Evaluating projects (1)

MIT**Sloan**

Class 3
Financial Management, 15.414

Today

Evaluating projects

- Measuring cashflows

- Taxes, depreciation, and working capital

Reading

- Brealey and Myers, Chapters 6 and 12.1 – 12.3

- Myers (1984)

Capital budgeting

What projects should the firm take?

- Marketing and advertising

- R&D

- Choices among different production processes

- Expanding into new products, industries, or markets

- Investments in new technology

- Acquisitions

Example

Boeing is evaluating whether or not to proceed with development of a new regional jet. The firm expects development to take 2 years, cost roughly $750 million, and it hopes to get unit costs down to $32 million. Boeing forecasts that it can sell 30 planes each year at an average price of $41 million.

How would you evaluate this project?

Review

Valuation

The value of any asset or project equals the **net present value of its expected cashflows**

- $\text{NPV} = \text{CF}_0 + \dfrac{\text{CF}_1}{(1+r)} + \dfrac{\text{CF}_2}{(1+r)^2} + \dfrac{\text{CF}_3}{(1+r)^3} + \dfrac{\text{CF}_4}{(1+r)^4} + \dfrac{\text{CF}_5}{(1+r)^5} + ...$

- **r = opportunity cost of capital**
  Rate of return required on investments in the financial market with similar risk

- **A project creates value (NPV > 0) only if it has a higher return than other investments with the same risk**

Evaluating projects

Forecasting cashflows

➤ What cashflows are relevant?

➤ What are the differences between earnings and cashflows?

➤ How uncertain are the cashflow forecasts? How sensitive is NPV to our assumptions?

➤ How can we take into account strategic concerns?

Measuring cashflows

Incremental cashflows

The difference between the firm's overall cashflows with and without the project, including any competitive or strategic side effects

Considerations

- Sunk cost
- Opportunity costs
- Average vs. marginal costs
- Depreciation
- Real options

- Project interactions
- Inflation
- Investments in working capital
- Taxes
- Projects with different lives

Measuring cashflows 1

Ignore sunk costs

A sunk cost is a cashflow that must be incurred whether or not the project is accepted.

Example

Motorola has the opportunity to supply 5,000 cell phones to the Summer Olympics. The accounting department estimates that each phone costs $15 to make, of which $5 represents overhead and $10 represents labor and materials. What is the cost of the sponsorship deal?

Measuring cashflows 2

Remember opportunity costs

Any cashflow that the firm gives up if it takes the project.

Example

Modigliani Import Co. owns an empty warehouse in Boston. The warehouse cost $200,000 to build and has a current value of $250,000. MIC would like to import a new line of Italian lamps, which will be stored in the warehouse. What is the cost of the warehouse space?

Opportunity costs, cont.

Example 2

Boeing is evaluating a new regional jet. If it proceeds with development, the firm will have to invest $200 million next year in R&D. The cash is currently invested in short-term securities yielding 2%.

An accounting executive argues that the project should be charged for lost interest, amounting to $4 million per year ($200 million × 0.02). Is he right?

Measuring cashflows 3

Marginal costs

Decisions should be based on marginal, not average, costs.

Example

Boeing is negotiating with Air Canada over the price of 20 new 737s. Air Canada offers $40 million per plane. Based on past data, Boeing estimates that the average cost of a new 737 is $30 million in labor and materials. How valuable is the Air Canada offer?

Measuring cashflows 4

Project interactions

Recognize project interactions / strategic issues in the cashflow forecasts

Loss leaders, cannibalization of existing product lines, …

Example

Wegmans, a supermarket chain based in Rochester, NY, is thinking about installing movie rental centers in its stores. Each rental center costs $80,000 to build, and Wegmans forecasts that profits will be $7,000 in perpetuity. If the discount rate is 10%, should Wegmans go ahead with the plan?

Project interactions, cont.

Example 2

Boeing is evaluating a new regional jet. The firm expects
development to take 2 years and cost roughly $750 million.
Boeing forecasts sales of 30 planes per year and expects profits
of $9 million on each sale.

Example 3

Baldwin, a profitable widget maker, has developed a product
called the Turbo-Widget (TW). Baldwin has invested $300,000 in
R&D to develop TWs, and expects that TWs will capture a large
share of the market.

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Inflation

Discount nominal cashflows using nominal rates; discount real cashflows using real rates.

Warnings

- Discount rates are typically nominal rates $\Rightarrow$ cashflow forecasts should be nominal, too.

- Some cashflows are inherently nominal (e.g., depreciation tax shields).

- Forecasting nominal growth $\rightarrow$ forecasting real growth + inflation.

Measuring cashflows 6

Working capital

Short-term assets and liabilities that the firm generates in the course of doing business.

