

CHAPTER 11

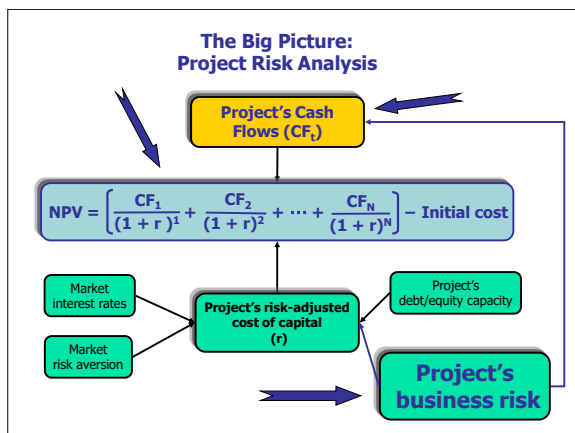
Cash Flow Estimation and Risk Analysis

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Topics

- Estimating cash flows:
 - Relevant cash flows
 - Working capital treatment
- Risk analysis:
 - Sensitivity analysis
 - Scenario analysis
 - Simulation analysis
- Real options

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Proposed Project Data

- \$200,000 cost + \$10,000 shipping + \$30,000 installation.
- Economic life = 4 years.
- Salvage value = \$25,000.
- MACRS 3-year class.

Continued...

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Project Data (Continued)

- Annual unit sales = 1,250.
- Unit sales price = \$200.
- Unit costs = \$100.
- Net working capital:
 - $NWC_t = 12\%(\text{Sales}_{t+1})$
- Tax rate = 40%.
- Project cost of capital = 10%.

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Incremental Cash Flow for a Project

- Project's incremental cash flow is:

Corporate cash flow with the project

Minus

Corporate cash flow without the project.

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Treatment of Financing Costs

- Should you subtract interest expense or dividends when calculating CF?
- NO.
 - We discount project cash flows with a cost of capital that is the rate of return required by all investors (not just debtholders or stockholders), and so we should discount the total amount of cash flow available to all investors.
 - They are part of the costs of capital. If we subtracted them from cash flows, we would be double counting capital costs.

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Sunk Costs

- 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 sunk cost. Focus on incremental investment and operating cash flows.

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Incremental Costs

- 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 opportunity cost and it should be charged to the project.
- A.T. opportunity cost = $\$25,000 (1 - T) = \$15,000$ annual cost.

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Externalities

- 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 are "externalities."
- 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.

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What is an asset's depreciable basis?

$$\begin{aligned} \text{Basis} &= \text{Cost} \\ &+ \text{Shipping} \\ &+ \text{Installation} \\ &\underline{\hspace{1.5cm}} \\ &\$240,000 \end{aligned}$$

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Annual Depreciation Expense (000s)

Year	%	X	(Initial Basis)	= Deprec.
1	0.33		\$240	\$79.2
2	0.45			108.0
3	0.15			36.0
4	0.07			16.8

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Annual Sales and Costs

	Year 1	Year 2	Year 3	Year 4
Units	1,250	1,250	1,250	1,250
Unit Price	\$200	\$206	\$212.18	\$218.55
Unit Cost	\$100	\$103	\$106.09	\$109.27
Sales	\$250,000	\$257,500	\$265,225	\$273,188
Costs	\$125,000	\$128,750	\$132,613	\$136,588

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Why is it important to include inflation when estimating cash flows?

- Nominal $r >$ real r . The cost of capital, r , includes a premium for inflation.
- Nominal CF $>$ real CF. This is because nominal cash flows incorporate inflation.
- If you discount real CF with the higher nominal r , then your NPV estimate is too low.

Continued...

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Inflation (Continued)

- Nominal CF should be discounted with nominal r , and real CF should be discounted with real r .
- It is more realistic to find the nominal CF (i.e., increase cash flow estimates with inflation) than it is to reduce the nominal r to a real r .

