CHAPTER 12
Project Cash Flow Analysis

- Relevant cashflows
- Working capital treatment
- Unequal project lives
- Abandonment value
- Inflation

Estimating cash flows:

- The most important, but also most difficult, step in capital budgeting is estimating a project's CFs.
- The underlying principle is to estimate the incremental CFs (the firm's CFs with the project minus the firm's CFs without the project).

Project CF versus Accounting Income:

- Cash outlays must be considered at time they occur.
- Non-cash charges must be included in CF estimations.
- Changes in net working capital.
- Interest expenses are NOT included in CF estimations.

Incremental CFs:

- Represent the change in the firm's total CF as a result of the project.

- Sunk costs are always ignored.
- Opportunity costs are considered.
- Effects on other parts of the firm are important (externalities).

Timing of CFs:

- Technically we should account for CFs exactly as they are expected to occur.
- However, we generally assume CFs occur at the end of each year for estimation and calculation simplicity.
  (Remember, these are estimates.)

Depreciation:

- Depreciation is a non-cash charge and are included in CF estimates.
- We must calculate depreciation and originally remove it from estimated CFs since it lowers taxable income which results in a reduction of a cash expense (taxes).

MACRS Depreciation:

- Identifies several classes of assets with set *recovery periods*.
- Based on class of assets, MACRS gives the allowable percentage of depreciation charged each year.
- Depreciable basis: Purchase price plus any shipping and installation costs.

CF Estimation:

- Unfortunately, there is no “set” formula for estimating CFs for all projects.
- Logic is required to determine that all relevant CFs are considered.
- General guidelines are listed on the following slides.

Initial Outlay:

- Cost of new project: (Total cost including, S&H, and installation.
- Net value of replaced equipment (market value adjusted for tax effects).
- Increase in NWC beyond that covered by spontaneous accounts.

Operating CFs:

- Incremental revenues
- Incremental costs
- Incremental depreciation
- Tax effects

Terminal year CFs:

- Salvage value of equipment
- Tax effects
- Recovery of NWC

Proposed Project

- Cost: $200,000 + $10,000 shipping +$30,000 installation. (Depreciable cost $240,000.)
- Inventories will rise by $25,000 and payables will rise by $5,000. (Increase in NWC=$20,000)
- Economic life = 4 years.
- Salvage value = $25,000.
- MACRS 3-year class.

- Incremental gross sales = $250,000.
- Incremental cash operating costs = $125,000.
- Tax rate = 40%.
- Cost of capital = WACC = 10%

Net Investment Outlay At t=0

Equipment	**($200,000)**
Freight + Inst.	**(40,000)**
Change in NWC	**(20,000)**
Net CF_0	**($260,000)**

Δ NWC = $25,000 - $5,000

What is the annual depreciation?

Year	Rate	x	Basis	Depreciation
1	0.33		$240	$ 79
2	0.45		240	108
3	0.15		240	36
4	0.07		240	17
	1.00			$240

Due to half-year convention, a 3-year asset is depreciated over 4 years.

Operating cash flows:

	1	2	3	4
Sales	$250	$250	$250	$250
Cash costs	125	125	125	125
Depreciation	79	108	36	17
EBT	$ 46	$ 17	$ 89	$108
Taxes (40%)	18	7	36	43
Net Income	28	10	53	65
Add: Depreciation	79	108	36	17
Operating Cash flow	$107	$118	$ 89	$ 82

Net Terminal Cash Flow
At t = 4

Salvage value	$25,000
Tax on SV	(10,000)
Recovery on NWC	20,000
Net Termination CF	$35,000

What if you terminate a project before the asset is fully depreciated?

