Corporate Finance

Lecture 4.1: Project Cash Flows

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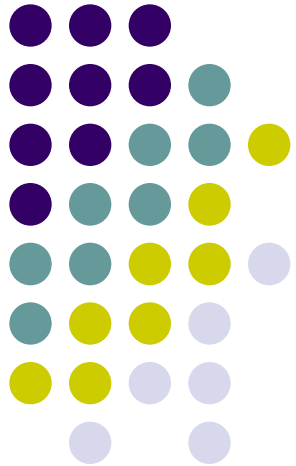

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Where we are

NPV is the right **capital budgeting** technique

- Tells us if a particular project is a good investment
- But you must make sure you are using it correctly by **identifying the right cash flows** and using the **correct discount rate**

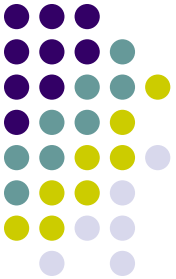
This topic

Cost of capital

More from next topics

Project cash flow: motivating example

Project cash flow: motivating example



Google Glass was a set of wearable smart glasses developed as a Google moonshot technology.

Google Glass was launched in 2014 but pulled from the market by 2015.

Relaunched in 2019 and 2019, it was removed from the market again in 2023.

Should google engage in such new project in the first place?

Project cash flow in finance

Launching a new chatbox at Pingan finance

Initiate a new consumption loan service to unserved customers

Start a new mutual fund

Project Cash Flows

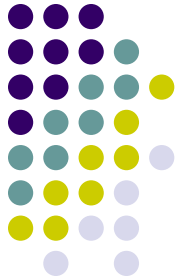
- Should a company start a new project?
  - How do we find the relevant cash flow?
  - And how do we exclude the irrelevant ones?
  - What discount rate should we use?
- For a new project, how do we trade-off exploration vs exploitation?
- When facing uncertainty, how do we value the opportunity cost and option value?
- How about the strategic implications
  - If the project will affect whether my competitor's decisions (Nokia)
  - If the project affects the sales of my current products (iPhone)

Outline

At the end of this presentation, you should be able to

- Understand three alternative methods of calculating project cash flows.
- Explain why we need to adjust for net working capital spending, and need *not* subtract financial items.
- Identify what are *relevant* cash flows for a project, and make capital budgeting decisions.

Project Cash Flows (PCF)



Think of **project** and **company** as *separate* entities, which were fully financed through equity.

- If in any year, project returned cash to company, then that is a cash *inflow*.
- If in any year, project took away cash to company, then that is a cash *outflow*.

PCF = OCF – Capex – ΔNWC

- OCF: Operating Cash Flow
- Capex: Capital Expenditure
- Δ NWC: Change in Net Working Capital (=cash + account receivable + inventory – account payable)

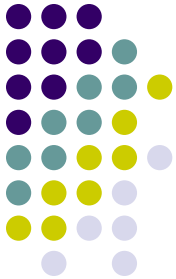
Three Ways to Compute OCF

The Bottom-Top Approach

The Top-Bottom Approach

The Tax-Shield Approach

The Top-Bottom Approach



OCF

= Sales - Costs – Taxes

= (S - C) - (S - C - D) x t

where

S: sales

C: operating costs

D: depreciation

t: corporate tax rate

*Tax billed upon the profits generated from the project, ignoring any interest payments

The Bottom-Top Approach

OCF

= Net Income + Depreciation

= (S - C - D) x (1 - t) + D

where

S: sales

C: operating costs

D: depreciation

t: corporate tax rate

*This is the "net income" from the project, ignoring the interest payments

The Tax-Shield Approach

OCF

= (S - C - D) x (1 - t) + D

= (S - C) x (1 - t) + (D x t)

= (S - C) x (1 - t) + Depreciation Tax Shield

where

S: **sales**

C: **operating costs**

D: **depreciation**

t: **corporate tax rate**

OCF – Example 1

What is OCF ?

