

# **CHAPTER 15**

## **Project Risk Assessment and Incorporation**

- **The source of project risk**
- **Types of project risk**
  - **Stand-alone**
  - **Corporate**
  - **Market**
- **Risk assessment techniques**
- **Risk incorporation**

## Risk in Capital Budgeting

- In capital budgeting, financial risk is related to *uncertainty* about a project's profitability.
- If any of the forecasted cash flows are not known with certainty, the project's forecasted profitability is uncertain, and hence risk is present.
- As in all investments, risk is the *primary determinant* of a project's required rate of return (discount rate).

## Types of Project Risk

- **Three different types of project risk can be defined and, at least in theory, measured.**
  - **Stand-alone**
  - **Corporate**
  - **Market**
- **The risk that is relevant to a particular analysis depends on the situation at hand.**

## Stand-Alone Risk

- **Stand-alone risk** assumes that the project will be operated in *isolation*, and hence ignores any portfolio effects.
- It is measured by the amount of uncertainty in forecasted profitability—the greater the uncertainty, the greater the risk.
- Often, **standard deviation** ( $\sigma$ ) [or **coefficient of variation** (**CV**)] is used as the measure of stand-alone risk.

## Corporate Risk

- **Corporate risk** is the contribution of the project to the overall riskiness of the *business* (standard deviation of the business's ROE).
- It depends on:
  - The project's stand-alone risk ( $\sigma$ ).
  - The correlation of the project's returns to the overall returns of the *business*.
- It is measured (at least conceptually) by a project's **corporate beta**.

## Market Risk

- **Market risk** is the contribution of the project to the overall riskiness (standard deviation) of a *well-diversified stock portfolio*.
- It depends on:
  - The project's stand-alone risk ( $\sigma$ ).
  - The correlation of the project's returns to the returns of the *market portfolio*.
- It is measured (at least conceptually) by a project's **market beta**.

## Risk Type Relevancy

- ***Stand-alone risk*** is relevant only to very small not-for-profit businesses.
- ***Corporate risk*** is most relevant to large not-for-profit businesses.
- ***Market risk*** is most relevant to investor-owned businesses. However, corporate risk is relevant to nonowner stakeholders and affects bankruptcy potential. Thus, corporate risk is also relevant within investor-owned businesses.

## Risk Type Relevancy (Cont.)

- However, stand-alone risk generally is the *only risk* that is somewhat measurable, and it is most intuitive.
- Fortunately, most projects under consideration have returns that are *highly correlated* with the overall returns on the business and with market returns.
- ? Why are such correlations important?

## Risk Assessment Example

- Consider Midtown Clinic's evaluation of new diagnostic equipment presented in the Chapter 14 slideshow.
- Cost
  - \$200,000 purchase price
  - \$40,000 shipping and installation
- Expected life = **four** years.
- Salvage value = **\$25,000**.

## Cash Flow Estimation Example (Cont.)

- Utilization = **5,000** scans/year.
- Net revenue = **\$80** per scan.
- Supplies costs = **\$40** per scan.
- Labor costs = **\$100,000**.
- *Neutral* inflation rate = **5%**.
- Corporate cost of capital = **10%**.

## Base Case ROI



**NPV = \$117,000.**

**IRR = 29.7%.**

**MIRR = 21.4%.**

**Imbedded in these CFs:**

**Unit sales = 5,000.**

**Labor costs = \$100,000.**

## Risk Assessment Techniques

- There are two techniques most commonly used to measure a project's stand-alone risk:
  - Sensitivity analysis
  - Scenario analysis
- In addition, **Monte Carlo simulation** can be used (not discussed here).
- Note that risk measurement (and incorporation) is not a precise process.