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Operating Cash Flows (Years 1 and 2)

	<u>Year 1</u>	<u>Year 2</u>
Sales	\$250,000	\$257,500
Costs	125,000	128,750
Deprec.	<u>79,200</u>	<u>108,000</u>
EBIT	\$ 45,800	\$ 20,750
Taxes (40%)	<u>18,320</u>	<u>8,300</u>
EBIT(1 - T)	\$ 27,480	\$ 12,450
+ Deprec.	<u>79,200</u>	<u>108,000</u>
Net Op. CF	\$106,680	\$120,450

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Operating Cash Flows (Years 3 and 4)

	<u>Year 3</u>	<u>Year 4</u>
Sales	\$265,225	\$273,188
Costs	132,613	136,588
Deprec.	<u>36,000</u>	<u>16,800</u>
EBIT	\$ 96,612	\$119,800
Taxes (40%)	<u>38,645</u>	<u>47,920</u>
EBIT(1 - T)	\$ 57,967	\$ 71,880
+ Deprec.	<u>36,000</u>	<u>16,800</u>
Net Op. CF	\$ 93,967	\$ 88,680

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Cash Flows Due to Investments in Net Working Capital (NWC)

	<u>Sales</u>	<u>NWC (% of sales)</u>	<u>CF Due to Investment in NWC</u>
Year 0		\$30,000	-\$30,000
Year 1	\$250,000	30,900	-900
Year 2	257,500	31,827	-927
Year 3	265,225	32,783	-956
Year 4	273,188	0	32,783

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Salvage Cash Flow at t = 4 (000s)

Salvage Value	\$25
Book Value	<u>0</u>
Gain or loss	\$25
Tax on SV	<u>10</u>
Net Terminal CF	\$15

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

- Basis = Original basis – Accum. deprec.
- Taxes are based on difference between sales price and tax basis.

$$\text{Cash flow from sale} = \text{Sale proceeds} - \text{Taxes paid}$$

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Example: If Sold After 3 Years for \$25 (\$ thousands)

- Original basis = \$240.
- After 3 years, basis = \$16.8 remaining.
- Sales price = \$25.
- Gain or loss = \$25 – \$16.8 = \$8.2.
- Tax on sale = 0.4(\$8.2) = \$3.28.
- Cash flow = \$25 – \$3.28 = \$21.72.

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Example: If Sold After 3 Years for \$10 (\$ thousands)

- Original basis = \$240.
- After 3 years, basis = \$16.8 remaining.
- Sales price = \$10.
- Gain or loss = $\$10 - \$16.8 = -\$6.8$.
- Tax on sale = $0.4(-\$6.8) = -\2.72 .
- Cash flow = $\$10 - (-\$2.72) = \$12.72$.
- Sale at a loss provides a tax credit, so cash flow is larger than sales price!

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Net Cash Flows for Years 1-2

	<u>Year 0</u>	<u>Year 1</u>	<u>Year 2</u>
Init. Cost	-\$240,000	0	0
Op. CF	0	\$106,680	\$120,450
NWC CF	-\$30,000	-\$900	-\$927
Salvage CF	0	0	0
Net CF	-\$270,000	\$105,780	\$119,523

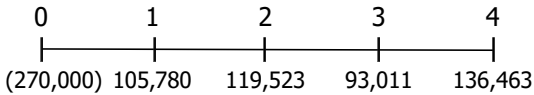
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Net Cash Flows for Years 3-4

	<u>Year 3</u>	<u>Year 4</u>
Init. Cost	0	0
Op. CF	\$93,967	\$88,680
NWC CF	-\$956	\$32,783
Salvage CF	0	\$15,000
Net CF	\$93,011	\$136,463

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Project Net CFs Time Line



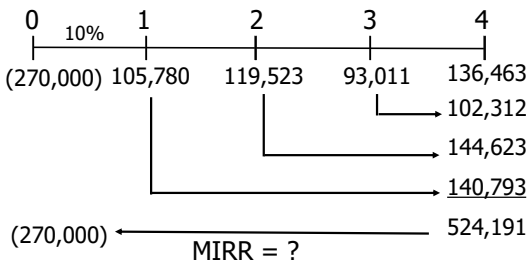
Enter CFs in CFLO register and I/YR = 10.

NPV = \$88,030.

IRR = 23.9%.

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What is the project's MIRR?



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Calculator Solution

- Enter positive CFs in CFLO. Enter I/YR = 10. Solve for NPV = \$358,029.581.
- Now use TVM keys: PV = -358,029.581, N = 4, I/YR = 10; PMT = 0; Solve for FV = 524,191. (This is TV of inflows)
- Use TVM keys: N = 4; FV = 524,191; PV = -270,000; PMT = 0; Solve for I/YR = 18.0%.
- MIRR = 18.0%.