Sales= $150

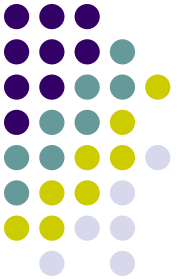
Depreciation = 30

Cost of Goods Sold = $ 80

Tax = 25%

Sales	150
COGS	80
	70
Less Dep.	30
EBIT	40
Less Tax = (EBIT*t)	40*0.25= 10
Net Income	30

Three Approaches on Example 1



The Top-Bottom Approach

OCF = Sales – Cost – Taxes

=150 – 80 - 10 = $60

The Bottom-Top Approach

OCF = Net Income + Depreciation

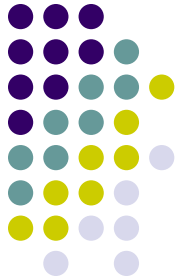
= 30 + 30 = $60

The Tax-Shield Approach

OCF = (Sales – Cost)(1-t) + The Dep. Tax Shield

= (150-80)(1-0.25)+ (30)*(0.25) = $60

Project Cash Flow



- **PCF =** OCF **– Capex – ΔNWC**
- **Remember! We do NOT subtract interest payments.**
  - Why? (* see page 19)
- *Capital expenditures* should **exclude sunk costs** that cannot be recovered.
- *Changes in current assets and liabilities* need to be considered to reflect true cash flow implications of sales or cost of production figures.
  - Why we need to adjust for ΔNWC?
  - *Accrual Accounting*: profits and expenses are recognized to match the business activity, instead of reflecting the cash flows.

ΔNWC -- Example 2

Suppose part of the Balance Sheet of Example 1 is as follows:

- Cash is kept *in the project* as a buffer against unexpected expenditures

	Beginning	End
Cash	20	80
Accounts Payable	30	30
Accounts Receivable	20	20
Inventory	10	10
Notes Payable	20	20

NWC at the end of the year = (80+20+10)-(30+20)=60.
NWC at the beginning of the year = (20+20+10)-(30+20)=0
ΔNWC = End NWC – Beg. NWC = 60.
PCF = OCF – ΔNWC – Capex = 60 - 60 – 0 = 0

ΔNWC -- Example 3

Suppose part of the Balance Sheet of Example 1 is as follows:

- Sales on credit & inventory purchase

	Beginning	End
Cash	20	20
Accounts Payable	30	30
Accounts Receivable	20	**40**
Inventory	10	**20**
Notes Payable	20	20

NWC at the end of the year = (20+40+20)-(30+20)=30.
NWC at the beginning of the year = (20+20+10)-(30+20)=0
ΔNWC = End NWC – Beg. NWC = 30.
PCF = 60-30 = 30.

ΔNWC -- Example 4

Suppose part of the Balance Sheet of Example 1 is as follows:

- Changes in Credit purchase

	Beginning	End	
Cash	20	20	
Accounts Payable	30	10	↓
Accounts Receivable	20	20	
Inventory	20	20	
Notes Payable	40	20	↓

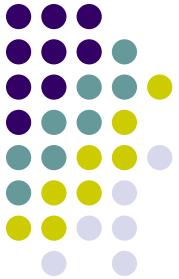
Ending NWC = (20+20+20)-(10+20)=30.
Beg. NWC = (20+20+20)-(30+40)= -10
ΔNWC = 30 – (-10) = 40.
PCF = 60-40=20.

ΔNWC -- Example 5

Consider years 2, 3, 4, 5 and 6 (the last year) in the life of the project in Example 1.

	Year 2	Year 3	Year 4	Year 5	Year 6
OCF		60	60	60	60
NWC	20	30	60	25	0
ΔNWC		**10**	**30**	**-35**	**-25**
Capex		0	0	0	0
PCF		50	30	95	85

Key Issues of Capital Budgeting

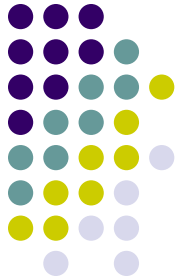


Relevant cash flows - the *incremental* cash flows associated with the decision to invest in a project.

The incremental cash flows for project evaluation consist of *any and all* changes in the firm's future cash flows that are a *direct consequence* of taking the project.

Stand-alone principle - evaluation of a project based on the project's incremental cash flows.

Sunk Costs and Opportunity Costs



- *Sunk costs* are costs that have been incurred, and cannot be changed regardless of whether or not the project is undertaken
- *Opportunity costs* are potential revenues that the firm missed out by taking the project
  - Assets in place to be used in the proposed project can be sold, leased, or used elsewhere

Sunk cost fallacy

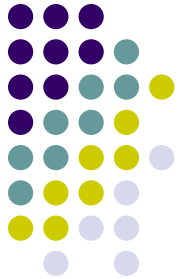
This fallacy is based on the premise that committing to the current plan is justified because resources have already been committed.