Cash flow = Sale proceeds - taxes paid

Taxes are based on IRS definition of capital gain = Sale proceeds - basis

Basis = Original basis - Accum. deprec.
= remaining depreciation

Example: if sold after 3 years

- Original basis = 240K
- After 3 years = 17K remaining
- Sale Price = 25K
- Tax on sale = .4(25K-17K)
  = $3,200
- Cashflow = 25,000 - 3,200
  =$21,700

Should CFs include interest expense? Dividends?

- NO. The costs of capital are already incorporated in the analysis since we use them in discounting.
- If we included them as cash flows, we would be double counting the cost of capital.

Suppose $100,000 had been spent last year to improve the production line site. Should this cost be included in the analysis?

- NO. This is a <u>sunk cost</u>. Focus on incremental investment and cash flows.

Suppose the plant space could be leased out for $25,000 a year. Would this affect the analysis?

- Yes. Accepting the project means we will not receive the $25,000. This is an <u>opportunity cost</u> and it should be charged to the project.

If the new product line would decrease sales of the firm's other products by $50,000 per year, would this affect the analysis?

- Yes. The effects on the other projects CFs is an "externality".
- Net CF loss per year on other lines would be a cost to this project.
- Externalities will be positive if new projects are complements to existing assets, negative if substitutes.

Externalities

- Of course, if you would lose the $50,000 in sales of the other product even if you reject the new project (a competitor steps in), the $50,000 is NOT charged to the new project. What matters is the difference between expected CFs with and without the new project.

If this were a replacement rather than a new project, would the analysis change?

Yes. The old equipment would be sold and the incremental CFs would be the changes from the old to the new situation.

- The relevant depreciation would be the change with the new equipment.
- Also, if the firm sold the old machine now, it would not receive the salvage value at the end of the machine's life. (This would represent an opportunity cost.)

What is real option analysis?

- Real options exist when managers can influence the size and riskiness of a project's cash flows by taking different actions during the project's life.
- Real option analysis incorporates typical NPV budgeting analysis with an analysis for opportunities resulting from managers' decisions.

What are some examples of real options?

- Investment timing options
- Abandonment/shutdown options
- Growth/expansion options
- Flexibility options

Consider a project with a 3 yr life. If abandoned prior to year 3, the machinery will have positive abandonment value.

Year	CF	Abandon Value
0	(5,000)	5,000
1	2,100	3,100
2	2,100	1,700
3	1,750	0

CF's Under Each Alternative

	0	1	2	3
1. No abandonment	(5K)	2.1K	2.1K	1.75K

NPV = -$41

CF's Under Each Alternative

	0	1	2	3
2. Abandon 2 years	(5K)	2.1K	2.1K	
			<u>1.7K</u>	
			3.8K	

NPV = $50

CF's Under Each Alternative

	0	1	2	3
3. Abandon 1 year	(5K)	2.1K		
		<u>3.1K</u>		
		5.2K		

NPV = -$273

Abandonment example

- The project is acceptable only if operated for 2 years.
- A project's engineering life does not always equal its economic life.
- The ability to abandon a project may make and otherwise unattractive project acceptable.
- Abandonment possibilities will be very important when we get to risk.

Is it likely that a project might have strategic option value over and above the indicated NPV?

- Strategic option value: Investment in a project may lead to other valuable opportunities
- Because of this, managers might be willing to accept a negative NPV project if it might lead to one or more positive NPV projects in the future.
- In many instances, only a qualitative evaluation is possible.

What are the 3 types of project risk?

- Stand-alone risk
- Corporate risk
- Market risk

What is stand-alone risk?

- The project’s total risk, if it were operated independently.
- Usually measured by standard deviation (or coefficient of variation).
- However, it ignores the firm’s diversification among projects and investor’s diversification among firms.

What is corporate risk?

- The project's risk when considering the firm's other projects, i.e., diversification within the firm.
- Corporate risk is a function of the project's NPV and standard deviation and its correlation with the returns on other projects in the firm.

What is market risk?

- The project's risk to a well-diversified investor.
- Theoretically, it is measured by the project's beta and it considers both corporate and stockholder diversification.