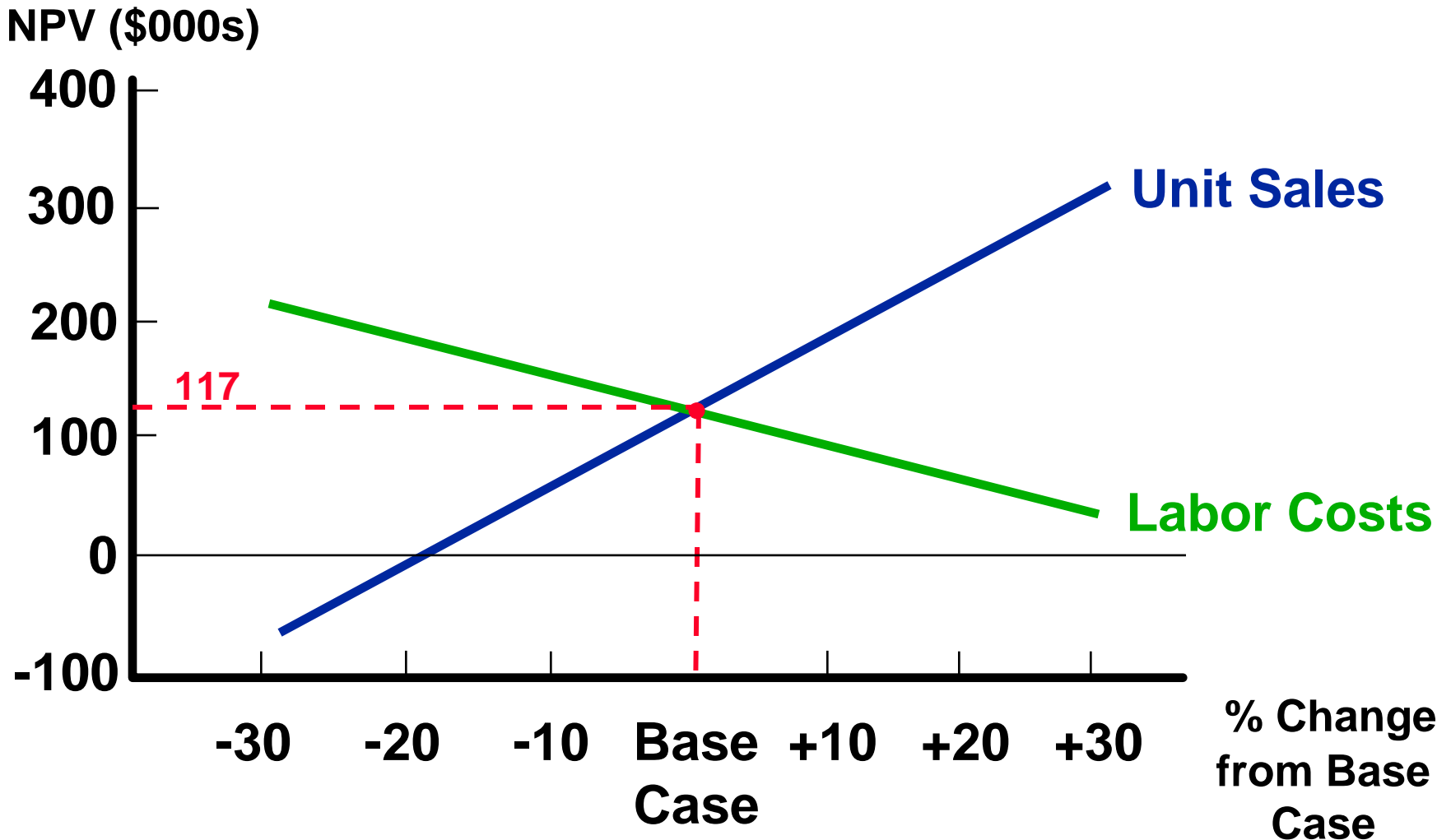
## Sensitivity Analysis

- **Sensitivity analysis** shows how *changes* in an input variable such as utilization affect profitability.
- Every input variable is held at its base case (expected) value except one. Then, the variable being analyzed typically is changed from its base case value by set percentages, say,  $\pm 10\%$ ,  $\pm 20\%$ , and  $\pm 30\%$ .
- For ease of illustration, we will focus on only two input variables: *unit sales* and *labor costs*.

## Sensitivity Analysis Illustration with Two Uncertain Variables

<u>Change from Base Level</u>	<u>NPV (000s)</u>	
	<u>Unit Sales</u>	<u>Labor Costs</u>
-30%	-\$ 87	\$219
-20	-19	185
-10	49	151
0	117	117
+10	185	83
+20	252	49
+30	320	15

# Graphical Results



## Interpretation of Sensitivity Analysis

- ***Steeper*** lines show greater risk, because small forecasting errors will result in large changes in NPV.
- The **unit sales** line is steeper than the **labor costs** line, so NPV is more sensitive to changes in sales volume than to changes in fixed (labor) costs.
- Historically, projects with steep lines were assumed to have greater risk than projects with flat lines.

## Advantages of Sensitivity Analysis

- Identifies the variables that are most *critical* to the analysis; that is, the variables that, if forecasts are wrong, have the most influence on profitability.
- Provides some basic breakeven information.

## Discussion Item

**Why is it important for managers to know the critical input variables?**

## Disadvantages of Sensitivity Analysis

- Does not consider the amount by which the input variables could actually change.
- Does not consider any interaction among the input variables.
- Provides no quantitative measure of risk, so it is difficult to make a supportable judgment about the riskiness of the project.

## Scenario Analysis

- **Scenario analysis** examines several possible profitability outcomes, usually three:
  - Worst case
  - Most likely case
  - Best case
- Provides a *range* of possible outcomes, which can be used to obtain a quantitative measure of risk.

