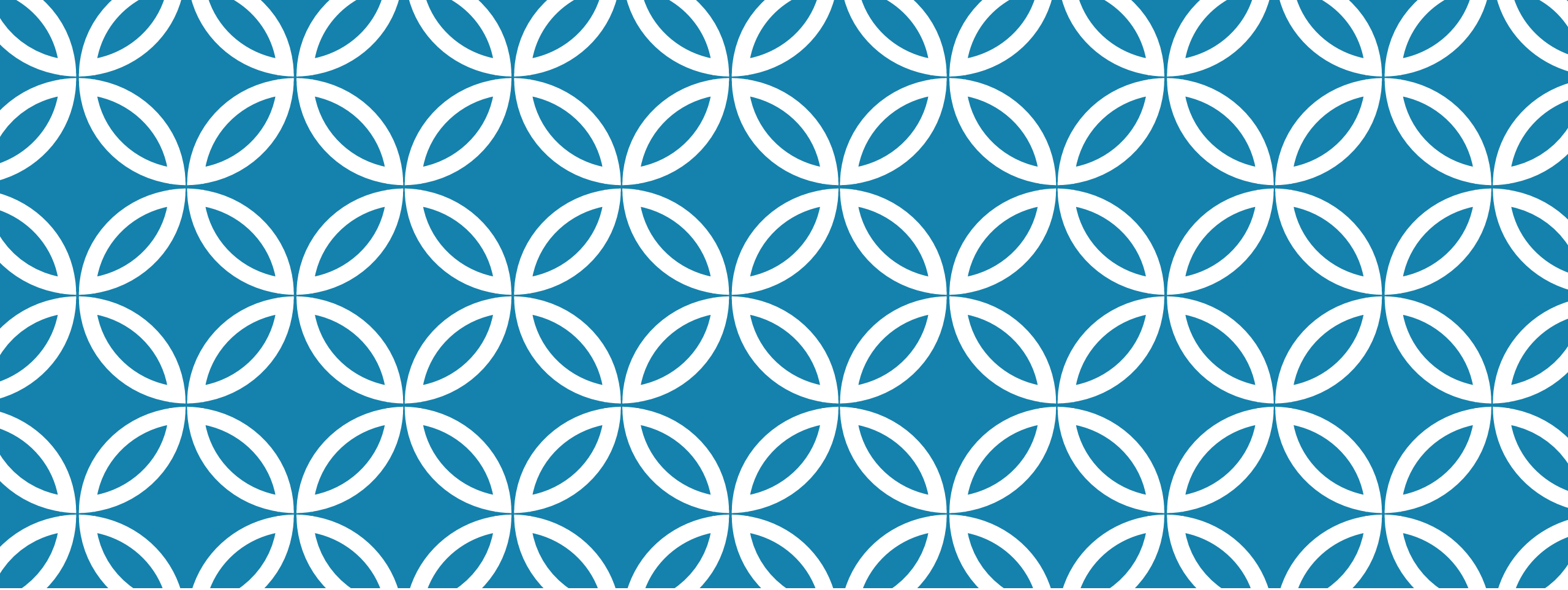


CAPITAL BUDGETING

Video Lecture VL13

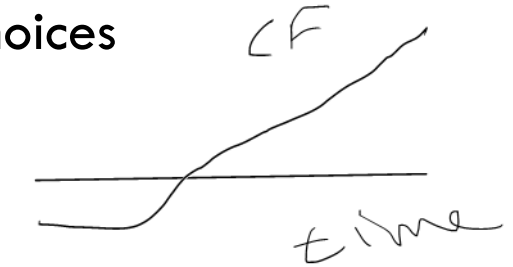
Valuation for Financial Engineers

Prof David Shimko

CAPITAL BUDGETING TERMS

budgeting (banks and insurance companies)

Definition: How to allocate cash and risk capacity to project choices



Terms:

NPV rule Net present value = PV(benefits) - PV(costs) ---> If > 0, then accept project

IRR Internal rate of return = discount rate that makes NPV=0. Accept project if IRR > threshold
Problems: 1. May have multiple solutions 2. No idea of project scale

Cost of capital Cost of debt or equity --- for equity, this is the discount rate equityholders use to value the company

Hurdle rate Company set a standard discount rate for all projects; any accepted project must have NPV>0 at that rate

Promised, most likely and expected returns similar to bonds

Project cost of capital vs company cost of capital

Corp Fin text: Each project should have its own discount rate

Shimko: Each line item on income statement should have its own discount rate

Project interactions projects may enhance each other or damage each other

WHAT IS CAPITAL BUDGETING?

