BA 351
CORPORATE FINANCE

LECTURE 7
UNCERTAINTY, THE CAPM AND CAPITAL BUDGETING

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In this lecture, we examine project valuation when cash flows are uncertain. As before, it is necessary to discount the expected cash flows from a project at an appropriate discount rate. We discuss how to find this discount rate when cash flows are uncertain. Additionally, we look at the weighted-average cost of capital and the adjusted net present value methods.

The historical return on various investment portfolios is not the same. The U.S. stock market, for example, in the long run has a much higher historical real return (9%) than a portfolio of government bonds (2.4%). (See figures 7-4 and 7-5 in Brealey and Myers.) However, its standard deviation is much greater. Similarly, the stock markets of different countries show somewhat differing returns as well.

The Capital Asset Pricing Model (CAPM), which was developed by Sharpe, Lintner, Markowitz and Tobin (three of them won a Nobel Prize!), explains these differences in the returns of different assets (and portfolios) by stating that the expected return on an asset is proportional to its beta, where beta is a measure of sensitivity of the returns of that asset with the market return. Thus in its original form:

\[
\text{EXPECTED RETURN ON ASSET} = \text{RISKFREE RATE} + (\text{BETA OF ASSET}) \times \text{MARKET RISK PREMIUM}.
\]

The market risk premium is defined as:

\[
\text{EXPECTED RETURN ON THE MARKET} - \text{RISKFREE RATE}
\]

The capital asset pricing model is based on the idea that investors will attempt to diversify away as many risks as they possibly can. These diversifiable risks are called **UNIQUE or IDIOSYNCRATIC or FIRM-SPECIFIC RISKS**. The risks that are not diversifiable and thus require compensation (i.e. a higher return) are called **MARKET** or
AGGREGATE or SYSTEMATIC RISKS.

Examples of news that reflect aggregate risks include:

1. Alan Greenspan and the Federal Reserve's dramatic reduction of the Fed discount rate by 1%.
2. The G-7 Finance ministers' announcing that accelerating growth and not controlling inflation is their main objective.
3. Congress deciding to reduce the capital gains tax rate.
4. Housing starts going up 3% this quarter.
5. Banks requiring greater collateral while making business loans.

The compensation for a particular stock is based on the way it reacts to these market risks. A stock that does well when the market goes down will be valued greatly and therefore not earn a very high expected return (because everyone will bid its price up).

Examples of news that is firm-specific or unique are:

1. American Airlines flight attendants rejecting a labor contract offered by management.
2. Gulf Oil finding more crude oil off the coast of Texas.
3. American Express announcing a $50 million dollar write-off in its Optima credit card unit due to fraud (it would be a different issue if it were due to greater delinquencies due to a recession).
4. Upjohn withdrawing the drug Halcyon because of adverse reactions to the drug.
5. The Department of Defense giving the telephone system contract for the Pentagon to MCI.

The CAPM implies that risks that are unique or firm-specific are diversifiable and hence are not priced while risks that are aggregate or non-diversifiable are priced; a risk premium
(and higher return) is demanded by individuals who are willing to bear such risks.

To estimate the required return on the CAPM, we need to estimate the security's beta. For most traded securities this is done on a historical basis by running a regression of the firm's returns on the market return. These numbers are generally available from a beta book that is sold as a service by Value Line, Merrill Lynch, Ibbotson Associates, and others.

The reliability of beta estimates is often an issue. The regression approach assumes that beta is a constant. However, betas change as the sensitivity to market factors changes. The beta risk of GM today is very different from what it was 20 years ago. Empirical studies indicate that betas do change over time, though slowly.

**Stability of Betas**

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>% in same class 5 years later</th>
<th>% +- one class 5 years later</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (high betas)</td>
<td>35</td>
<td>69</td>
</tr>
<tr>
<td>9</td>
<td>18</td>
<td>54</td>
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<td>16</td>
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<td>4</td>
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<td>40</td>
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<tr>
<td>3</td>
<td>16</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>61</td>
</tr>
<tr>
<td>1 (low betas)</td>
<td>40</td>
<td>62</td>
</tr>
</tbody>
</table>

Source: Sharpe and Cooper (1972), Copyright McGraw-Hill Inc.
The CAPM is not a perfect model and the empirical evidence on the CAPM is mixed. For example, the actual fitted line of the average monthly returns versus beta is flatter than that predicted by the CAPM. Thus, low-beta stocks earn higher returns than that predicted by the CAPM and high-beta stocks earn lower returns than that predicted by the CAPM.

