

Models of Risk and Return

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First Principles

- Invest in projects that yield a return greater than the **minimum acceptable hurdle rate**.
 - **The hurdle rate should be higher for riskier projects and reflect the financing mix used - owners' funds (equity) or borrowed money (debt)**
 - Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.
- Choose a financing mix that minimizes the hurdle rate and matches the assets being financed.
- If there are not enough investments that earn the hurdle rate, return the cash to stockholders.
 - The form of returns - dividends and stock buybacks - will depend upon the stockholders' characteristics.

Objective: Maximize the Value of the Firm

The notion of a benchmark

- Since financial resources are finite, there is a hurdle that projects have to cross before being deemed acceptable.
- This hurdle will be higher for riskier projects than for safer projects.
- A simple representation of the hurdle rate is as follows:

$$\text{Hurdle rate} = \text{Riskless Rate} + \text{Risk Premium}$$

- Riskless rate is what you would make on a riskless investment
- Risk Premium is an increasing function of the riskiness of the project

Basic Questions of Risk & Return Model

- How do you measure risk?
- How do you translate this risk measure into a risk premium?

What is Risk?

- Risk, in traditional terms, is viewed as a ‘negative’. Webster’s dictionary, for instance, defines risk as “exposing to danger or hazard”. The Chinese symbols for risk, reproduced below, give a much better description of risk

危機

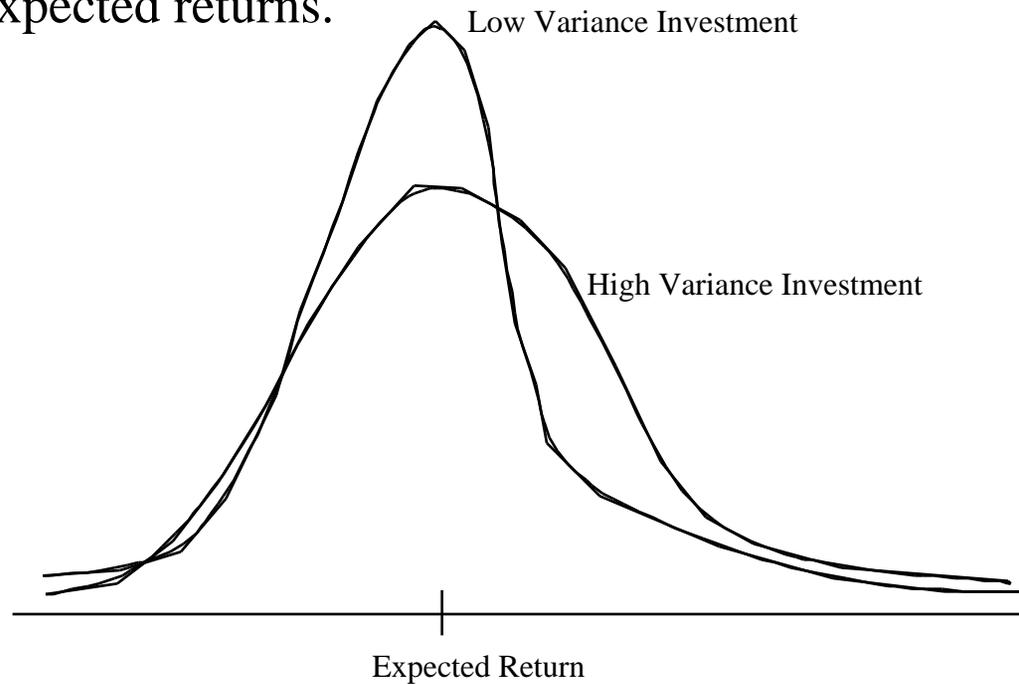
- The first symbol is the symbol for “danger”, while the second is the symbol for “opportunity”, making risk a mix of danger and opportunity.

