Analyzing Capital Asset Pricing Model

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Abstract

Academicians in finance have been trying to answer the question that how risk and returns are related to each other. The Capital Asset Pricing Model (CAPM) developed by William Sharpe and John Linter in 1960's was the first attempt towards finding an answer to this question. The basic idea underlying CAPM is that all risks present in the market do not affect the price of an asset and if risk of an asset can be diversified by keeping with other assets in a portfolio then that cannot be treated as a risk. CAPM explains how risk and returns are related to each other and also an effective tool to measure risk. Ever since its development CAPM has been widely used to calculate the cost of capital of the firms and measuring the performance of portfolios. Although a large number of researchers and academicians disagree on the assumptions of CAPM then also it is widely used. In this paper an attempt is made to discuss the application, importance and utility of CAPM model in current scenario.

Introduction: William Sharpe of Stanford University developed the CAPM model which based on the level of systematic risk of an asset calculated its expected return. CAPM is based on the concept of efficient frontier whereby expected return is defined as the return on risk free assets plus beta of the portfolio multiplied by the difference of the return on the risk free investment from the market return. CAPM clearly defines the risk and return of an investor. The return an investor gets from buying a security and holding it for a given period of time is equal to the cash dividends received plus the capital gain (or minus the capital loss) during the holding period divided by the purchase price of the security.

$$R== \frac{D + \text{Capital Gain/Loss}}{P} \times 100$$

Where R = Rate of Return

D = Dividends Received

P = Purchase Price of the Security

Market comprise of risky and non risky stocks. Stocks whose return varies a lot are considered to be risky stocks whereas stocks whose returns do not differ much are not considered to be non risky stocks. According to CAPM if risky stocks are combined with non risky stocks then the overall portfolio will be less risky than any of its components. A security's total risk can be divided into unsystematic risk and systematic risk. That part which is specific to a company and can be diversified is called unsystematic risk and the one which is not diversifiable is known as systematic risk. It is related to the movement of the stock .Thus CAPM is a measurement of a security's systematic risk.

Assumptions of CAPM:

- Single-period transaction horizon
- Investors borrow or lend funds at a risk-free interest rate
- Investors have identical subjective estimates of the means variances and covariance's of all securities
- The market for financial securities is perfectly competitive and all investors are price takers.
- The quantity of securities is fixed.
- All securities are perfectly divisible and liquid i.e. marketable without significant transaction costs
- There are no taxes.
- Market compensates investors for taking systematic but not for taking unsystematic risk which can be diversified.

Risk adverse investors expect higher returns form risky securities and low returns from less risky securities. The following equation describes the positive relationship between risk and return of a security. The expected return on a risky security R_s can be expressed as risk free rate R_f plus a premium for risk:

$R_s = R_f$ + risk premium

Beta is the measure of systematic risk in CAPM.

It represents relationship between the returns of a particular security and that of market return. Another way to express beta is that it is a measure of a security's volatility in relation to the market's volatility. Depending on the beta of a given security and expectations about future performance investors can make predictions about security's current price movements.

The Security Market Line:

As discussed earlier that

$R_s = R_f$ + risk premium

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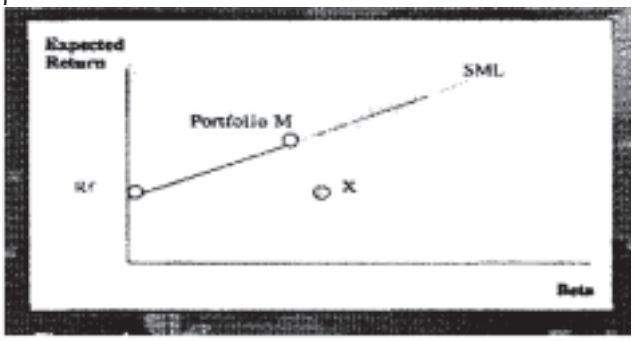
$R_s = R_f + \beta (R_m -- R_f)$

Here R_s = the stock's expected return (and the company's cost of equity capital)

R_f = the risk free rate

R_m = the expected return on the stock market as a whole

β = the stock's beta



The relationship between risk and expected return of an asset /security is called Security Market Line (SML). Generally the risk free rate of return plus the risk premium is considered to be equal to an investors expected rate of return. Risk premium in CAPM is defined as beta times the expected return on the market minus (R_m) the risk free rate (R_f). The R_m -- R_f is defined as risk premium on market. The risk premium of a security is a function of the risk premium on the market (R_m -- R_f) and varies directly with the level of beta.

In the highly competitive financial market no security can sell at prices low enough to yield more than its appropriate return on the SML for a very long period of time.