Example: project decision

Project A has already involved with fixed investment.

The **remaining** investment and return for project A vs the investment and return for a different project B.

Side Effects



- A project can have positive or negative side effects on other parts of the firm
  - Erosion: A new product reduces the sales (cash flows) of the existing products
  - Synergy: A new project increases the sales (cash flows) of the existing products

Last class

- Cash flow statement
  - End cash – Beginning cash =
  - Cash flow from operating + investment + financing

- Cash flow from operating = Net Income + depreciation – change in NWC
- Change in NWC = end NWC – beginning NWC
  - Why adjust for depreciation and NWC?

Last class

Project capital budgeting:

PCF definition: cf between project and firm

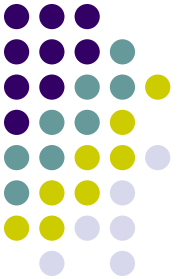
PCF = OCF – Capex – Change in NWC

OCF: Top bottom, bottom top, tax shield

Treatment of tax and depreciation

Which cash is relevant?

Incremental Cash Flows



- Treatment for different pitfalls
  - Exclude: sunk costs
  - Include: opportunity costs of assets in place
  - Include: side effects (erosion, synergy, etc.)
  - Include: investment in new net working capital
  - Exclude: financing items

Financial Items

Why do we exclude the financial items?

Why not deduct the interest payment?

Example:

- Suppose a project requires an investment of 1000, and will generate perpetual cash flow of 200.
- The discount rate appropriate for the cash flow is assumed to be 10%.
- The project is partially financed by *perpetual debt*.
- Risk-free rate is 5%.
- Debt raised is 200, and the interest rate is 5%.
- Assume that the expected perpetual cash flow of 200, though risky, will always exceed 10, the bond is correctly priced.

Financial Items

Should we deduct the interest payment of 10 to calculate the project cash flow?

Can you work out the equity investors' value gain (NPV) from the project?

- An **immediate problem** of doing so is that the cash flow of 200 and the cash (out)flow of 10 **do not have the same risk**.
- The discount rate for the former is 10%, but that for the latter should be 5%.
- Thus, even if we subtract interest payment, it should be discounted at 5%.
- Thus, the NPV of the project is:

$$NPV = (200/\mathbf{10\%}) - (10/\mathbf{5\%}) - (1000\text{-}200)$$

Financial Items

- Note that since 200 of the initial cost is financed with debt, the firm only need to invest another 1000-200 of the shareholders' equity.

$$NPV = (200/10\%) - (10/5\%) - (1000\textbf{-200})$$

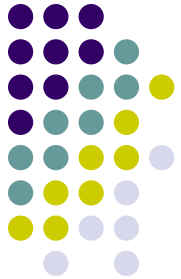
$$NPV = (200/10\%) - 1000.$$

- This is the NPV calculated ignoring the financial items.
- NPV of financial transaction is zero in a frictionless world.
- This is the foundation of designing **"project cash flow" as the additional cash flow assuming the project was completely equity financed**.

Exercise

Ch6-27 Calculating Project NPV With the growing popularity of casual surf print clothing, two recent MBA graduates decided to broaden this casual surf concept to encompass a "surf lifestyle for the home." With limited capital, they decided to focus on surf print table and floor lamps to accent people's homes. They projected unit sales of these lamps to be 10,400 in the first year, with growth of 8 percent each year for the next five years. Production of these lamps will require $45,000 in net working capital to start. Total fixed costs are $125,000 per year, variable production costs are $19 per unit, and the units are priced at $61 each. The equipment needed to begin production will cost $575,000. The equipment will be depreciated using the straight-line method over a 5-year life and is not expected to have a salvage value. The tax rate is 21 percent and the required rate of return is 18 percent. What is the NPV of this project?

Special Cases of Capital Budgeting



Test Marketing

Termination Option

Externalities and Preemption

Equivalent Cash Flows

Equivalent Annual Cost (tax & depreciation)

Valuing projects with uncertainty

Traditional capital budgeting approach assumes that investment is made immediately, and the project cannot be altered (expanded, contracted, delayed).