The allocation of capital (and possibly other resources) to the selection of projects.

Project: Any activity of the corporation that generates cash flows

Classical Finance Paradigm

Assumptions:

- We know the project's expected cash flows and risk-adjusted discount rate.
- The project has no interactions with other projects.
- Capital is unconstrained.
- No option to delay decision

Conclusion:

- Accept any project that has positive net present value (NPV)
  - i.e. PV of benefits > PV of costs

PROBLEMS WITH THE CLASSICAL PARADIGM

USE THIS RULE -->

Discounting

- Multiperiod discounting at a risk-adjusted rate assumes risk is a constant proportion of asset value
- Cash flow streams within a project may have different risk attributes
- Some cash flows may have existing benchmarks, e.g. futures prices and options and other equities
- Each project should have its own discount rate (many companies use a constant hurdle rate)

Interactions

- Projects may offer synergies or one may cannibalize another
- Risks may become more concentrated or perhaps offset
- Incremental portfolio valuation resolves these problems
  - i.e. value the portfolio with and without the project

Constrained capital

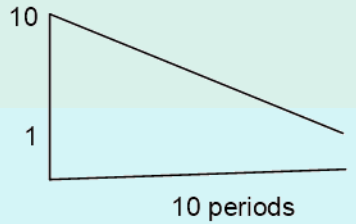
- Risk-based valuation may be appropriate

EXAMPLE WITH DEPRECIATION & SALVAGE VALUE

Problem:

- A company wants to evaluate a machine to make operations more efficient. The cost of the machine is $10 mm, depreciated over a 10-year life to its salvage value of $1 mm. The corporate tax rate is 40%, and the (after tax) hurdle rate is 8%. The cost of a full-time operator for the machine is $200,000 per year. The machine is expected to save the company $1.25 million per year.
- Should the company purchase the machine?

Expense the asset. or depreciate the asset.



Classical solution:

Income Statement (10 years - no contract)

Savings	1,250,000	
Cost	-200,000	
Tax credit	360,000	= 40% of 9MM/10
Net income	1,410,000	
PV	9,924,408	

NPV = PV benefits – PV costs

NPV = 9.92 mm – 10 mm = -$80,000

- The annual income statement is shown above. At an 8% hurdle rate, the present value of the savings, including the depreciation benefit, is less than $10 mm. Therefore the machine should not be purchased.

PROBLEMS WITH THE EXAMPLE

Problem:

- A company wants to evaluate a machine to make operations more efficient. The cost of the machine is $10 mm, depreciated over a 10-year life to its salvage value of $1 mm. The corporate tax rate is 40%, and the (after tax) hurdle rate is 8%. The cost of a full-time operator for the machine is $200,000 per year. The machine is expected to save the company $1.25 million per year.
- Should the company purchase the machine?

Is the company using the right discount rate (hurdle rate)?

Are the savings guaranteed?
- If yes, shouldn't the cash flows be discounted at the risk-free rate?
- If no, does the 8% appropriately reflect the risk?

Can the tax benefits be guaranteed to be realized?
- If yes, the discount rate should differ
- If no, this needs to be addressed as a project interaction

Can the company easily spend $10-11 mm?
- What are its opportunity costs? (Are these appropriately factored in?)
- If it finances the machine with debt, how does that affect capital structure and value-added?

Does the company have the ability to sell the machine early if benefits don't materialize?
- If so, this increases the project value as a real option

EXAMPLE WITH INCREMENTAL ANALYSIS

Airplane Manufacturer Problem:

- N = number of planes produced per year; r = 0
- Average cost (mm) $= \$4 + \frac{10}{N+1}$
- Sales price (mm) = $8 per airplane
- Currently selling four planes domestically
- Total net value $= 4 \cdot 8 - 4 \cdot \left[4 + \frac{10}{4+1}\right] = \$8$

International Expansion

- Costs $16 mm to open a foreign office
- Increase sales by 5 planes at same price
- Note: at 9 planes produced, avg cost = $5.
- Value of foreign ofc = Sales – Cost – Startup
- Value $= 5 \cdot 8 - 5 \cdot 5 - 16 = -1$

U.S. value = $8 mm
Canadian value = -$1 mm
Combined value = $11 mm
Incremental portfolio value = $3 mm

Should the airline open a foreign office?