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What is the project's payback? (\$ thousands)

0	1	2	3	4
(270)	106	120	93	136

Cumulative:

(270)	(164)	(44)	49	185
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Payback = 2 + $\$44/\93 = 2.5 years.

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What does "risk" mean in capital budgeting?

- Uncertainty about a project's future profitability.
- Measured by σ_{NPV} , σ_{IRR} , beta.
- Will taking on the project increase the firm's and stockholders' risk?

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Is risk analysis based on historical data or subjective judgment?

- Can sometimes use historical data, but generally cannot.
- So risk analysis in capital budgeting is usually based on subjective judgments.

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What three types of risk are relevant in capital budgeting?

- Stand-alone risk
- Corporate risk
- Market (or beta) risk

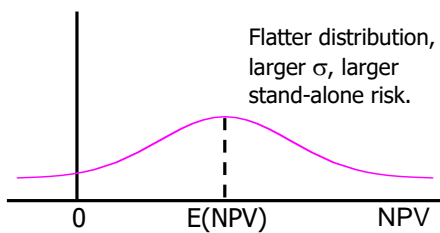
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Stand-Alone Risk

- The project's risk if it were the firm's only asset and there were no shareholders.
- Ignores both firm and shareholder diversification.
- Measured by the σ or CV of NPV, IRR, or MIRR.

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Probability Density



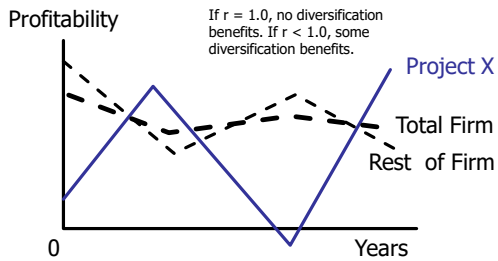
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Corporate Risk

- Reflects the project's effect on corporate earnings stability.
- Considers firm's other assets (diversification within firm).
- Depends on project's σ , and its correlation, ρ , with returns on firm's other assets.
- Measured by the project's corporate beta.

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Project X is negatively correlated to firm's other assets, so has big diversification benefits



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Market Risk

- Reflects the project's effect on a well-diversified stock portfolio.
- Takes account of stockholders' other assets.
- Depends on project's σ and correlation with the stock market.
- Measured by the project's market beta.

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How is each type of risk used?

- Market risk is theoretically best in most situations.
- However, creditors, customers, suppliers, and employees are more affected by corporate risk.
- Therefore, corporate risk is also relevant.

Continued...

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- Stand-alone risk is easiest to measure, more intuitive.
 - Core projects are highly correlated with other assets, so stand-alone risk generally reflects corporate risk.
 - If the project is highly correlated with the economy, stand-alone risk also reflects market risk.

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What is sensitivity analysis?

- Shows how changes in a variable such as unit sales affect NPV or IRR.
- Each variable is fixed except one. Change this one variable to see the effect on NPV or IRR.
- Answers "what if" questions, e.g. "What if sales decline by 30%?"

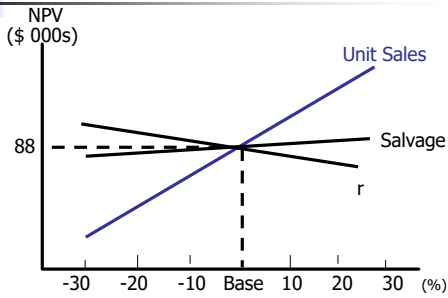
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Sensitivity Analysis

Change From Base level	r	Resulting NPV (000s)	
		Unit sales	Salvage
-30%	\$113	\$17	\$85
-15%	\$100	\$52	\$86
0%	\$88	\$88	\$88
15%	\$76	\$124	\$90
30%	\$65	\$159	\$91

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Sensitivity Graph



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Results of Sensitivity Analysis

- Steeper sensitivity lines show greater risk. Small changes result in large declines in NPV.
- Unit sales line is steeper than salvage value or r , so for this project, should worry most about accuracy of sales forecast.

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What are the weaknesses of sensitivity analysis?

- Does not reflect diversification.
- Says nothing about the likelihood of change in a variable, i.e. a steep sales line is not a problem if sales won't fall.
- Ignores relationships among variables.

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Why is sensitivity analysis useful?