When facing uncertainty, the flexibility to adjust investment decision when uncertainty is resolved is important.

We need to value the flexibility inherent in a project.

- Real option 实物期权

Real Options 实物期权

Most firms have a slew of real options.

For example,

- Option to expand—invest more in successful projects.
- Option to abandon—cancel unsuccessful projects.
- Timing options—when to invest in a particular project.

When these options are valuable, a standard NPV analysis will understate the value of the firm, since it does not account for the options.

When are these options especially valuable?

- Start-up firms.

Analyzing options: decision tree

Represent firm's problem as a decision tree.

Branches represent actions or outcomes.

Nodes are points of time where either decisions are taken or different outcomes are possible.

Solve the tree via backward induction: work back from the ends.

The Value of Test Marketing

- Suppose a company is considering a project whose cash flows could be either 100 with 50% chance, or 20 with 50% chance. The capital investment required is 50.
- If the company does the test marketing, it knows exactly what the cash flows will be. If it does not do the test marketing, it learns nothing new (that is, it does not revise the prior probabilities regarding cash flows).
- If test marketing costs $x, what is the highest possible value of x for which test marketing is worthwhile?
- Assume there is no discounting.

The Value of Test Marketing

- If the company does not do the test marketing, it has no additional information about the cash flows. The NPV is then
  - **0.5*100+0.5*20-50 = 10** (>0 ⟶Invest)
- Suppose it does the test marketing.

1. If the test marketing reveals that the cash flow will be 100,
   - the company will want to continue with the project, since the NPV is **100-50=50** in this case.
2. If the test marketing reveals that the cash flow will be 20,
   - the company will **NOT** make the capital investment, since the NPV is **20-50=-30<0**. In this case, **the company gets 0**.

The Value of Test Marketing

- What is (expected) NPV if the test marketing is done?
  - **0.5*50+0.5*0 = 25.**
- The benefit of test marketing is therefore the *additional NPV* that test marketing will allow the company to enjoy. How much is it?
  - **25-10 =15.**
- What is the maximal test marketing expense the firm would be willing to pay?
  - If the cost of test marketing is less than **15**, test marketing is a positive NPV project.
  - Otherwise, it is a negative NPV project.

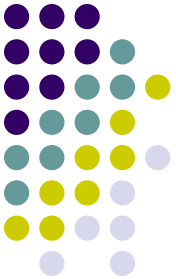
The Value of Test Marketing

- A simplified version of the multi-armed bandit多臂赌博机 problem
- Run A-B test to understand the market or implement the current plan to take the income?
- Your internship: explore more industries or repeat participation in the same industry?

Termination Option

- A company is planning to introduce a new product in division A. The management thinks this is attractive because part of the machines of division B, which are idle, can be used. The current market price of equivalent machinery is 30 million. Other initial capital expenditure is 50 million.
- There are two scenarios possible. In the "good" scenario, which will occur with probability 0.5, the present value of remaining cash flows from this new project is 135 million. In the "bad" scenario, which will occur with probability 0.5, the present value of remaining cash flows is 20 million.
- **Which scenario prevails will be learnt shortly after the initial investment is made.** *The machines "on loan" from division B can be returned to division B at this time without any loss of their market value.*

Termination Option

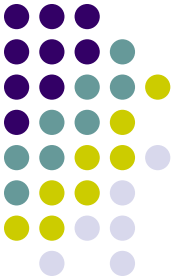


- Your friend - a financial analyst - has learnt in an MBA finance course that the "opportunity cost" of using the idle machines should be considered a cost for the project. He calculates that the NPV of the project is

$$NPV = 0.5x135+0.5x20-(50+30)= -2.5$$

- Do you agree with your friend's calculation?
- Why, or why not?

Termination Option



- The friend's calculation is wrong. His calculation can be restated as

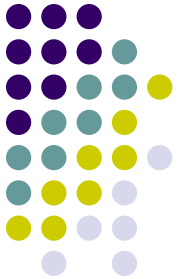
$$NPV=0.5x(135-80)+0.5x(20-80)= -2.5$$

- However, this calculation ignores the ***termination option***. In the bad state, the project will be terminated, since the present value of the cash flows (20) is less than what the company would get by selling the machines from division B (30).
- Thus, the only "cost" to the company if the project is terminated is the 50m sunk investment. Therefore,

$$NPV = 0.5x(135-80)+0.5x(-50) = 2.5 > 0$$

- So the project should be taken.