The Capital Asset Pricing Model

- Uses variance as a measure of risk
- Specifies that only that portion of variance that is not diversifiable is rewarded.
- Measures the non-diversifiable risk with beta, which is standardized around one.
- Translates beta into expected return -
$$\text{Expected Return} = \text{Riskfree rate} + \text{Beta} * \text{Risk Premium}$$
- Works as well as the next best alternative in most cases.

The Mean-Variance Framework

- The variance on any investment measures the disparity between actual and expected returns.



The Importance of Diversification: Risk Types

- The risk (variance) on any individual investment can be broken down into two sources. Some of the risk is specific to the firm, and is called firm-specific, whereas the rest of the risk is market wide and affects all investments.
- The risk faced by a firm can be fall into the following categories –
 - (1) Project-specific; an individual project may have higher or lower cash flows than expected.
 - (2) Competitive Risk, which is that the earnings and cash flows on a project can be affected by the actions of competitors.
 - (3) Industry-specific Risk, which covers factors that primarily impact the earnings and cash flows of a specific industry.
 - (4) International Risk, arising from having some cash flows in currencies other than the one in which the earnings are measured and stock is priced
 - (5) Market risk, which reflects the effect on earnings and cash flows of macro economic factors that essentially affect all companies

The Effects of Diversification

- Firm-specific risk can be reduced, if not eliminated, by increasing the number of investments in your portfolio (i.e., by being diversified). Market-wide risk cannot. This can be justified on either economic or statistical grounds.
- On economic grounds, diversifying and holding a larger portfolio eliminates firm-specific risk for two reasons-
 - (a) Each investment is a much smaller percentage of the portfolio, muting the effect (positive or negative) on the overall portfolio.
 - (b) Firm-specific actions can be either positive or negative. In a large portfolio, it is argued, these effects will average out to zero. (For every firm, where something bad happens, there will be some other firm, where something good happens.)

The Market Portfolio

- Assuming diversification costs nothing (in terms of transactions costs), and that all assets can be traded, the limit of diversification is to hold a portfolio of every single asset in the economy (in proportion to market value). This portfolio is called the market portfolio.
- Individual investors will adjust for risk, by adjusting their allocations to this market portfolio and a riskless asset (such as a T-Bill)

Preferred risk level

Allocation decision

No risk

100% in T-Bills

Some risk

50% in T-Bills; 50% in Market Portfolio;

A little more risk

25% in T-Bills; 75% in Market Portfolio

Even more risk

100% in Market Portfolio

A risk hog..

Borrow money; Invest in market portfolio;

- Every investor holds some combination of the risk free asset and the market portfolio.

The Risk of an Individual Asset

- The risk of any asset is the risk that it adds to the market portfolio
- Statistically, this risk can be measured by how much an asset moves with the market (called the covariance)
- Beta is a standardized measure of this covariance
- Beta is a measure of the non-diversifiable risk for any asset can be measured by the covariance of its returns with returns on a market index, which is defined to be the asset's beta.
- The cost of equity will be the required return,

$$\text{Cost of Equity} = R_f + \text{Equity Beta} * (E(R_m) - R_f)$$

where,

R_f = Riskfree rate

$E(R_m)$ = Expected Return on the Market Index

Beta's Properties

- Betas are standardized around one.
- If
 - = 1 ... Average risk investment
 - > 1 ... Above Average risk investment
 - < 1 ... Below Average risk investment
 - = 0 ... Riskless investment
- The average beta across all investments is one.

Limitations of the CAPM

- 1. The model makes unrealistic assumptions
- 2. The parameters of the model cannot be estimated precisely
 - - Definition of a market index
 - - Firm may have changed during the 'estimation' period'
- 3. The model does not work well
 - - If the model is right, there should be
 - a linear relationship between returns and betas
 - the only variable that should explain returns is betas
 - - The reality is that
 - the relationship between betas and returns is weak
 - Other variables (size, price/book value) seem to explain differences in returns better.