Current assets – inventory, accounts receivable, cash
Current liabilities – accounts payable

Net working capital = CA – CL

Investments in NWC are costly. An increase in NWC represents a cash outflow; a decrease in NWC represents a cash inflow.

Working capital

Assets	**Liabs. and equity**

Current assets
   cash
   accounts receivable
   inventory

Current liabilities
   accounts payable

Long-term assets
   equipment
   buildings
   land
   intangibles

Long-term debt
   bank loans
   bonds

Equity
   common stock
   retained earnings

Example

GM has just designed a new Saturn. It forecasts sales of 200,000 cars per year at an average price of $18,000. Costs are expected to be $17,000 / car. The model will sell for 4 years and GM expects an inventory of 40,000 cars.

What are the cashflows?

Operating profits ($ million)

Year	1	2	3	4
Sales	$3,600	$3,600	$3,600	$3,600
Cost of goods sold	3,400	3,400	3,400	3,400
Profit	$200	$200	$200	$200

[Sales = 200,000 × 18,000;   COGS = 200,000 × 17,000]

Example, cont.

What are the cashflows?

Year	1	2	3	4
Sales	$3,600	$3,600	$3,600	$3,600
COGS	3,400	3,400	3,400	3,400
Profit	**$200**	**$200**	**$200**	**$200**
Beg. inventory	0	680	680	680
End. inventory	680	680	680	0
Change	**680**	**0**	**0**	**-680**
Cashflow	**-$480**	**$200**	**$200**	**$880**

[Inventory = 40,000 $\times$ 17,000]

[Cashflow = Profit $-$ ΔInventory]

Example, cont.

How costly is the investment in working capital? Assume a discount rate of 8%.

Year	1	2	3	4
Beg. inventory	0	680	680	680
End. inventory	680	680	680	0
Cashflow	**-$680**	**0**	**0**	**$680**
$\div$	1.08	1.08^2	1.08^3	1.08^4
PV	**-$630**	**0**	**0**	**$500**

PV = –630 + 500 = –$130 million

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Depreciation

An accounting expense, not a cashflow

Notes

➤ Tax consequences ('depreciation tax shields')

➤ Accounting – fixed assets are capitalized, then depreciated
  Finance – focus on cashflows

➤ Sale of the equipment is a cashflow

➤ Depreciation methods: straight-line and declining balance

➤ Depreciation for tax and financial reporting can be different

Example

GM must invest $248 million in new equipment and stamping machines to produce the Saturn. The equipment will be used for the full production cycle of the car, expected to be 4 years, and will have a salvage value of $8 million at the end.

The tax rate is 40%.

What are depreciation expense and tax shields using straight-line and double-declining balance methods?

Example, cont.

Straight-line depreciation

Depreciable value = 248 million – 8 million = $240 million
Annual depreciation = 240 million / 4 = $60 million

Year	1	2	3	4
Beg. bk. value	248.0	188.0	128.0	68.0
Depreciation	60.0	60.0	60.0	60.0
End. bk. value	188.0	128.0	68.0	8.0
Cashflows				
Purchase and sale	-248.0			8.0
Depr. tax shields	24.0	24.0	24.0	24.0
Total CFs	224.0	24.0	24.0	32.0

[Assumes full year of depreciation 1st year]
[Tax shields = depreciation $\times$ tax rate]

Example, cont.

Double-declining balance

If the useful life is k years, depreciate 2/k of the **remaining** book value each year. In this example, GM would depreciate the equipment 50% = 2/4 each year.

Year	1	2	3	4
Beg. bk. value	248.0	124.0	62.0	31.0
Depreciation	124.0	62.0	31.0	23.0
End. bk. value	124.0	62.0	31.0	8.0
Cashflows				
Purchase and sale	-248.0			8.0
Depr. tax shields	49.6	24.8	12.4	9.2
Total CFs	-198.4	24.8	12.4	17.2

[Assumes full year of depreciation 1st year]   [Tax shields = depreciation × tax rate]

Depreciation, cont.

Year	3-Year	5-Year	7-Year	10-Year	15-Year	20-Year
1	33.33	20.00	14.29	10.00	5.00	3.75
2	44.45	32.00	24.49	18.00	9.50	7.22
3	14.81	19.20	17.49	14.40	8.55	6.68
4	7.41	11.52	12.49	11.52	7.70	6.18
5		11.52	8.93	9.22	6.93	5.71
6		5.76	8.93	7.37	6.23	5.28
7			8.93	6.55	6.23	4.89
8			4.45	6.55	5.90	4.52
9				6.55	5.90	4.46
10				6.55	5.90	4.46
11				3.29	5.90	4.46
12					5.90	4.46
13					5.90	4.46
14					5.90	4.46
15					5.90	4.46
16					2.99	4.46
17-20						4.46
21						2.25

Tax Depreciation Schedules by Recovery-Period Class

Example

Baldwin, a profitable widget maker, has developed an innovative new product called the Turbo-Widget (TW). Baldwin has invested $300,000 in R&D to develop TWs, and expects that TWs will capture a large share of the market.