If it happens so then security will become very attractive in comparison to other securities of similar risk and investors would bring the price of that security up until the expected return falls to the appropriate position on the SML. Alternately investors would sell off any stock selling at a price high enough to put its expected return below its appropriate position. The resulting reduction in price would continue until the stocks expected return rise to the level justified by its systematic risk. The SML can be used to determine assets expected return given its beta. Theoretically all investments in a given portfolio should lie on the SML.

Using CAPM: CAPM is not only widely used as a tool for asset pricing in the field of investment but has an important application in corporate finance too. Cost of equity is defined as the expected return on a company's stock. The expected return on stock is equal to the shareholders opportunity cost of the equity funds which is employed by the company on behalf of the shareholders.

The company must earn a return equal to the opportunity cost on the equity financed portion of its investments otherwise the price of its share will fall. If the company is unable to earn equal to the cost of equity then it should return the funds to the shareholders allowing them to earn an expected return by investing the funds themselves from the market. Measuring the expectations of the market about the expected returns is very difficult although a few techniques are available but they all suffer from some or the other drawback.

Cost of equity is one of the components of weighted average cost of capital which is often uses as a hurdle rate in evaluating investments. CAPM can be used to estimate of the cost of equity capital. Security Market Line gives the expected return on a stock since this expected return, R_s by definition equal to the company's cost of equity K_e then SML provides estimates of equity costs as well. Thus

$K_e = R_s = R_f + \beta (R_m -- R_f)$

Now to calculate cost of equity estimates of values of the risk free rate, the expected return on the market and beta is also required. T bills rates can be taken as an estimate for risk free return as over the period of time they have given rates almost equal to inflation rate. Estimation of expected return from market is more difficult one common approach is that investors desire same amount of risk premium in the future as in the past.

Assuming the values of the risk free rate, the expected return on the market, and beta into consideration the security market line generates estimates of the cost of equity capital. Table 1 gives the cost of equity estimates of three hypothetical companies. The betas in the table are consistent with those of companies in the three industries represented.

Table 1: Estimation of Cost of Equity Capital

Security Market Line:--		
$K_e = R_s = R_f + \beta (R_m -- R_f)$		
$R_s == 10\% + \beta (19\% - 10\%)$		
$R_s == 10\% + \beta (9\%)$		
X	Y	Z
$\beta = 0.75$	$\beta = 1.10$	$\beta = 1.55$
$R_e = 10\% + 0.75(9\%)$	$R_e = 10\% + 1.10(9\%)$	$R_a = 10\% + 1.55(9\%)$
$K_e = R_e = 16.75\%$	$K_e = R_s = 19.90\%$	$K_e = R_s = 23.95\%$
$== 17\%$	$== 20\%$	$== 24\%$
** Assumed that $R_f = 10\%$ and $R_m = 19\%$		

Implications of CAPM: CAPM has a number of important implications. The most important aspect of the CAPM is that the expected return of an asset does not depend on its stand alone risk. A high beta stock will tend to have a high stand alone risk because a portion of a stock's stand alone risk is determined by its beta but a stock need not have high beta to have a high stand alone risk. A stock with a high stand alone risk therefore will

only have a high expected return to the extent that its stand alone risk is derived from its sensitivity to the broad stock market.

Measurement of risk for determining expected returns should satisfy the requisite that the risk of a portfolio is the weighted average of all the risks of the securities in the portfolio. Beta satisfies this requirement. According to CAPM a stocks expected return does not depend on the growth rate of its expected future cash flows. To find the expected return of a company's shares it is thus not necessary to carry out an extensive financial analysis of the company and to forecast its future cash flows. According to the CAPM all we need to know about the specific company beta of its shares a parameter that is usually much easier to estimate than the expected future cash flows of the firm.

Critical Evaluation: CAPM though very useful in asset pricing but suffers from a number of problems. CAPM may hold for securities but it may not hold true for a portfolio of other business as a business might include financial assets, plant and equipment, inventories, an organizational structure, an experienced staff, and good will.

The entire analysis underlying the CAPM assumes that we can estimate beta of the company as a whole as well as for each business unit. There is an implicit assumption that management cannot either directly or indirectly affect these parameters. Not only is management unable to exercise a high degree of control over these parameters but there may be a host of practical and statistical problems involved in estimating them in the first place. The CAPM is essentially a static equilibrium model. Yet the problem of deciding which businesses a company is going to hold and the level of investment to make in each business is essentially a dynamic problem. There is some doubt as to the relevance of a static equilibrium model to a dynamic investment problem.

If an investor is managing a portfolio of securities then he or she will be interested in only few parameters as well as the market value of the portfolio. When the management is of purely financial assets, risk and return are the only parameters. But in the case of a portfolio of businesses, it is essential to take into consideration lots of other factors such as economic, behavioral, political, organizational, social, and regulatory factors.