Alternatives to the CAPM

Step 1: Defining Risk

The risk in an investment can be measured by the variance in actual returns around an expected return

Riskless Investment



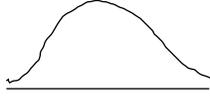
E(R)

Low Risk Investment



E(R)

High Risk Investment



E(R)

Step 2: Differentiating between Rewarded and Unrewarded Risk

<p><i>Risk that is specific to investment (Firm Specific)</i> Can be diversified away in a diversified portfolio</p> <ol style="list-style-type: none"> 1. each investment is a small proportion of portfolio 2. risk averages out across investments in portfolio <p>The marginal investor is assumed to hold a “diversified” portfolio. Thus, only market risk will be rewarded and priced.</p>	<p><i>Risk that affects all investments (Market Risk)</i> Cannot be diversified away since most assets are affected by it.</p>
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Step 3: Measuring Market Risk

The CAPM	The APM	Multi-Factor Models	Proxy Models
<p>If there is</p> <ol style="list-style-type: none"> 1. no private information 2. no transactions cost <p>the optimal diversified portfolio includes every traded asset. Everyone will hold this <u>market portfolio</u>. Market Risk = Risk added by any investment to the market portfolio:</p>	<p>If there are no arbitrage opportunities then the market risk of any asset must be captured by betas relative to factors that affect all investments. Market Risk = Risk exposures of any asset to market factors</p>	<p>Since market risk affects most or all investments, it must come from macro economic factors. Market Risk = Risk exposures of any asset to macro economic factors.</p>	<p>In an efficient market, differences in returns across long periods must be due to market risk differences. Looking for variables correlated with returns should then give us proxies for this risk. Market Risk = Captured by the Proxy Variable(s)</p>
<p>Beta of asset relative to Market portfolio (from a regression)</p>	<p>Betas of asset relative to unspecified market factors (from a factor analysis)</p>	<p>Betas of assets relative to specified macro economic factors (from a regression)</p>	<p>Equation relating returns to proxy variables (from a regression)</p>

Comparing Risk Models

<i>Model</i>	<i>Expected Return</i>	<i>Inputs Needed</i>
CAPM	$E(R) = R_f + \beta (R_m - R_f)$	Riskfree Rate Beta relative to market portfolio Market Risk Premium
APM	$E(R) = R_f + \sum_{j=1}^n \beta_j (R_j - R_f)$	Riskfree Rate; # of Factors; Betas relative to each factor Factor risk premiums
Multi factor	$E(R) = R_f + \sum_{j=1, \dots, N} \beta_j (R_j - R_f)$	Riskfree Rate; Macro factors Betas relative to macro factors Macro economic risk premiums
Proxy	$E(R) = a + \sum_{j=1..N} b_j Y_j$	Proxies Regression coefficients

The Cost of Debt

- The cost of debt is the market interest rate that the firm has to pay on its borrowing. It will depend upon three components-
 - (a) The general level of interest rates
 - (b) The default premium
 - (c) The firm's tax rate

What the cost of debt is and is not..

- The cost of debt is
 - the rate at which the company can borrow at today
 - corrected for the tax benefit it gets for interest payments.
$$\text{Cost of debt} = k_d = \text{Interest Rate on Debt} (1 - \text{Tax rate})$$
- The cost of debt is not
 - the interest rate at which the company obtained the debt it has on its books.

Estimating the Cost of Debt

- If the firm has bonds outstanding, and the bonds are traded, the yield to maturity on a long-term, straight (no special features) bond can be used as the interest rate.
- If the firm is rated, use the rating and a typical default spread on bonds with that rating to estimate the cost of debt.
- If the firm is not rated,
 - and it has recently borrowed long term from a bank, use the interest rate on the borrowing or
 - estimate a synthetic rating for the company, and use the synthetic rating to arrive at a default spread and a cost of debt
- The cost of debt has to be estimated in the same currency as the cost of equity and the cash flows in the valuation.