## Scenario Analysis Illustration

<u>Scenario</u>	<u>Prob.</u>	<u>Unit Sales</u>	<u>Labor Costs</u>	<u>NPV</u>
Worst	0.25	4,000	\$120,000	-\$ 86,000
ML	0.50	5,000	100,000	117,000
Best	0.25	6,000	80,000	320,000

**E(NPV) = \$117,000.**

**SD = \$144,000.**

**CV = \$144 / \$117 = 1.2.**

## Advantages of Scenario Analysis

- Considers *more* than one variable at a time.
- Provides information about the worst possible results.
- Provides a *quantitative measure* of stand-alone risk.

## Discussion Items

Why is it important for managers to know the worst possible outcome? (Hint: Consider *risk* versus the ability of a business to *bear* that risk.)

Does the size (scale) of an investment affect its risk? Or, put another way, is a **\$10,000** investment in HMA stock riskier than a **\$1,000** investment?

## Disadvantages of Scenario Analysis

- Only considers a *limited number* of outcomes, whereas the real world is much more complex.
- Forces all best case and worst case input values to occur together, so it may push the “extreme” values out farther than they should be.

## Final Project Risk Assessment

- Suppose Midtown Clinic's average project has a CV of **0.5–1.0**.
- $CV = 1.2$  for this project, so it has *high risk* as judged quantitatively.
- We measured the project's *stand-alone risk*. However, it is likely that the returns on this project will be highly correlated with the business's overall returns and with the general economy.

## Project Risk Incorporation

- Assume that the firm adds or subtracts **3** percentage points to account for risk.
- Project cost of capital:  
$$10\% + 3\% = 13\%.$$
- Now, NPV = **\$93,000**, so the project remains highly profitable (**expectationally**) even after adjusting for its high risk.

## Discussion Item

**Would it make sense to classify  
the risk of projects as:**

**Very high**

**High**

**Moderately high**

**And so on**

## Objective Versus Subjective Risk

- **Objective risk** is risk measured in a quantitative way, such as using cash flow estimates to obtain a coefficient of variation (CV) of NPV.
- **Subjective risk** is the risk that the objective measurement is wrong. In other words, the cash flows estimates are worthless.
- In general, subjective risk is highest when the investment being evaluated is using *new, unproven technology* or is in a *new, unfamiliar line of business*.

## Qualitative Approach to Risk Assessment

- The quantitative risk assessment may be validated using the **qualitative approach**.
- Here values (such as  $Y = 1$ ;  $N = 0$ ) are assigned to the answers to questions such as these:
  - Does the project require new market share?
  - Is it outside of current management expertise?
  - Does it require hard-to-get technical expertise?
  - Will there be heavy competition?
  - Does it require the use of new, unproven technology?
- The higher the total, the higher the risk.

## Discussion Item

**Does the qualitative approach to project risk assessment have any merit, or is it just some wacky scheme developed by a liberal arts major who never learned how to use a spreadsheet?**

## Some Final Thoughts

- **The whole process of risk assessment and incorporation is clearly fraught with both conceptual and implementation problems.**
- **Nevertheless, good financial practices dictate that required returns must consider the riskiness of the investment.**
- **Even if the process is subjective rather than numerical, project risk should play a role in the decision process.**

## Evaluating Risky Outflows

- Assume Northwest Healthcare is evaluating two alternative medical waste disposal systems. **Plan W** requires more workers but less capital. **Plan C** requires a larger up-front investment but has lower operating costs.
- Both systems have **three-year** lives.
- The choice will have no impact on Northwest's revenues, so the decision will be based on ***relative costs***.
- Initially, both systems are judged to have average risk, so the cost of capital is **10%**.

Here are the net cash flows:

<u>Year</u>	<u>Plan W</u>	<u>Plan C</u>
0	(\$500)	(\$1,000)
1	(500)	(300)
2	(500)	(300)
3	(500)	(300)

$$PV_{\text{COSTS}_W} = -\$1,743.$$

$$PV_{\text{COSTS}_C} = -\$1,746.$$

? Which system should be chosen?

? What is the IRR of **Plan W**?

Now suppose **Plan W** is judged to be **riskier** than **Plan C** because future wage rates are difficult to forecast.  
Would this affect the choice?

If we add a **3%** risk adjustment to the **10%** CCC to get a **13%** project cost of capital for **W**, then:

$$PV_{\text{COSTS}_W} = -\$1,681.$$

- ? Which system should be chosen now?
- ? Does this make sense?

