Making Capital Investment Decisions

AEM 2241 - Finance

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Outline

Principles of Cash Flow Modeling

- The investment decision methods that we discussed earlier are based on cash flows.
- These cash flows cannot be known with precision in advance - we must build a model to predict them.
- In many cases, the result of building the model is a set of "expected" cash flows. The textbook, without being explicit about this, follows this approach.
- A more sophisticated approach would explicitly recognize the uncertainty in the cash flows, and it would predict several, potentially many different outcomes, each with its own probability. These possibilities would then be aggregated into a final answer using probabilistic methods beyond the scope of this course.

Relevant Cash Flows

- The analysis must include only **relevant cash flows**, i.e., cash flows that would not exist but for the existence of the project we are contemplating.
- We call these cash flows incremental cash flows: They consist of any and all changes in the firm's future cash flows that are a direct consequence of undertaking the project.
- Importantly, we should not consider only completely new cash flows, but also changes (increases or decreases in the magnitude) of already existing cash flows due exclusively to the contemplated project.
- A cash flow that will occur whether the project is undertaken or not is irrelevant.

The Stand-Alone Principle

- In many cases, the contemplated project will be just a (small) part of an already existing complex firm.
- In such cases, it is both hard and unnecessary to model the cash flows of the entire firm, only to then separate the incremental cash flows of the contemplated project.
- Instead, we can only focus on the incremental cash flows, modeling only the contemplated project.
- In effect, we are treating the project as a stand-alone "mini-firm."
- This approach reduces the complexity of the modeling, separates the uncertainty related to the project from the uncertainties affecting the firm overall, and allows for the evaluation of the project on its own.

Incremental Cash Flows

- **Sunk costs** are costs (expenses) that have already been incurred, or the liability to pay them has already been incurred. **Sunk costs are irrelevant, since they exist whether the project is undertaken or not.**
  Sunk costs are difficult to ignore in practice, since humans are often reluctant to give up a project in which they invested lots of time and/or other resources.
- **Opportunity costs** are costs that are incurred implicitly, when an asset or some other resource is used in the project and, consequently, it cannot be used for other purposes.
- **Side effects** are spillover effects that the project has on other parts of the firm. Given our focus, we focus on side effects that modify the firm's cash flows. Side effects can be either positive or negative.

Incremental Cash Flows (2)

- **Net working capital**: Besides capital investments, such as buildings or machinery, projects typically also have working capital needs. For example, some cash must be on hand to pay for routine expenses. May projects will also require investments in inventory, as well as accounts receivable (to be able to sell on credit).
- Some of the working capital will be financed by the firm's vendors who will sell to the firm on credit.
- The difference between the working capital invested by the firm and the working capital financed by others is the net working capital.
- The net working capital is an initial cash expense to the firm. When the project is wound down, the working capital (or just a part of it) is typically recovered, generating a cash inflow.

Other Considerations

- Financing costs will not be included in the incremental cash flows of the contemplated project. Financing is an independent decision. More about this later.
- There will be differences between the accounting analysis of the project, and our cash-flow based analysis. To the extent we rely on accounting data, we must make sure to undo accrual effects and to focus only on actual cash flows.
- All cash flows must be considered on an after-tax basis. This is crucial, since taxes may represent one of the biggest individual expenses that a firm incurs.

Pro-Forma Financial Statements

- A project can be modeled in full from the ground up, and cash flows can be obtained by simulating the entire activity of the business. Such a model can be very complicated and the many details involved may make important high-level characteristics of the project less amenable to analysis.
- Instead, one often prepares pro-forma (projected) financial statements for the project. These often rely on information that is relatively high-level and easier to generate and understand.
- Pro-forma statements must use estimates of various relevant quantities, e.g., of sales, expenses, production levels, inventory costs.
- Cash flows are then inferred from the pro-forma financial statements.