Which type of risk is most relevant?

- Market risk is the most relevant risk for capital projects, because management's primary goal is shareholder wealth maximization.
- However, since total risk affects creditors, customers, suppliers, and employees, it should not be completely ignored.

Which risk is the easiest to measure?

- Stand-alone risk is the easiest to measure. Firms often focus on stand-alone risk when making capital budgeting decisions.
- Focusing on stand-alone risk is not theoretically correct, but it does not necessarily lead to poor decisions.

Are the three types of risk generally highly correlated?

- Yes, since most projects the firm undertakes are in its core business, stand-alone risk is likely to be highly correlated with its corporate risk.
- In addition, corporate risk is likely to be highly correlated with its market risk.

What is sensitivity analysis?

- Sensitivity analysis measures the effect of changes in a variable on the project's NPV.
- To perform a sensitivity analysis, all variables are fixed at their expected values, except for the variable in question which is allowed to fluctuate.
- Resulting changes in NPV are noted.

What are the advantages and disadvantages of sensitivity analysis?

- Advantage
  - Identifies variables that may have the greatest potential impact on profitability and allows management to focus on these variables.
- Disadvantages
  - Does not reflect the effects of diversification.
  - Does not incorporate any information about the possible magnitudes of the forecast errors.

Perform a scenario analysis of the project, based on changes in the sales forecast

- Suppose we are confident of all the variable estimates, except unit sales. The actual unit sales are expected to follow the following probability distribution:

Case	Probability	Unit Sales
Worst	0.25	75,000
Base	0.50	100,000
Best	0.25	125,000

Scenario analysis

- All other factors shall remain constant and the NPV under each scenario can be determined.

Case	Probability	NPV
Worst	0.25	(\$27.8)
Base	0.50	\$15.0
Best	0.25	\$57.8

Determining expected NPV, σ_{NPV}, and CV_{NPV} from the scenario analysis

- E(NPV) = 0.25(-\$27.8)+0.5(\$15.0)+0.25(\$57.8)
  = \$15.0

- σ_{NPV} = $[0.25(-\$27.8-\$15.0)^2 + 0.5(\$15.0-\$15.0)^2 + 0.25(\$57.8-\$15.0)^2]^{1/2}$
  = \$30.3.

- CV_{NPV} = \$30.3 /\$15.0 = 2.0.

If the firm's average projects have CV_{NPV} ranging from 1.25 to 1.75, would this project be of high, average, or low risk?

- With a CV_{NPV} of 2.0, this project would be classified as a high-risk project.
- Perhaps, some sort of risk correction is required for proper analysis.

Is this project likely to be correlated with the firm's business? How would it contribute to the firm's overall risk?

- We would expect a positive correlation with the firm's aggregate cash flows.
- As long as correlation is not perfectly positive (i.e., $\rho \neq 1$), we would expect it to contribute to the lowering of the firm's total risk.

If the project had a high correlation with the economy, how would corporate and market risk be affected?

- The project's corporate risk would not be directly affected. However, when combined with the project's high stand-alone risk, correlation with the economy would suggest that market risk (beta) is high.

If the firm uses a +/- 3% risk adjustment for the cost of capital, should the project be accepted?

- Reevaluating this project at a 13% cost of capital (due to high stand-alone risk), the NPV of the project is -$2.2 .
- If, however, it were a low-risk project, we would use a 7% cost of capital and the project NPV is $34.1.

What subjective risk factors should be considered before a decision is made?

- Numerical analysis sometimes fails to capture all sources of risk for a project.
- If the project has the potential for a lawsuit, it is more risky than previously thought.
- If assets can be redeployed or sold easily, the project may be less risky.

What is Monte Carlo simulation?

- A risk analysis technique in which probable future events are simulated on a computer, generating estimated rates of return and risk indexes.
- Simulation software packages are often add-ons to spreadsheet programs.