- It appears the NPV = -1 implying not to open
- Let's compute total net value of domestic plus foreign office
  - 9 airplanes generate sales of $72 mm
  - Average cost is $5 mm , or $45 in total
  - Office opening costs $16 mm
  - NPV = $11 mm
- Since 11>8, we should open the foreign office!

- Why does this happen?

Synergy is that foreign operations bring down producetions costs for the domestic operations

INCREMENTAL ANALYSIS AND SUNK COSTS

Hale & Hearty earns $6500 per day on the NYU Metrotech campus and are open from 11:00-5:00. They are considering extending their hours to 7:00 p.m. Which factors should they consider from the list below:

1. The cost of additional soup & salad ingredients — Include
2. The expected reduction in average customer traffic after 5 p.m. — Reduction not interesting. Need to know expected traffic after 5 p.m.
3. Regular wages for employees — Sunk cost, do not consider
4. Overtime wages — Include
5. Pro-rata share of costs of cooking and heating equipment — Do not include in general unless there are additional wear-and-tear costs
6. Share of franchise fee or lease for hours after 5:00 p.m. — Not include this - because it will be paid anyway. "SUNK COST"

MORAL HAZARD AND PROJECT VALUATION

Competition for capital – managers compete for scarce resources

may overstate benefits, or understate risk

Employment – Managers and employees take decisions that are likely to influence their continued employment

selection bias - prefer projects that provide continued employment

Perks – Managers try to retain perks (short for "perquisites")

company jet, expense account. etc.

Power – Managers love to build empires

Hidden slack – Managers love to be able to cover up future problems

shift sales or expenses in order to smooth earnings or take advantage of incentive plans

Risk aversion – Managers may be reluctant to take on risk

Theft

POSITIVE AND NEGATIVE PROJECT INTERACTIONS

Positive interactions

- Synergy – cost savings or revenue enhancement created by new project in addition to its baseline benefit

e.g. airplane example

Negative interactions

- Pollution/congestion – Operating interactions between projects may have unintended adverse consequences
- Cannibalization – One project reduces revenue or increases costs of another project
- Complexity – Project combinations may increase managerial or regulatory complexity, leading to unforeseen costs
- Resource exhaustion – One project consumes sufficient scarce resources to damage the prospects of future projects

REAL OPTION EXAMPLES

Expansion/Contraction production levels (option)

Acceleration/delay option to control timing

Switching switch materials or fuels

Spinoffs

CAPITAL BUDGETING FOR FINANCIAL ENGINEERS

Capital Budgeting is a portfolio valuation and optimization problem

Because Capital Budgeting, Capital Structure and Risk Management are linked, there is no point in separating the valuations --- separate optimizations will lead to the wrong results.

Review of valuation steps

1. Simulate all cash flows for the status quo portfolio and the one including the projects.
2. Regress cash flows on traded assets, including futures and options (benchmarking) to find the PV of those components.
3. Using the residuals of the regression, choose a reference portfolio and value the residuals relative to the reference portfolio. LCAPM
4. Choose projects and optimization strategies to maximize the incremental value of the portfolio