Shark Attractant Project

- Projected income statement:

Sales (50,000 units @ \$4/unit)	200,000
Variable costs (\$2.5/unit)	125,000
Fixed costs	17,430
Depreciation (\$90,000/3)	30,000
EBIT	**27,570**
Taxes (@21%)	5,790
Net income	**21,780**

- EBIT: Earnings before interest and taxes.
- Depreciation is not a cash expense. However, taxes are a cash expense.

Shark Attractant Project

- Projected capital requirements:

	Year 0	Year 1	Year 2	Year 3
Net working capital	20,000	20,000	20,000	20,000
Net fixed assets	90,000	60,000	30,000	0
Total investment	110,000	80,000	50,000	20,000

- The initial capital investment is \$90,000; it is **depreciated** uniformly over 3 years. The yearly depreciation is \$30,000.
- Working capital needs are assumed to be constant over the (modeled) lifetime of the project.

Project Cash Flows

- There are relationships that we can use to infer project cash flows from financial statements and related information:

$$\begin{aligned} \textit{project cash flow} &= \textit{operating cash flow} \\ &\quad - \textit{change in net working capital} \\ &\quad - \textit{project capital spending} \end{aligned}$$

$$\begin{aligned} \textit{operating cash flow} &= \textit{EBIT} \\ &\quad + \textit{depreciation} \\ &\quad - \textit{taxes} \end{aligned}$$

- Because depreciation is not a cash expense, we must add it back. Taxes, however, are a cash expense, and EBIT must be decreased to account for them.

Project Cash Flows (2)

- Projected operating cash flow:

EBIT	27,570
Depreciation	+30,000
Taxes	-5,790
Operating cash flow	**51,780**

- Projected total cash flows:

	Year 0	**Year 1**	**Year 2**	**Year 3**
Operating cash flow		51,780	51,780	51,780
- Changes in net working capital	-20,000			+20,000
- Capital spending	-90,000			
Total projected cash flow	**-110,000**	**51,780**	**51,780**	**71,780**

Note how the working capital is recovered at the end of the project's life. In practice, only a fraction of the working capital would be recovered. Note the negative sign in front of "Changes in working capital" and "Capital Spending"!

Project Cash Flows (3)

- If the appropriate discount rate is 20%, the NPV of the project can now be computed:

$$NPV = -110,000 + \frac{51,780}{1+0.2} + \frac{51,780}{(1+0.2)^2} + \frac{71,780}{(1+0.2)^3} = \$10,647.69.$$

- Also, the project's IRR is approximately 25.76%.
- Both our investment criteria suggest that this project should be undertaken.
- Note, however, that this is a **model-based decision** - if the cash flow predictions have large errors, the decision may be incorrect.
- It is always prudent to repeatedly question models' assumptions, to make sure that no important information has been overlooked, and that the underlying assumptions are not overly optimistic.

Net Working Capital

- Consider the following simplified income statement:

Sales	500
Costs	310
Net income	**190**

- Now consider the following account balances:

	Beginning of Year	**End of Year**	**Change**
Accounts receivable	880	910	+30
Accounts payable	550	605	+55
Net working capital	**330**	**305**	**-25**

- If no capital spending is incurred in this year, we have:

$$\begin{aligned} \textit{project cash flow} &= \textit{operating cash flow} \\ &\quad - \textit{change in net working capital} \\ &\quad - \textit{project capital spending} \\ &= \$190 - (-\mathbf{\$25}) - 0 \\ &= \$215. \end{aligned}$$

Net Working Capital (2)