- Gives some idea of stand-alone risk.
- Identifies dangerous variables.
- Gives some breakeven information.

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What is scenario analysis?

- Examines several possible situations, usually worst case, most likely case, and best case.
- Provides a range of possible outcomes.

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Best scenario: 1,600 units @ \$240
Worst scenario: 900 units @ \$160

Scenario	Probability	NPV(000)
Best	0.25	\$279
Base	0.50	88
Worst	0.25	-49
E(NPV) = \$101.6		
$\sigma(\text{NPV}) = 116.6$		
CV(NPV) = $\sigma(\text{NPV})/E(\text{NPV}) = 1.15$		

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Are there any problems with scenario analysis?

- Only considers a few possible outcomes.
- Assumes that inputs are perfectly correlated—all "bad" values occur together and all "good" values occur together.
- Focuses on stand-alone risk, although subjective adjustments can be made.


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What is a simulation analysis?

- A computerized version of scenario analysis that uses continuous probability distributions.
- Computer selects values for each variable based on given probability distributions.


(More...)

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- NPV and IRR are calculated.
 - Process is repeated many times (1,000 or more).
 - End result: Probability distribution of NPV and IRR based on sample of simulated values.
 - Generally shown graphically.


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Simulation Example Assumptions

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- Normal distribution for unit sales:
 - Mean = 1,250
 - Standard deviation = 200
 - Normal distribution for unit price:
 - Mean = \$200
 - Standard deviation = \$30

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Simulation Process

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- Pick a random variable for unit sales and sale price.
 - Substitute these values in the spreadsheet and calculate NPV.
 - Repeat the process many times, saving the input variables (units and price) and the output (NPV).

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Simulation Results (2,000 trials)

	Units	Price	NPV
Mean	1,252	\$200	\$88,808
Std deviation	199	30	\$82,519
Maximum	1,927	294	\$475,145
Minimum	454	94	-\$166,208
Median	685	\$163	\$84,551
Prob NPV > 0			86.9%
CV			0.93

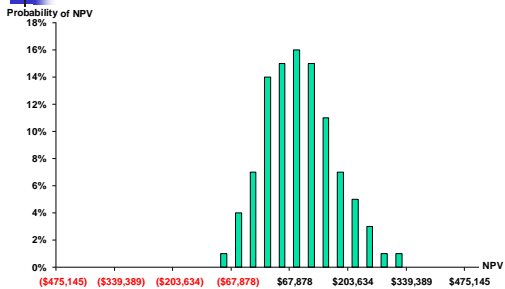
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Interpreting the Results

- Inputs are consistent with specified distributions.
 - Units: Mean = 1,252; St. Dev. = 199.
 - Price: Mean = \$200; St. Dev. = \$30.
- Mean NPV = \$ 88,808. Low probability of negative NPV (100% – 87% = 13%).

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Histogram of Results



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What are the advantages of simulation analysis?

- Reflects the probability distributions of each input.
- Shows range of NPVs, the expected NPV, σ_{NPV} , and CV_{NPV} .
- Gives an of the risk situation. intuitive graph

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What are the disadvantages of simulation?

- Difficult to specify probability distributions and correlations.
- If inputs are bad, output will be bad: "Garbage in, garbage out."

(More...)

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- Sensitivity, scenario, and simulation analyses do not provide a decision rule. They do not indicate whether a project's expected return is sufficient to compensate for its risk.
- Sensitivity, scenario, and simulation analyses all ignore diversification. Thus they measure only stand-alone risk, which may not be the most relevant risk in capital budgeting.

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If the firm's average project has a CV of 0.2 to 0.4, is this a high-risk project? What type of risk is being measured?

- CV from scenarios = 1.15, CV from simulation = 0.93. Both are > 0.4, this project has high risk.
- CV measures a project's stand-alone risk.
- High stand-alone risk usually indicates high corporate and market risks.

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With a 3% risk adjustment, should our project be accepted?

- Project $r = 10\% + 3\% = 13\%$.
- That's 30% above base r .
- NPV = \$65,371.
- Project remains acceptable after accounting for differential (higher) risk.

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Should subjective risk factors be considered?

- Yes. A numerical analysis may not capture all of the risk factors inherent in the project.
- For example, if the project has the potential for bringing on harmful lawsuits, then it might be riskier than a standard analysis would indicate.

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