Externalities and Preemption



- A car manufacturer has determined that to prevent a competitor from introducing a new model that will lower its profits by $1000 per year for the next 10 years, it needs to introduce its own new model next year.
- This will require an investment today of $14,000, and the new model will generate sales of $3,000 per year for the next 10 years (and nothing thereafter). Cost of production will be $1000 per year.
- Of course, introducing its own new model will also lower the profits of its existing models. The company estimates that this reduction will be $500 per year for the next 10 years.
- Should the company introduce the new model if the discount rate is 10%? (Ignore depreciation, taxes, and working capital).

Externalities and Preemption

Annual OCF for yrs. 1 to 10:

= Sales – COGS – **Erosion** + **Profits saved**

=3,000 – 1,000 – 500 + 1,000

= 2,500

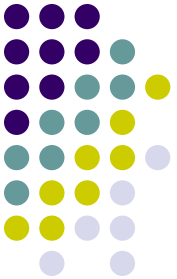
NPV

$= 2500(1-1/(1.1)^{10})/(0.1)-14,000$

= 15,361-14,000 = 1,361 >0

Thus, the company should make the investment.

Equivalent Cash Flows



- Your company has to choose between two components 组件, A and B, which will reduce the operating costs.
- Component A costs $6m, lasts 5 years, and reduces operating costs by $1.5m per year.
- Component B costs $11m, lasts 7 years, and reduces operating costs by $2m per year.
- If a component wears out, you can *replace it with a new one, with the same impact on cash flows*.
- **Which one will you choose**, if the cost reductions are assumed "not risky" and the return on 5-year government bonds is 5%?
- Ignore depreciation and taxes.

Equivalent Cash Flows

An answer:

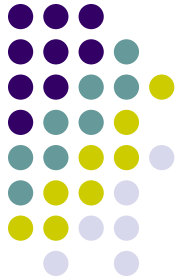
- First, we find the NPV of each investment.
  - Since the cash flows are not risky, the return on government bonds is an appropriate discount rate, since it reflects the return on an investment of comparable risk.

$$NPV_A = -6 + \frac{1.5}{0.05} * (1 - (1/1.05)^5) = 0.4942$$

$$NPV_B = -11 + \frac{2}{0.05} * (1 - (1/1.05)^7) = 0.5727$$

- Should we choose B?

Equivalent Cash Flows



- It would be wrong to conclude right away that B is better.
- Because the components have *different lifetimes* and *can be replaced* by the same model, we should compute the cash flow gain *per year*.
- This is the concept of ***equivalent annual cash flow***.
- We ask the question: for each component, how much annual cash flow ***per year*** does it add?
- This annual cash flow is such that its *present value over the life of the component* is the same as the *NPV* of the component.

Equivalent Cash Flows

- Let C_A denote this annual additional cash flow attributable to component A, and C_B denote the corresponding number for component B.
- We have:

$$0.4942 = \frac{C_A}{0.05} * (1 - (1/1.05)^5)$$

$$0.5727 = \frac{C_B}{0.05} * (1 - (1/1.05)^7)$$

- Which give $C_A = 0.1141$ and $C_B = 0.0989$.
- Thus, component A gives the higher additional cash flow on a per-year basis, and should be chosen.

Solving for ECF in Excel: pmt

=PMT(rate, nper, pv)

$$0.5727 = \frac{C_B}{0.05} * (1 - (1/1.05)^7)$$

1. **Rate** (0.05) – The interest rate of the loan.
2. **Nper** (7) – Total number of payments for the loan taken.
3. **Pv** (0.5727) – The present value or total amount that a series of future payments is worth now. It is also termed as the principal of a loan.

Equivalent Annual Cost

Let's now consider *taxes* and *depreciation*.

- The following assumes that depreciation is straight-line, the tax rate is 34% and the required return is 15%.
- Two types of batteries are being considered for use in electric golf carts by the city country club.
- Burnout batteries cost $36 each, have a life of 3 years, cost $100 per year to keep charged, and have a salvage value of $5.
- Long lasting batteries cost $60 each, have a life of 5 years, cost $88 per year to keep charged, and have a salvage value of $5.
- **Which battery should be chosen?**