In other words, strategic planning is a multi-dimensional problem that cannot easily be solved with the help of CAPM. In corporate finance application of CAPM several potential sources of error exist. First the simple model may be an inadequate description of the behavior of financial markets. In attempts to improve its realism, researchers have developed a variety of extensions of the model. Another problem is that betas are unstable through time. This fact creates difficulties when betas estimated from historical data are used to calculate costs of equity in evaluating future cash flows. Betas should change as both company fundamentals and capital structures change. In addition betas estimated from past data are subject to statistical estimation error. Several techniques are available to help deal with these sources of instability. The estimates of the future risk free rate and the expected return on the market are also subject to error. Here too research has focused on developing techniques to reduce the potential error associated with these inputs to the SML. There are practical and theoretical problems associated with employing CAPM or any financial market model in capital budgeting decisions involving real assets.

CAPM Works?

As an idealized theory of financial markets the model's assumptions are clearly unrealistic. But the true test of CAPM naturally is how well it works. There have been numerous empirical tests of CAPM. Most of these have examined the past to determine the extent to which stock returns and betas have corresponded in the manner predicted by the security market line. With a few exceptions the major empirical studies in this field have concluded that:

- As a measure of risk beta appears to be related to past returns. Because of the close relationship between total and systematic risk, it is difficult to distinguish their effects empirically. Nonetheless inclusion of a factor representing unsystematic risk appears to add little explanatory power to the risk/return relationship.
- The relationship between past returns and beta is linear-that is reality conforms to what the model predicts. The relationship is also positively sloped-that is there is a positive trade-off between the two (high risk equals high returns, low risk equals low returns)
- It has been observed that empirically SML appears less steeply sloped than the theoretical SML. Low beta securities earn returns somewhat higher than CAPM would predict and high beta stocks earn less than predicted. A variety of deficiencies of CAPM and/or in the statistical methodologies employed have been advanced to explain this phenomenon.

Recent work in the investment management field has challenged the proposition that only systematic risk matters. In a complex world it would be unlikely to find only one relevant type of risk-market risk. Much progress has been made in the development of richer asset pricing models. As of yet however none of these more

sophisticated models has proved clearly superior to CAPM. This continues to be a fertile area of research, focused primarily on investment management applications.

CAPM though Imperfect But Useful: Investment managers have widely applied the simple CAPM and its more sophisticated extension. CAPM's application to corporate finance is a recent development. Although it has been employed in many utility rate setting proceedings, it has yet to gain widespread use in corporate circles for estimating companies cost of equity. Because of its shortcomings financial executives should not rely on CAPM as a precise algorithm for estimating the cost of equity capital. Nevertheless tests of the model confirm that it has much to say about the way returns are determined in financial markets. In view of the inherent difficulty in measuring the cost of equity. CAPM's deficiencies appear no worse than those of other approaches. Its key advantage is that it quantifies risk and provides a widely applicable, relative objective routine for translating risk measures into estimates of expected return. CAPM represents a new different approach to an important task. Financial decision makers can use the model in conjunction with traditional techniques and sound judgment to develop realistic, useful estimates of the costs of equity capital.

Conclusion: The version of the CAPM developed by Sharpe (1964) and Lintner (1965) has never been an empirical success. In the early empirical work, the Black (1972) version of the model, which can accommodate a flatter tradeoff of average return for market beta, has some success. But in the late 1970s, research begins to uncover variables like size, various price ratios and momentum that add to the explanation of average returns provided by beta. The problems are serious enough to invalidate most applications of the CAPM. For the CAPM to hold, normality of returns is a crucial assumption, and if the CAPM holds, then only the beta should be priced. Several studies have shown that security returns are non-normal and this is evident especially in high frequency data. When returns are normal, the mean and the variance are sufficient to describe the return distribution. On the other hand, an adequate description of a non-normal return distribution requires statements on higher-order moments such as skewness and kurtosis. Prompted by the mixed results of the single-factor CAPM studies and the non-normal nature of return distribution, the CAPM with higher-order co-moments was proposed in the literature as an alternative to the single-factor CAPM. These empirical studies, too, reported mixed results. Because of the failure of market beta alone to explain cross-sectional variation in security returns, multifactor models emerged. These models not only incorporated market beta but also incorporated fundamental variables such as size and price to earnings ratios. Despite all odds The Capital Asset Pricing Model is a fundamental contribution to our understanding of the determinants of asset prices. The CAPM tells us that ownership of assets by diversified investors lowers their expected returns and raises their prices. Moreover, investors who hold undiversified portfolios are likely to be taking risks for which they are not being rewarded. As a result of the model, and despite its mixed empirical performance, we now think differently about the relationship between expected returns and risk; we think differently about how investors should allocate their investment portfolios; and we think differently about questions such as performance measurement and capital budgeting.

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