Chapter 9
Using Discounted Cash-Flow Analysis to Make Investment Decision

Financial Management (MGCM10018)

Preview

- Chapter 8 introduced valuation techniques based on discounted cash flows.
- This chapter develops criteria for properly identifying and calculating cash flows.

Outline

- Identifying Cash Flows
- Calculating Cash Flow
- An Example: Blooper Industries

Identifying Cash Flows (9.1)

- Cash flows vs. accounting income
  - Discount actual cash flows, not necessarily net income.
  - Using accounting income, rather than cash flow, could lead to erroneous decisions.
- Recall from chapter 3, income statements are intended to show how well the firm has performed, not to track cash flows.

Identifying Cash Flows (continued)

- If the firm lays out a large amount of money on a big capital project.
  - We should not say that the firm performed poorly that year, even though a lot of cash is going out.
  - Thus, the accountant does not deduct capital expenditure when calculating income.
  - Instead, we depreciate it over several years.
- This is fine for computing annual profits, but it could get you into trouble when finding NPV.

Example

A project costs $2,000 and is expected to last 2 years, producing cash income of $1,500 and $500, respectively. The cost of the project can be depreciated at $1,000 per year. Given a 10% required return, compare the NPV using cash flows to the NPV using accounting income.

	Year 1	Year 2
Cash Inflow	$1,500	$ 500
Depreciation	-$1,000	-$1,000
Accounting Income	+$ 500	- $ 500

Example

The NPV using cash flows:

	Today	Year 1	Year 2
Cash Inflow		$1,500	$ 500
Project Cost	-$2,000		
Free Cash Flow	-$2,000	+$1,500	+ $500

Identifying Cash Flows (continued)

- There is no doubt that we should use the cash NPV in the previous example.
- When calculating NPV, recognize investment expenditures when they occur, not later when they show up as depreciation.
- The focus of capital budgeting must be on cash flow, not profits.

Incremental Cash Flows

- A project's present value depends on the extra cash flows that it produces.
  - First, we need to forecast the firm's cash flows if we go ahead with the project.
  - Second, forecast the cash flows if we don't accept the project.
  - The difference is the incremental cash flows.

Incremental Cash Flow	=	Cash Flow with Project	-	Cash Flow without Project

Incremental Cash Flows

- We need to trace all the incremental cash flows from a proposed project in capital budgeting.
- There are some things to look out for:
  - Include All Indirect Effects
  - Forget Sunk Costs
  - Include Opportunity Costs
  - Recognize the Investment in Working Capital
  - Beware of Allocated Overhead Costs
  - Remember Shutdown Cash Flows

Include All Indirect Effects

- New products often damage sales of existing product.
  - Take iPhone as a good example.
- A new project may help the firm's existing business.
  - New air route from a small town itself may have negative NPV but add customers in existing traffic.
- We must include all indirect effects in the analysis.

Forget Sunk Costs

- Recall that sunk cost is a retrospective cost that has already been incurred and cannot be recovered.
  - Sunk costs remain the same whether or not we accept the project.
  - Thus, they do not affect project NPV.
  - Example: Lockheed's Tristar airplane.
- We always ignore sunk costs when calculating incremental cash flows.

Include Opportunity Costs

- Opportunity cost: benefit or cash flow foregone as a result of an action.
  - A new manufacturing operation uses a land that could otherwise be sold for $100,000.
  - This $100,000 should be included as the cost of new project.
  - The original cost of purchasing the land is irrelevant – that cost is sunk.

Investment in Working Capital

CA − CL = NWC

- The net working capital is the difference between a company's short-term assets and its liabilities.
  - Current assets: cash, accounts receivable, inventories…etc.
  - Current liabilities: accounts payable, notes payable, accruals…etc.
- Most projects entail an additional investment in working capital.

Investment in Working Capital

- For example, a new production may require more inventories of raw materials, and the customers may be slow to pay.
  - This increases current assets.
  - Thus, investments in working capital, just like investments in plant and equipment, result in increase in cash outflows.

Investment in Working Capital

- Common ways working capital is overlooked:
  - Forgetting about working capital entirely.
  - Forgetting that working capital may change during the life of the project.
  - Forgetting that working capital is recovered at the end of the project.

Terminal Cash Flows

- The end of project almost always brings additional cash flows.
  - We might be able to sell some of the plant, equipment, or real estate that was dedicated to the project.
  - We may also recover some of working capital when collect the outstanding receivable.

Allocated Overhead Costs

- Accountants must assign costs of a firm to its projects.
- Some overhead costs such as rent or electricity may or may not belong to a project.
- We should be cautious about accountants' allocation of overhead cost.
- Include only the extra expenses of the project.

Inflation and Discounting Cash Flows

- Discounting rule: real cash flows must be discounted at a real discount rate, nominal cash flows at a nominal rate.

$$1 + \text{real interest rate} = \frac{1+\text{nominal interest rate}}{1+\text{inflation rate}}$$

Inflation Example: Nominal Rates

You own a lease that will earn you $8,000 next year, increasing at 3% a year for 3 additional years (4 years total). If discount rates are 10% what is the present value of the lease?