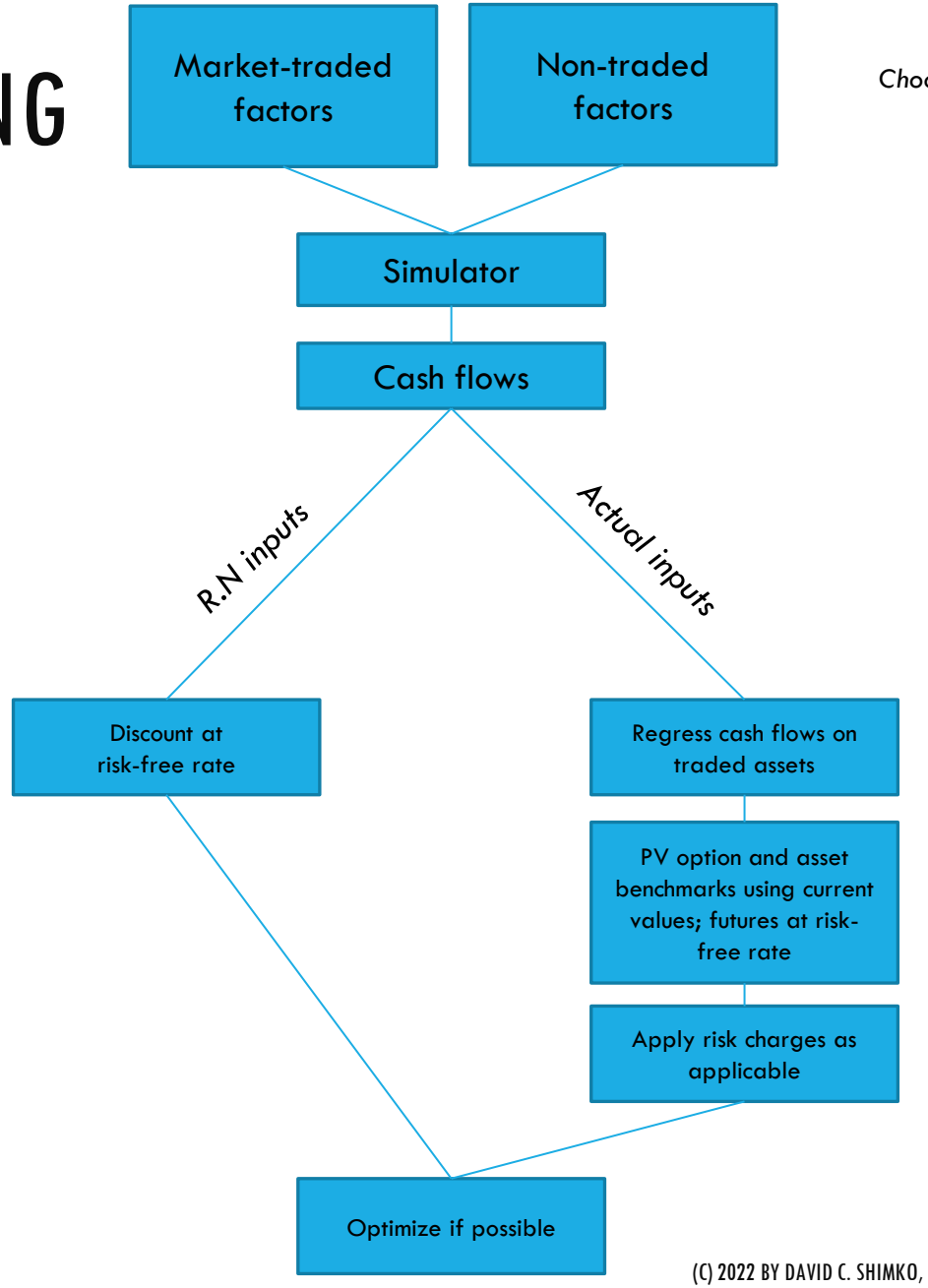
YOU CAN VALUE ANYTHING

Cash flow valuation styles in practice

- For traded underlying risk factors, use risk-neutral valuation (simulation)
- For non-traded underlying risk factors, use regression (simulation)

Examples of embedded options

- Transportation
- Storage
- Conversion
- Anything nonlinear



RECITATION QUESTIONS - A

Explain the NPV rule

Where does the discount rate come from in NPV?

What is an IRR?

What is the cost of capital?

What is a project?

RECITATION QUESTIONS - B

Why distinguish between a project cost of capital and the company cost of capital?

What are examples of project interaction?

What are the three assumptions of Classical Finance applied to capital budgeting?

What are the main conclusions of the classical model?

When we use a constant discount rate over many periods, what does it imply?

RECITATION QUESTIONS - C

Why might cash flow components have different discount rates?

What is meant by the “existing benchmark” method?

What are examples of synergy and cannibalization?

If a project’s NPV is positive only due to depreciation benefits, should we do the project?

RECITATION QUESTIONS - D

What are sunk costs, and how are they used in capital budgeting?

What moral hazard problems affect capital budgeting?

What is competition for capital, and its effect on capital budgeting?

What are perks?

What is hidden slack, and why is it relevant?

RECITATION QUESTIONS - E

Provide two examples of corporate real options NOT PROVIDED in the presentation.

"Capital Budgeting is a Portfolio Valuation and Optimization Problem" – What does this mean?

How do the capital structure decision and the risk management decision relate to the capital budgeting decision?

What are the steps in a general valuation of simulated cash flows?