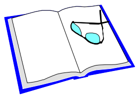
# Chapter 3: Risk Analysis

There are many approaches to incorporate risk into project analysis. The first one is use of sensitivity analysis. Sensitivity analysis uses a number of outcome estimates (cash flows estimates) to get a sense of the variability among potential returns. While, the second approach is to deal with risk and uncertainty through adjustments to the discount rate or by the certainty equivalent factor.

Introduction



## 3.1 Introduction: What is risk?

Risk is the variation of future expectations around an expected value. Risk is measured as the range of variation around an expected value. Risk and uncertainty are interchangeable words. In project analysis, risk is the variation in predicted future cash flows.

Handling Risk

## 3.2 Handling Risk

There are several approaches to handling risk: In this unit, risk is accounted for by applying a discount rate commensurate with the riskiness of the cash flows, and by using a certainty equivalent factor. However, risk may be also accounted for by evaluating the project under simulated cash flow and discount rate scenarios.

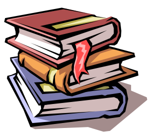
Using a Risky Discount Rate

## 3.3 Using a Risky Discount Rate

The structure of the cash flow discounting mechanism for risk is:

$$NPV = \frac{(Risky\ cash\ flows)\ 1}{(1 + risky\ rate)^1} + \frac{(Risky\ cash\ flows)\ 2}{(1 + risky\ rate)^2} + \ldots\ldots - Initial\ outlay$$

Defining a Risky Discount Rate



## 3.4 Defining a Risky Discount Rate

Conceptually, a risky discount rate, k, has three components:

- A risk-free rate (r), to account for the time value of money
- An average risk premium (u), to account for the firm's business risk
- An additional risk factor (a), with a positive, zero, or negative value, to account for the risk differential between the project's risk and the firms' business risk.

Calculating a Risky Discount Rate

## 3.5 Calculating a Risky Discount Rate

A risky discount rate is conceptually defined as:

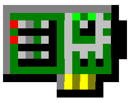
$k = r + u + a$

Unfortunately, k, is not easy to estimate.

**Two approaches to this problem:**

1. Use the firm's overall Weighted Average Cost of Capital (WACC), after tax, as k. The WACC is the overall rate of return required to satisfy all suppliers of capital.
2. A rate estimating (r + u) is obtained from the Capital Asset Pricing Model, (CAPM) and then a is added.

Calculating the WACC



### 1- Calculating the WACC

**WACC =** Wps*Cps + Wcs*Ccs + (Wd * Cd)
Where:
Wps is the weight of preferred stock.
Wcs is the weight of common stock.
Wd is the weight of debt.
Cps is the cost of preferred stock
Ccs is the cost of common stock
Cd is the cost of debt = interest * (1-tax rate)

**Example:**
Assume a firm has a capital structure of:
50% common stock, 10% preferred stock, 40% long-term debt.
Rates of return required by the holders of each are: common, 10%; preferred, 8%; pre-tax debt, 7%. The firm's income tax rate is 30%.

WACC = (0.5 x 0.10) + (0.10 x 0.08) + (0.40 x (0.07x (1-0.30)))
= 7.76% pa, after tax.

The Capital Asset Pricing Model

### 2- The Capital Asset Pricing Model (CAPM)

This model establishes the covariance between market returns and returns on a single security. The covariance measure can be used to establish the risky rate of return, r, for a particular security, given expected market returns and the expected risk free rate.

**Calculating *r* from the CAPM**
The equation to calculate r, for a security with a calculated Beta is:

E (rit) = RFR + Bi (Rmt – RFR)

Where:
E(rit) is the expected return of the share or the asset (the required rate of return).

RFR is the risk free rate
Rmt is the rate of return on the market portfolio.
Beta is the Slope of an Ordinary Least Squares Regression Line

Example

**Example:**
If the RFR is 7% and the return on the market portfolio is 12% what is the expected return of share x if the shares beta is 0.5? If the stock beta has increased to one, what is the expected return on that stock?

Erit = 7% + 0.5 (12% - 7%) = 9.5% (this is the discount rate to be used in calculating the NPV)

If the beta is increased to 1 the expected return will be:
Erit = 7% + 1 (12% - 7%) = 12% (this is the discount rate to be used in calculating the NPV)

Note: Beta is a measure of risk i.e. High beta means high risk thus a higher required rate of return.

The Certainty Equivalent Method

## 3.6 The Certainty Equivalent Method: Adjusting the Cash Flows to their 'Certain' Equivalents

The Certainty Equivalent method adjusts the cash flows for risk, and then discounts these 'certain' cash flows at the risk free rate.

$$NPV = \frac{CF_1 \times b}{(1+r)^1} + \frac{CF_2 \times b}{(1+r)^2} etc - CO$$

Where: b is the 'certainty coefficient' (established by management, and is between 0 and 1); and r is the risk free rate.

Analysis under Risk

## 3.7 Analysis under Risk: Summary

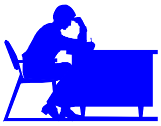
Risk is the variation in future cash flows around a central expected value.

Risk can be accounted for by adjusting the NPV calculation discount rate: there are two methods – either the WACC, or the CAPM

Risk can also be accommodated via the Certainty Equivalent Method.

All methods require management judgment and experience.

Project Decision Analysis



## 3.8 Project Decision Analysis (Guide Lines)

### 3.8.1 Making Go/No-Go Project Decision

Virtually all general managers face capital-budgeting decisions in the course of their careers. The most common of these is the simple "yes" versus "no" choice about a capital investment. The following are some general guidelines to orient the decision maker in these situations.

**Focus on *cash flows,* not profits.** One wants to get as close as possible to the economic reality of the project. Accounting profits contain many kinds of economic fiction. Flows of cash, on the other hand, are economic facts.

**Focus on *incremental* cash flows.** The point of the whole analytical exercise is to judge whether the firm will be better off or worse off if it undertakes the project. Thus, one wants to focus on the changes in cash flows effected by the project. The analysis may require some careful thought: a project decision identified as a simple go/no-go question may hide a subtle substitution or choice among alternatives. For instance, a proposal to invest in an automated machine should trigger many questions: Will the machine expand capacity (and thus permit us to exploit demand beyond our current limits)? Will the machine reduce costs (at the current level of demand) and thus permit us to operate more efficiently than before we had the machine? Will the machine create other benefits (e.g., higher quality, more operational flexibility)? The key economic question asked of project proposals should be, "How will things change (i.e., be better or worse) if we undertake the project?"

**Account for time.** *Time is money.* We prefer to receive cash sooner rather than later. Use NPV as the technique to summarize the quantitative attractiveness of the project. Quite simply, NPV can be interpreted as the amount by which the market value of the firm's equity will change as a result of undertaking the project.

**Account for *risk.*** Not all projects present the same level or risk. One wants to be compensated with a higher return for taking more risk. The way to control for variations in risk from project to project is to use a discount rate to value a flow of cash that is consistent with the risk of that flow.

These 4 precepts summarize a great amount of economic theory that has stood the test of time. Organizations using these precepts make better investment decisions than organizations that do not use them.