However, the overall empirical evidence is consistent with the CAPM's prediction that beta risk is priced, i.e., higher beta stocks earn a higher return. Hence, even though there are some competing models of capital asset pricing, the CAPM is still the most widely used model.

One of the issues that we have yet to cover when implementing the CAPM is what is the right index to measure the market premium. Should we use the NYSE value-weighted index return or the S&P 500 index return (as is more commonly done)? These two indices ignore investments in real estate (historically 40% of U.S. investment) and investments in foreign stock markets. Foreign stock market capitalization has increased considerably in the last 20 years (this increase is mainly due to Japan and Europe) -- 10 years ago Japan represented much more of the world market than did Europe, and nearly as much as the U.S.; now Japan is a distant third behind Europe. Also, investments in real estate and foreign stock indexes as part of a portfolio (20% each in U.S. domestic stocks, real estate, Treasury bills, U.S. Corporate bonds and foreign stocks) would have enabled an investor to beat the S&P 500 index over the past few decades.

Since the NYSE value-weighted index and the S&P index are easily available, they are commonly used to compute the market risk premium, and so real estate and foreign stocks are ignored. For multinationals that have the capacity to raise capital in various countries using these indices may be an error. We will return to this issue later in this lecture.
HOW TO USE THE CAPM IN CAPITAL BUDGETING

We will now move to the main focus of our lecture. How does one use the CAPM in capital budgeting and valuation?

The key aim in using the CAPM is to find the weighted-average cost of capital (WACC), to use to discount cash flows. When doing so, we need to focus on the risk (beta risk) of the project and not the risk (beta risk) of the firm that is undertaking it. This principle, referred to as (the STAND ALONE PRINCIPLE) can be stated as follows:

THE COST OF CAPITAL FOR A PROJECT DEPENDS ON THE PROJECT (THE RISKINESS OF PROJECT ASSETS) AND NOT ON THE RISKINESS OF THE FIRM FINANCING IT.

Thus the company's cost of capital is irrelevant while considering a project whose beta risk is very different from those of the projects that currently constitute the company.

The STAND ALONE PRINCIPLE implies the following approach to capital budgeting (we are using the weighted average cost of capital method here):

WEIGHTED AVERAGE COST OF CAPITAL (WACC):

Suppose we are interested in finding the weighted average cost of capital WACC for a project (note that this may be very different from the historical WACC of the firm). Assume that the target debt to equity ratio of our project is $D_p/E_p$ where the subscript $p$ stands for our project. The steps are:

i) Find the equity beta of a firm whose asset risk matches that of the project (i.e. it is in the same or similar industry) using stock market data.

ii) Convert the equity beta into an unlevered beta or asset beta using the formula:
where the subscript $f$ stands for the firm we match our project with. This formula is consistent with the personal tax rate on interest income being equal to the personal tax rate on equity income, i.e., there is no tax disadvantage to debt at the personal level.

iii) Relever the beta to the capital structure of our project; this will yield the equity beta for our project.

\[
\beta_{\text{equity}} = \left[ 1 + (1 - \tau_c) \frac{D_p}{E_p} \right] \beta_{\text{unlevered}}
\]

iv) Find the required return on equity using the CAPM

\[
E[\tilde{R}_{\text{equity}}] = r_f + \beta_{\text{equity}} (E[\tilde{R}_M] - r_f)
\]

v) Find the weighted average cost of capital using the formula

\[
WACC = (1 - \tau_c) \frac{D_p}{D_p + E_p} r_f + \frac{E_p}{D_p + E_p} E[\tilde{R}_{\text{equity}}]
\]

Correctly used, the WACC technique yields the right discount rate. The problem in practice is that the capital structure of the project is not properly adjusted for. For example, suppose I find a firm whose assets risks match that of the project under analysis. The WACC
of this firm cannot be directly used as the discount rate because the capital structure of the firm has does not necessarily match the capital structure intended for our project. Also, often WACC refers to some historical number for the firm; in contrast here we are computing the WACC for a specific project. Moreover, different projects will have different WACCs.

