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Comparative analysis of return on equity determined by market derived CAPM

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Abstract
The Capital Asset Pricing Model (CAPM) is generally used in calculating cost of equity. CAPM relies on chronicled data to project beta which is then used to predict the future returns. Many researchers have accentuated deviations with CAPM and have recommended various models that take these deviations. This study reviews the Market Derived Capital Asset Pricing Model (MCPM), which uses option premium prices and featured volatility to estimate future risk premium which then is considered while calculating cost of equity. The featured volatility accentuates market risk expectation. This is considered important for corporate officials who are required to constitute an appropriate barrier rate while taking decisions regarding capital budgeting. Also, investors need to calculate expected future returns based on ex-ante risk of an investment. The study investigates the comparison of cost of equity estimated by using CAPM and MCPM.

Keywords: Capital asset pricing model, equity capital, return on capital, financial risk, volatility, market expectations

1. Introduction
Firms that commence on new capital investments need to estimate if these investments are beneficial to the firm and hence to the shareholders as a part of capital budgeting decisions. To estimate a project's value, the discounted future cashflow valuation method is used in which the firm's cashflows are discounted by an estimated discount rate. This discount rate is the weighted average cost of capital (WACC) when a project's risk profile is similar to that of the firm (Firer, 1993) [23]. WACC is determined by providing certain weights to firms cost of debt (after considering tax deductions) and cost of equity. Fink (2003) [22] state that an incorrect WACC estimate can result in a firm not rejecting project which could add value to shareholder's wealth if the cost of funds was lower. The cost of debt is the rate of return the firm's debt holders require and can be observed directly or indirectly in capital markets (Ross, Westerfield and Jordan, 2001) [40].

The focal point of the study is on cost of equity which is the required rate of return by the equity investor and is not observable as it is future oriented (Firer, 1993) [23]. The Capital Asset Pricing Model (CAPM) derived by William Sharpe in 1964 [42] is the most widely used model to determine cost of equity capital given its visceral way of calculating risk and future returns. One of the model inputs is beta, also known as systematic risk, computed as the co-variation of individual asset's return with market return (Sharpe, 1964) [42]. Since beta depends on covariance between itself and market, the method is widely considered while building a well-diversified portfolio. However the downside is that this fails to measure the overall risk of the asset (Fink, 2003) [22]. McNulty, Yeh, Schulze and Lubatkin (2002) [37] assert that corporate investors do not necessarily want to diversify risk, however they manage it appropriately through "sound management practices", consequently requiring a higher rate of return. Additionally, CAPM beta rely on historical data (ex post) that might not fully reflect future risks of the firm that need to be incorporated when estimating an ex ante rate of return (Van der Berg, 2010) [48].

Researchers use CAPM model in studies to explain unnatural returns and test for efficiency in market. It is also used as criteria to judge the performance of an investment portfolio manager.

2. Problem Statement

Sharpe's classical CAPM has been shown to have a poor empirical record which may be linked to model's simplified assumptions (Fama and French, 2004) [20]. The model depends upon previous period data in estimating beta. The calculated beta is then cyphered to calculate future period returns. The assumption of past performance is a good predictor of expected returns may not be necessarily true as there are periods in history when unreliable returns occur due to events such as changes in capital structure, merger and acquisition activity and secondary equity offerings (SEOs) (Christoffersen, Jacobs and Vainberg, 2007) [15]. Furthermore, Fink (2003) [22] states that the predictive power of ex post beta has been shown to be poor with investment specialist as they regularly make adjustments to cost of equity capital that represents the investment risk. This presents a challenge to investment manager as these events may lead to under or overestimation of risk associated with asset.

Second assumption of CAPM is that beta considered all the risk factor which could explain excess returns on equity therefore there is no other priceable risk associated with asset. Several authors such as Basu (1977) [4], Banz (1981) [2], Rosenberg, Reid and Lanstein (1985), Fama and French (1992, 1993, 1996) have documented anomalies such as high price/earnings ratios, small stock capitalization (size premium), high book-to-market/value (value premium) that provide a better explanation of expected returns compared to beta. Fama and French (1992, 1993, 1996) further went on to develop a model that encapsulates the market, size and value premiums and has performed better empirically in explaining excess equity returns using US stock data. Van Rensburg and Robertson (2003) [4] also document anomalies that are not captured by CAPM's beta.

3. Objective of Study

The objective of the study is to compare the returns calculated by method of CAPM and MCPM. As already said, CAPM's beta is not faultless hence it cannot be fully depend upon to predict future returns without making the adjustment for risk not captured by beta. The paper studies the use of market derived capital asset pricing model to overcome the imperfections of CAPM.