Year	Cash Flow	PV @ 10%
0	$ 8,000	$8,000
1	$ 8,000 x 1.03^1 = $ 8,240	$\frac{8240}{1.10^1} = \$7,491$
2	$ 8,000 x 1.03^2 = $ 8,487	$\frac{8487}{1.10^2} = \$7,014$
3	$ 8,000 x 1.03^3 = $ 8,742	$\frac{8742}{1.10^3} = \$6,568$
		$29,073

Inflation Example: Real Rates

real op cost: $1 - \frac{1.1}{1.03} = 0.068$

Year	Cash Flow	PV @ 6.80%
0	$ 8,000	$ 8,000
1	$ 8,000	$\frac{8,000}{1.068^1} = \$7,491$
2	$ 8,000	$\frac{8,000}{1.068^2} = \$7,014$
3	$ 8,000	$\frac{8,000}{1.068^3} = \$6,568$
		$29,073

Investment and Financing Decisions

- Suppose we finance a project partly with debt.
  - Should we subtract the debt proceeds from the required investment?
  - Should we recognize the interest and principal payments on the debt as cash outflows?
  - No, these are decisions on financial actions.
- We should view the project as if it were all equity-financed.

Final Thoughts

- Ask the following question:
  - Would the cash flow still exist if the project does not exist?
- If yes, do not include it in your analysis. If no, include it.

Calculating Cash Flow (9.2)

- Cash flows are made up of three separate parts:

Total cash flow =
cash flows from capital investments
+ operating cash flows
+ cash flows from changes in working capital

Capital Investment

- To get a project started, a company typically needs to make up-front investments in plant, equipment, research, marketing, and so on.
  - For example, development of a new car model typically involves expenditure of $500 million or more.

Operating Cash Flow

- In the new car model example, operating cash flow consists of revenues from sale of the new product less the cost of production and any taxes.

Operating cash flow = Revenue – Costs – Taxes

Operating Cash Flow

- When firm calculates its taxable income, it makes a deduction for depreciation.
  - The depreciation charge is not a cash expense but affects the tax that the firm pays.
- There are three ways to deal with depreciation:
- Model 1: Dollars in Minus Dollars Out
  - Take only the items from the income statement that represent actual cash flows.

Operating Cash Flow = Revenue - Cash Expenses - Taxes

Operating Cash Flow

- Model 2: Adjusted Accounting Profits
  - Start with after-tax accounting profits and add back any depreciation deduction.

$$\text{Operating Cash Flow (OCF)} = \text{After-tax Profit} + \text{Depreciation}$$

- Model 3: Add Back Depreciation Tax Shield
  - Depreciation tax shield: reduction in taxes attributed to depreciation.

$$\text{OCF} = (\text{Revenue} - \text{Cash Expenses}) \times (1 - \text{Tax Rate}) + (\text{Tax Rate} \times \text{Depreciation})$$

Changes in Working Capital

- Investment in working capital such as in inventories of raw materials or in accounts receivable represents negative cash flows.
- Later in the life of a project, when the inventories are sold and receivable are collected, positive cash flows occur.

Example: Blooper Industries (9.3)

- Suppose we are the financial managers of Blooper Industries to analyze a proposal for mining and selling a small deposit of high-grade magnoosium ore.
- We are given the forecasts shown in the following table.

	A	B	C	D	E	F	G	H
1	**A. Inputs**		Spreadsheet Name					
2	Initial investment	10,000	Investment					
3	Salvage value	2,000	Salvage					
4	Initial revenue	15,000	Initial_rev					
5	Initial expenses	10,000	Initial_exp					
6	Inflation rate	0.05	Inflation					
7	Discount rate	0.12	Disc_rate					
8	Acct receiv. as % of sales	1/6	A_R					
9	Inven. as % of expenses	0.15	Inv_pct					
10	Tax rate	0.35	Tax_rate					
11								
12	**Year:**	**0**	**1**	**2**	**3**	**4**	**5**	**6**
13	**B. Fixed assets**							
14	Investment in fixed assets	10,000						
15	Sales of fixed assets							1,300
16	CF, invest. in fixed assets	-10,000	0	0	0	0	0	1,300
17								
18	**C. Operating cash flow**							
19	Revenues		15,000	15,750	16,538	17,364	18,233	
20	Expenses		10,000	10,500	11,025	11,576	12,155	
21	Depreciation		2,000	2,000	2,000	2,000	2,000	
22	Pretax profit		3,000	3,250	3,513	3,788	4,078	
23	Tax		1,050	1,138	1,229	1,326	1,427	
24	Profit after tax		1,950	2,113	2,283	2,462	2,650	
25	Operating cash flow		3,950	4,113	4,283	4,462	4,650	
26								
27	**D. Working capital**							
28	Working capital	1,500	4,075	4,279	4,493	4,717	3,039	0
29	*Change* in working cap	1,500	2,575	204	214	225	-1,679	-3,039
30	CF, invest. in wk capital	-1,500	-2,575	-204	-214	-225	1,679	3,039
31								
32	**E. Project valuation**							
33	Total project cash flow	-11,500	1,375	3,909	4,069	4,238	6,329	4,339
34	Discount factor	1.0	0.8929	0.7972	0.7118	0.6355	0.5674	0.5066
35	PV of cash flow	-11,500	1,228	3,116	2,896	2,693	3,591	2,198
36	Net present value	4,223						