To point out the pitfalls in using the weighted average cost of capital formula incorrectly, consider the story of manager Q who says (this is taken from Brealey and Myers):

*My firm has a good credit rating. I can borrow 90% of the capital required for the project. Thus \( D/V = 0.9 \) (the debt to total assets ratio) and \( E/V = 0.1 \) (the equity to total assets ratio). My firm borrows at 8% and the required return on equity is 15%. Therefore the appropriate discount rate using the weighted-average cost of capital formula is*

\[
WACC = r_f (1 - \tau_c) \frac{D}{V} + E \left( \bar{R}_{\text{equity}} \right) \frac{E}{V} = 0.08 (1 - 0.34)(0.9) + 0.15 (0.1) = 0.063
\]

*where \( \tau_c = 0.34 \). Using this discount rate of 6.3% my project looks great.*

There are two major errors that Q is making:

i) He/She assumes that the project risk is identical to that of the current firm. This is implicit in the fact that he/she uses the current required rate of return on equity. This is what shareholders desire and get on current projects. It is appropriate as a benchmark only if the risk of the new project is similar to that of the current project.

ii) The use of the debt-equity ratio of 0.9 is inappropriate. The debt-equity ratio of the
marginal financing is not relevant. What is relevant here is the long run debt-equity ratio.

iii) The debt-equity ratio affects the required rate of return on equity. Q is using the required rate of return that corresponds to the firm's current debt-equity ratio; however he inserts the new marginal debt-equity ratio in the WACC calculation. The expected return on equity should be calculated for the financial risk (debt-equity ratio) that is used in the WACC formula.

iv) Even if the long run debt-equity ratio changes, is it necessarily due to this project? To borrow 90% of the project cost you may have to pledge current assets. In that situation, the additional borrowing power does not come from the new project but from existing assets. The value of the additional borrowing power is then not due to the new projects but to the old one. This introduces some complexities that our simple cost of capital approach is not capable of handling.

We can also decompose the expected return on a stock into that which is based on a business risk premium and that based on a financial risk premium. The business risk premium (BRP) is defined by

\[
BRP = \beta_{asset} \left( E\left[ R_M \right] - r_f \right)
\]

Thus the business risk premium represents the additional return over the risk free rate that an unlevered firm's equityholders demand. Similarly, the financial risk premium is defined by
Thus the financial risk premium represents the additional return that the levered firm's equityholders demand over that hypothetically demanded by the equityholders of the unlevered version of the firm. This additional expected return is required due to the increased risk that the shareholders of a levered firm have to bear.

All this yields

\[ \text{Expected Return} = r_f + BRP + FRP \]

**MULTINATIONAL INVESTMENT**

Foreign direct investment by U.S. companies abroad continues to increase dramatically. In 1987, for example, such investment exceeded $49 billion. Today, a large number of U.S. companies are investing in the Far East and in the former Eastern bloc countries. What should one do when using the CAPM to evaluate such investments?

First, the returns on stock indexes in such countries are not perfectly correlated with the U.S. Perhaps surprisingly, Spain has a low a very low beta with respect to the U.S. market. This is mainly due to the fact that Spain was a sheltered economy till the late 1970s. From then on, as Spain has integrated into the EEC, it has shown substantial growth.

This may be a surprise to some individuals. Investment in countries like Spain may have been viewed as riskier than investment in the U.K. But the high correlation of the U.S. market with the U.K. market means that the required rate of return in the U.K. may be higher. What is important is not the unique risk of the country but it's beta with respect to a global index. The same argument may be made with regard to Lesser Developed Countries. LDC
investment is viewed as very risky due to political and other risks. However, much of this risk is unique and can probably be diversified away.

For example, it is often argued that a copper project in Zaire or Chile is more risky than one in Canada and hence a premium ought to be charged for such projects. However, the error here is to confuse expected cashflows and the discount rate. The expected payoff in Zaire may be lower than that in Canada because there is a greater chance of a disaster occurring following years of misrule by President Mobutu of Zaire. However, it is important to note that the systematic risk of both copper projects is the same. They both serve the same global copper market and both are subject to the vagaries of the demand for copper. Hence, it is inappropriate to add fudge factors for political risk; one ought to adjust the expected cash flows instead.

However, this can be carried to an extreme. For example, Pakistan has a negative beta relative to the world market; therefore, the CAPM implies that Pakistan has an expected return (i.e., a return demanded by investors) LESS than the risk-free rate! Estimating international cost of equity/capital is one of the most difficult areas of finance. Fuqua's own Prof. Campbell Harvey is recognized as a world expert in the international cost of capital arena.