

Capital Asset Pricing Model

Introduction:

The Capital Asset Pricing Model (CAPM) is a widely used financial model that dictates how investors should be compensated for the time value of money and risk. The time value of money can be thought of as the opportunity cost of investing in one asset vs another over time. This is generally expressed in the risk free rate (often based on LIBOR). Risk is expressed in terms of beta (β_i) comparing the expected returns of the asset as compared to the larger market (or portfolio) during a comparable period.

In portfolio management, the CAPM is used to determine a required rate of return for an asset if the asset is added to a portfolio of other assets.

CAPM History:

Initially based on the work of Harry Markowitz in portfolio diversification theory (MPT), the CAPM model was introduced independently by William Sharpe, John Lintner, Jack Treynor, and Jan Mossin. As a result of their contribution to financial economics, Sharpe, Miller and Markowitz received the Nobel Prize in Economics in 1990.

Mathematics:

- $E(R_i) = R_f + \beta_i (E(R_m) - R_f)$

Where:

- $E(R_i)$ = Expected return on the asset
- $E(R_m)$ = Expected return of the market
- R_f = Risk-free rate of return
- β_i = The sensitivity of the expected excess asset returns to the expected excess market returns.

Example:

In investing, CAPM can be used to determine the appropriate pricing for a particular stock. Holding all else constant, if one stock is less risky than another, the price should be lower since investors will demand compensation for additional risk. For example, assume the following:

$$R_f = 1\% / R_m = 12\% / \beta_i = 0.85$$

Given the criteria, we can calculate the expected return with the following formula:

$$1\% + (0.85 * (12\% - 1\%)) = 10.35\%$$

Therefore, investors should demand a rate of return no less than 10.35%

Advantages:

- Having been used consistently since the 1970's, it is one of the most widely recognized and tested methods of asset valuation.
- The model allows investors to assign a value to opportunity cost of both sitting on the investment and making other investments.
- The model recognizes there is value associated with tying up assets in a particular investment.
- The model explicitly assigns value to systematic risk (inadvertently) taken on by the investment.

Disadvantages:

- The model assumes that stock returns are normally distributed, which has been disproven with returns often reaching up to 5 deviations from the mean.
- The model assumes a rational and efficient financial market, but recently market movements have been dictated more by investor bias instead of actual equity valuation.
- The model assumes that investors will pay less for higher risk assets. Given today's active investors, it is very possible that many traders will pay more for riskier assets.
- The model often relies on some inputs (such as LIBOR) that have been illegally manipulated in the past.

Useful Links:

- http://en.wikipedia.org/wiki/Capital_asset_pricing_model
- www.wikipedia.org/wiki/Modern_portfolio_theory
- <http://www.wolframalpha.com/input/?i=capm+calculator>

References:

- Black, Fischer., Michael C. Jensen, and Myron Scholes (1972). *The Capital Asset Pricing Model: Some Empirical Tests*, New York: Praeger Publishers.
- French, Craig W. (2003). "The Treynor Capital Asset Pricing Model". *Journal of Investment Management*