- Given the data above, we can also reverse engineer the cash revenues (inflows) and cash costs (outflows).
- We can now write:

$$\textit{Cash revenues} = \textit{Sales} - (\textit{change in accounts receivable}) = 500 - 30 = \$470.$$

$$\textit{Cash costs} = \textit{Costs} - (\textit{change in accounts payable}) = 310 - 55 = \$255.$$

$$\begin{aligned} \textit{Cash flow} &= (\textit{cash revenues}) - (\textit{cash costs}) \\ &= \textit{sales} - (\textit{change in accounts receivable}) - \textit{costs} + (\textit{change in accounts payable}) \\ &= \textit{sales} - \textit{costs} - [(\textit{change in accounts receivable}) - (\textit{change in accounts payable})] \\ &= (\textit{operating cash flow}) - (\textit{change in net working capital}) \\ &= \$190 - (-\$25) \\ &= \$215. \end{aligned}$$

Depreciation

- Depreciation is a non-cash expense that businesses book over the lifetime of capital assets. It spreads the initial cost of the capital asset over the asset's **legally-defined** useful economic life. Ultimately, the most important role of depreciation is the reduction in tax that it generates.
- From our perspective, the cash flow related to the initial purchase of the asset is relevant. Depreciation is relevant only to the extent it reduces the tax expense, thus indirectly contributing to an increase in cash flows.
- To stimulate investments, tax law generally favors aggressive (fast) depreciation schedules.
- The most important system for computing depreciation is the modified accelerated cost recovery system (MACRS). Each capital asset is classified into one of several categories, which then determins the asset's depreciation schedule.

Depreciation (2)

- Depreciation is a non-cash expense; its main role is to reduce taxable income, and thus taxes.
- Depreciation ties the costs associated with an asset to the economic life of the asset. From an accounting and tax perspective, these costs are spread out over the length of useful economic life. From a cash flow perspective, however, all that matters is when "cash moves."
- While an asset depreciates from an accounting and tax perspective, it also loses value. Ideally, the depreciated value and the true economic value would be close. Establishing true economic value can be both labor-intensive (and thus expensive and slow) and subject to manipulation.
- To simplify the process, depreciation schedules are defined by laws and regulations.

MACRS

- The Modified Accelerated Cost Recovery System (MACRS) has been in use in the US since 1981.
- Each asset is classified into one of several categories. The asset's category determines the depreciation schedule. Some assets do not depreciate (land).
- Examples:

Class	Asset
3-year	research equipment
5-year	automobiles, computers
7-year	industrial equipment

- Is an **accelerated** depreciation schedule good for businesses?

MACRS Example

- Consider a car that a business buys for $12,000. A car is a 5-year depreciable asset, and thus the 5-year MACRS schedule shown below can be used to account for the car's depreciation.

Year	MACRS Percentage	x Initial Cost	Depreciation	Ending Book Value
1	20.00%	x 12,000	$2,400.00	$9,600.00
2	32.00%	x 12,000	$3,849.00	$5,760.00
3	19.20%	x 12,000	$2,304.00	$3,456.00
4	11.52%	x 12,000	$1,382.40	$2,073.60
5	11.52%	x 12,000	$1,382.40	$691.20
6	5.76%	x 12,000	$691.20	$0
	100%		$12,000	

- Note that the first and last year are considered partial years (half years, actually), so the schedule spans **6 calendar** years.

Actual vs. Depreciated Value

- If a partially or totally depreciated asset is sold, there will be a gain or loss, depending of the sale price and the assets depreciated value.
- A gain will be taxable; a loss will be a tax expense. Neither is taxed as a capital gain.
- Consider a car that is sold after 5 years, when its book value is \$691.20 (see prior slide).
  - If the sale price is \$3,000, then the seller would record a taxable **gain** of \$3,000-\$691.20=\$2,308.80. There was too much depreciation; it must be "recaptured" for tax purposes.
  - If the sale price is \$500, then the seller would record a taxable **loss** of \$691.20-\$500=\$191.20.

Operating Cash Flow: Alternative Definitions

- One can use various accounting identities to rewrite operating cash flows in different forms.
- These alternatives all yield the same result, so in this sense they are equivalent.
- The various expressions are useful because they emphasize different aspects of the business. Thus the alternative formulas allow for either a better understanding of a project overall, or for an easier analysis of particular situations (projects) when certain data are more readily available.