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17								

2000 × (1 − 0.35) = 1300

Example: Blooper Industries (continued)

- Panel A summarizes the assumptions.
- Panel B details investments and disinvestments in fixed assets.
  - The project requires an initial investment of $10 million.
  - After 5 years, the mining equipment may be sold for $2 million.
    - We assume that the firm depreciates the equipment to final value of zero.
    - Thus, the $2 million sale would be treated as taxable gain, and with 35% tax, the net cash flow become $1.3 million.

Example: Blooper Industries (continued)

- Panel C shows changes in operating cash flow.
  - The firm expects to sell 750,000 pounds of magnoosium a year at $20 per pound.
    - This leads to $15 million revenue.
    - Row 19 shows revenues rising each year in line with inflation of 5%.
    - Annual expense is $10 million, this also need to consider impact of inflation (row 20).
    - Using straight-line depreciation to deduct the 1/5 of initial $10 million from profits.

18	**C. Operating cash flow**							
19	Revenues		15,000	15,750	16,538	17,364	18,233	
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36	Net present value	4,223						

Example: Blooper Industries (continued)

- Panel C shows changes in operating cash flow.
  - Row 22 shows pretax profit as (revenues – expenses - depreciation).
  - Row 23 shows taxes as 35% of pretax profit.
  - Row 24 shows profit after tax.
  - Row 25 shows cash flows as sum of after-tax profits and depreciation.
- Panel D shows changes in working capital.
  - Row 28 shows the level, and row 29 shows changes.
  - Row 30 shows cash flows as negative of changes.

Example: Blooper Industries (continued)

- Panel E presents the project valuation.
  - Row 33 shows total project cash flows as sum of 3 sources (rows 16, 25, and 30).
  - Discount each year's cash flows to row 35 with 12% opportunity cost.
  - Row 36 shows the NPV of $4.2 million as sum of row 35.

Example: Blooper Industries (continued)

- Forecasting working capital.
  - Consider the revenue of $15,000 in year 1.
    - Suppose that the customers pay with 2-month lag in average, the account receivable would be 2/12 of each year's sales.
    - That would be (2/12)*15,000 = $2,500 for year 1.
  - Consider the expense of $10,000 in year 1.
    - Assume 15% of expense represent an investment in inventory that took place in previous year.
    - So the inventory of year 0 would be 0.15*10,000 = $1,500.

Example: Blooper Industries (continued)

- Forecasting working capital.

	0	1	2	3	4	5	6
1. Receivables (2/12 × revenues)	$ 0	$2,500	$2,625	$2,756	$2,894	$3,039	0
2. Inventories (.15 × following year's expenses)	1,500	1,575	1,654	1,736	1,823	0	0
3. Working capital (1 + 2)	1,500	4,075	4,279	4,493	4,717	3,039	0

  - This is the level of working capital reported in row 28 in the spreadsheet.

Example: Blooper Industries (continued)

- Note on depreciation.
  - Here the firm depreciates the investment in mining equipment by $2 million a year.
    - This produces an annual tax shield of $0.7 million for 5 years.
    - These tax shields increase cash flows and present values.
      - If they can be obtained sooner, they would be worth more.
  - The modified accelerated cost recovery system (MACRS) is permitted by tax law.

Year(s)	Recovery Period Class					
	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	8.92	7.37	6.23	5.28
7			8.93	6.55	5.90	4.89
8			4.46	6.55	5.90	4.52
9				6.56	5.91	4.46
10				6.55	5.90	4.46
11				3.28	5.91	4.46
12					5.90	4.46
13					5.91	4.46
14					5.90	4.46
15					5.91	4.46
16					2.95	4.46
17–20						4.46
21						2.23

How does MACRS depreciation affect the value of depreciation tax shield?

	Straight-Line Depreciation			MACRS Depreciation		
Year	Depreciation	Tax Shield	PV Tax Shield at 12%	Depreciation	Tax Shield	PV Tax Shield at 12%
1	2,000	700	625	2,000	700	625
2	2,000	700	558	3,200	1,120	893
3	2,000	700	498	1,920	672	478
4	2,000	700	445	1,152	403	256
5	2,000	700	397	1,152	403	229
6	0	0	0	576	202	102
Totals	10,000	3,500	2,523	10,000	3,500	2,583

Example: Blooper Industries (continued)

- All large corporations in the U.S. keep two sets of books, one for stockholders and one for the Internal Revenue Service (IRS).
  - It is common to use straight-line depreciation on the shareholder books and MACRS depreciation on the tax books.
- Only the tax books are relevant in capital budgeting.