- When **costs** are being discounted, use a **lower** discount rate to reflect **higher** risk. Thus, the appropriate discount rate for **W** would be  $10\% - 3\% = 7\%$ , which gives:

$$PV_{\text{COSTS}_W} = -\$1,812.$$

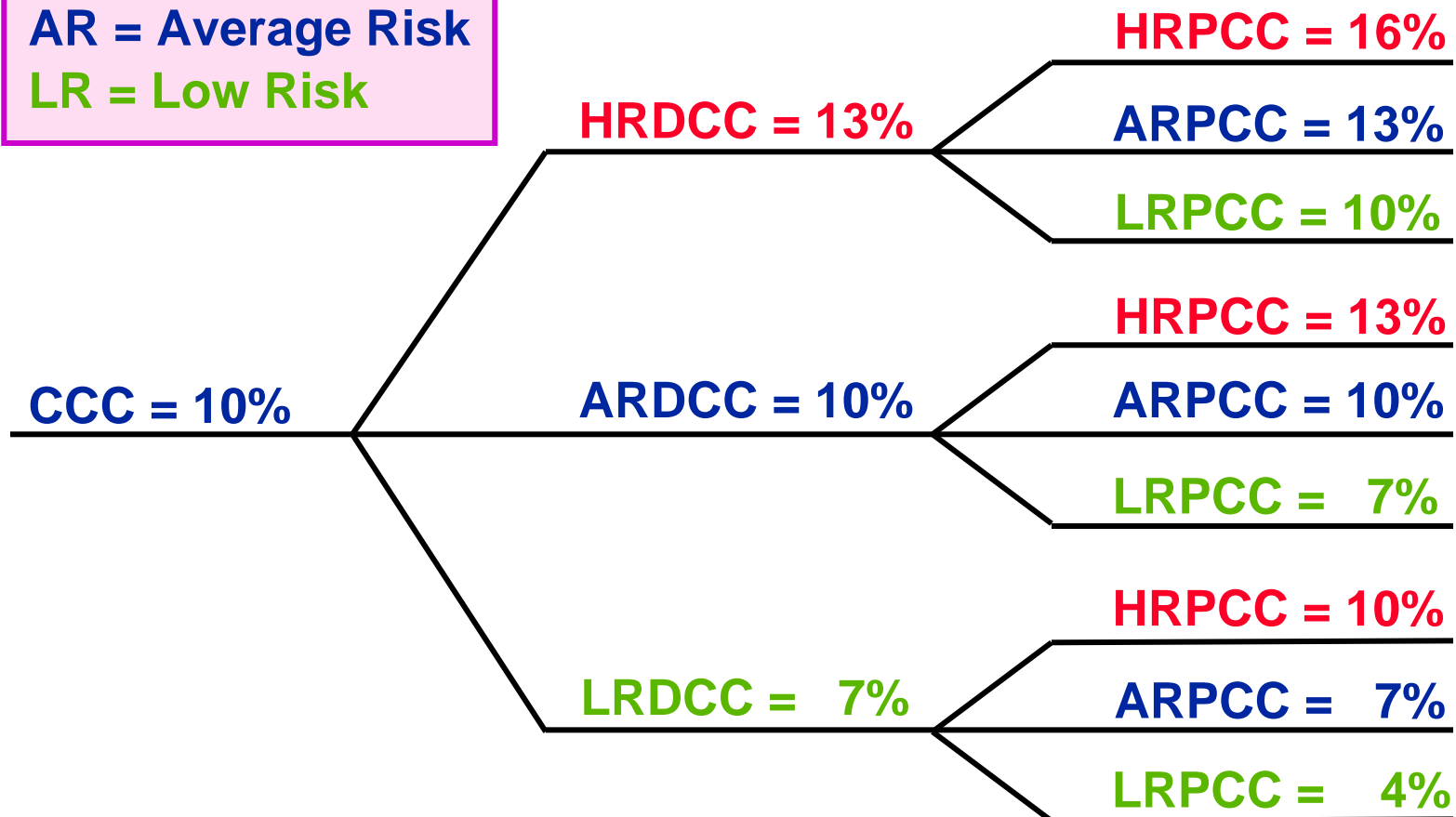
- With the the proper risk adjustment,  $PV_{\text{COSTS}_W} > PV_{\text{COSTS}_C}$ , so now **choose Plan C.**

## The Capital Budgeting Process

- First, the business estimates its corporate (divisional) cost(s) of capital.
- The riskiness of projects is assessed *relative* to the average project risk in the corporation (division).
- **Project costs of capital** are estimated by adjusting the corporate (divisional) cost(s) of capital.
- Projects are then evaluated using a differential risk-adjusted cost of capital.

# Capital Budgeting Process Graphic

**HR = High Risk**  
**AR = Average Risk**  
**LR = Low Risk**



## Capital Rationing

- Under **capital rationing**, a business has more acceptable projects than it has investment capital.
- From a purely financial perspective, the set of projects that creates the greatest financial value should be chosen.

## Discussion Item

**Is there a profitability measure that is especially helpful when capital rationing applies?**

## Conclusion

- This concludes our discussion of *Chapter 15* (Project Risk Assessment and Incorporation).
- Although not all concepts were discussed in class, you are responsible for all of the material in the text.
- ? Do you have any questions?