OCF: A Simple Example

- Consider a hypothetical firm described by the following data:

Sales	\$1,500
Costs	\$700
Depreciation	\$600
Tax Rate	21%

- Given the above, we have:

$$\text{EBIT} = \text{Sales} - \text{Costs} - \text{Depreciation} = 1,500 - 700 - 600 = \$200$$
$$\text{Taxes} = \text{EBIT} \times T_c = 200 \times 21\% = \$42$$
$$\text{OCF} = \text{EBIT} + \text{Depreciation} - \text{Taxes} = 200 + 600 - 42 = \$758$$

Three Alternatives

- Bottom-Up:
  - Net Income = EBIT - Taxes = 200 - 42 = \$158.
  - **OCF = Net Income + Depreciation** = 158 + 600 = \$758.
- Top-Down:
  - **OCF = Sales - Costs - Taxes** = 1,500 - 700 - 42 = \$758.
- Tax Shield Approach:
  - **OCF = (Sales - Costs) $\times$ (1 - T_c) + Depreciation $\times$ T_c**
    $= (1{,}500 - 500) \times 0.79 + 600 \times 0.21 = 632 + 126 = \$758.$
  -
$$\begin{aligned}\text{OCF} &= \text{EBIT - Taxes} + \text{Depreciation}\\ &= (\text{Sales - Costs - Depreciation}) \times (1 - T_c) + \text{Depreciation}\\ &= (\text{Sales - Costs}) \times (1 - T_c) - \text{Depreciation} \times (1 - T_c) + \text{Depreciation}\\ &= (\text{Sales - Costs}) \times (1 - T_c) + \text{Depreciation} \times (-1 + T_c + 1)\\ &= (\text{Sales - Costs}) \times (1 - T_c) + \text{Depreciation} \times T_c.\end{aligned}$$
- Note that all three formulas yield the same result - they are mathematically equivalent.

Cost-Cutting Proposals

- New automation equipment will save \$22,000/year (pre-tax). The equipment costs \$80,000, will be depreciated linearly over 5 years. Salvage value after 5 years will be \$20,000.
- We set up a table and we start filling it up:
-

	Year					
	0	1	2	3	4	5
Operating Cash Flow						
Net Change in Working Capital	0	0	0	0	0	0
Capital Spending	-80,000					**15,800**
Total Cash Flow						

- The **after-tax** salvage value in year 5 will be:
((pre-tax salvage value)-(depreciated value))$\times$(1-T_c)
=(20,000-0)$\times$(1-0.21)=\$15,800.

Cost-Cutting Proposals (2)

- **Incremental linear** depreciation per year
= 80,000/5 = \$16,000.
- **Incremental** operating income = \$22,000.
- **Incremental** EBIT
= (incremental operating income) - (incremental depreciation)
= 22,000-16,000=\$6,000.
- **Incremental** taxes on (incremental) EBIT
= 6,000 $\times$ 0.21 = \$1,260.
- **Incremental** operating cash flow
= (incr. EBIT) - (incr. taxes) + (incr. depreciation)
= 6,000 - 1,260 + 16,000 = \$20,740.

Cost-Cutting Proposals (3)

	Year					
	0	1	2	3	4	5
Operating Cash Flow		20,740	20,740	20,740	20,740	20,740
Net Change in Working Capital	0	0	0	0	0	0
Capital Spending	-80,000					15,800
Total Cash Flow	**-80,000**	**20,740**	**20,740**	**20,740**	**20,740**	**36,540**

- Using a 10% discount rate, the NPV of this series of cash flows is $8,431.47, so the project is worth undertaking.

To Do!

- Carefully read the other examples in section 10.6 "Some Special Cases of Discounted Cash Flow Analysis."
- Read the example of the Majestic Mulch And Compost Company - it is an example too long to analyze in class, but it gives you a good idea about the flavor of non-trivial cash flow analysis.