Forecasts

➤ Baldwin will have to invest $2 million in new equipment. The machines have a 5-year useful life, with an expected salvage value of $250,000. The machines will require a major overhaul after 3 years, costing $100,000.

➤ Over the five-year product life-cycle, unit sales are expected to be 5,000 units, 8,000 units, 12,000 units, 10,000 units, and 6,000 units. Prices in the first year will be $480, and then will grow 2% annually.

Turbo-Widgets, cont.

➤ Sales and administrative costs will be $150,000 every year. Production costs will be $500 / unit in the first year, but will decline 8% annually.

➤ Baldwin must maintain approximately 2 weeks inventory of TWs, or 4% (2 / 52) of forecasted annual sales. Inventory can be stored in one of Baldwin's existing warehouses. The firm estimates that inventory will require 3,000 square feet and warehouse space costs $80 / s.f. / year.

➤ Customers don't pay immediately. Baldwin expects to have 30-days of sales outstanding as accounts receivable. Raw materials must be paid for immediately.

➤ The tax rate is 34% and the after-tax cost of capital is 12%.

Turbo-Widgets

Checklist

- **Sunk cost?**

- **Opportunity costs?**

- Average vs. marginal costs

- Depreciation

- Real options

- **Project interactions?**

- Inflation

- Investments in NWC

- Taxes

- Projects with different lives

Turbo-Widgets

Equipment ($000)

Year	0	1	2	3	4	5
Beg. bk. value	$2,000					
Tax depr (%)	20.0	32.0	19.2	11.5	11.5	5.8
Tax depr ($)	400	640	384	230	230	115
End. bk. value	1,600	940	576	346	115	0
Cashflows						
Buy and sale	-2,000					165
Depr. tax shields	136	218	131	78	78	39
Maintenance				-66		

[After-tax gain from sale = 250,000 $\times$ 0.66]
[Depr. tax shield = Tax depr $\times$ 0.34]
[After-tax maintenance = 100,000 $\times$ 0.66]

Turbo-Widgets

Operating income ($000)

Year	0	1	2	3	4	5
Unit sales		5	8	12	10	6
Price		480	490	499	509	520
Cost / unit		500	460	423	389	358
Revenues		2,400	3,917	5,993	5,094	3,117
COGS		2,500	3,680	5,078	3,893	2,149
Admin. expense		150	150	150	150	150
Depreciation	400	640	384	230	230	115
Op inc bef tax	-400	-890	-297	535	821	703
Tax (34%)	-136	-303	-101	182	279	239
Oper income	-264	-587	-196	353	542	464

[Oper inc bef tax = Rev – COGS – admin exp – depreciation]
[Price grows 2% annually; cost per unit declines 8% annually]

Turbo-Widgets

Working capital ($000)

Year	0	1	2	3	4	5
Sales		2,400	3,917	5,993	5,094	3,117
Acct receiv.		**200**	**326**	**499**	**424**	**0**
COGS		2,500	3,680	5,078	3,893	2,149
Inventory	**100**	**147**	**203**	**156**	**86**	**0**
NWC	100	347	529	655	510	0
Δ in NWC	100	247	182	126	-145	-510

[Acct rec = Sales / 12; in last year, receivables set to zero]

[Inventory = COGS next year × 0.04]

[NWC = Acct receivable + Inventory]

[Δ in NWC = NWC this year – NWC last year]

Turbo-Widgets

Putting it all together ($000)

Year	0	1	2	3	4	5
Oper income	-264	-587	-196	353	542	464
Depreciation	400	640	384	230	230	115
Δ in NWC	100	247	182	126	-145	-510
Equip. cashflow	-2,000			-66		165
Cashflow	**-1,964**	**-194**	**6**	**391**	**917**	**1,255**

[Cashflow = Op. income + depreciation – ΔNWC + equipment]

r = 12%

NPV = -$560,704

Turbo-Widgets

Summary

➤ **Cashflows = Oper. income + depr – ΔNWC + Equipment**

➤ **Changes in NWC represent cashflows**, but have no tax
   consequences

➤ **Remember cashflows from the sale of fixed assets**
   Only the gain or loss, relative to ending book value, is taxed

➤ **Depreciation is not a cashflow, but reduces taxes**

Sensitivity analysis

NPV as a function of r

Sensitivity analysis

NPV as a function of price growth

Sensitivity analysis

NPV as a function of cost growth