4. Literature Review

4.1 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) was derived by Sharpe (1964) [42], Lintner (1965) and Mossin (1966). The model provides an exquisite relationship between an asset's return and risk measure. This one factor model is based on the Markowitz (1952) and Tobin's (1958) seminal papers "Portfolio Selection" and "Liquidity preference as behavior towards risk", respectively.

4.1.1 Sharpe-Lintner CAPM Model

Sharpe (1964) [42], Lintner (1965) and Mossin (1966) enhanced the work on portfolio selection and the risk/return relationship framework that had been done by Markowtiz (1952) and Tobin (1958) to develop the one factor CAPM. The model provides a "market equilibrium theory of asset prices under conditions of risk" as stated by Sharpe (1964) [42].

The assumptions used while deriving the model at equilibrium were:

- Investors are rational and seek to maximize their consumption utility function;
- Investors are risk averse, that is they maximize return and minimize risk;
- Investors are price takers;
- Asset returns are normally distributed and highly divisible;
- Markets are efficient and absorb information quickly;
- There are no transaction cost and taxes;
- The pure rate of interest at which investors can borrow or lend is equal; and
- Investor's expectations are homogenous.

The first six assumptions were considered while deriving the mean-variance Markowitz (1952) [3] model and Sharpe (1964) [42] added two more assumptions.

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

Where

- $E(R_i)$ is expected rate of return on ith asset;
- R_f is the risk free rate of return;
- $E(R_m)$ is the expected rate of return on market portfolio;
- Beta (β) is the measure of co-movement of security i and the market relative to risk of the market. This is also known as systematic risk. β is defined as follows:

$$\beta = \frac{cov(R_i, R_m)}{var\,(R_m)} = \frac{correl(R_i, R_m).stdev(R_i)}{stdev(R_m)}$$

The equation represents the positive linear relation between beta and expected returns of an asset. Hence it compensates an investor for not diversifying systematic risk associated with asset.

4.1.2 Empirical Test Conducted on CAPM

Fama and Macbeth (1973) stated three testable implication of the CAPM equation

- Returns of an asset have linear relationship with risk associated with it;
- Beta captures complete risk associated with an asset
- Higher expected returns are associated with higher risk these implications were tested using either time series or cross section regression.

The regression run by Blume and Friend (1973), Black Jensen and Scholes (1972) and Fama and Macbeth (1973) showed that the intercept was significantly larger than riskfree rate. In addition slope of the regression was flat. On updating the sample period Fama and French (2004) [20] shows that results contradict with early results. The regression showed that returns for low beta profiles were higher than expected.

Fama and Macbeth (1973) tested for relationship between returns and asset beta by including a squared beta term to the regression model and results showed the linear relationship among them. Basu (1977) [4] showed that asset with low price-earnings ratio provides higher returns than asset with high price-earnings ratio.

Banz (1981) [2] showed the effect of market capitalization on the average returns. Rosenberg, Reid and Lanstein's (1985) study of US data and Chan, Hamao and Lakonishok's (1991) study of Japanese data showed that high book-to-market equity (BE/ME) stocks had higher returns compared to stocks with low BE/ME.

Debondt and Thaler (1985) showed stocks with poor returns over three to five years had higher returns in the next three to five years when compared to stocks that had high returns over past similar period. The same was documented by Chopra, Lakonishok and Ritter (1992).

Jegadeesh's (1990) showed the momentum effect that is stocks with high returns over last few periods tends to have high returns next period as well. The same was shown by Subrahmanyam (2010) [45]. Bhandari (1998) [5] found the evidence on effect of leverage on stock returns. The study revealed that high levered firms had higher returns when compared to lower levered firm.

4.2 Black Model

The assumption of pure interest rate used by the Sharpe is an unrealistic assumption for the real economy. The proxy used for risk free rate is also ill defined. Bodie *et al*. (1999) [10] posit that Treasury bill real values are exposed price risk from inflation fluctuations, therefore the T-bill is not a riskfree instrument.

Black (1972) introduced a model which assumes that no risk free asset is available and unrealistic short selling is allowed. Though the assumption of unrestricted short selling is unrealistic, Black claims that these restrictions would not affect the model. This model is also based on all other assumptions used by Sharpe in CAPM.

$$E(R_i) = E(R_z) + \beta_i [E(R_m) - E(R_z)]$$

Where, $E(R_z)$ is the zero beta portfolio expected return

4.3 Market Assets Pricing Models

4.3.1 Downside Capital Asset Pricing Model

CAPM model is based on maximization of utility function of investor which is based on mean and variance of returns associated with assets. Estrada (2002) interrogates the use of variance in calculation of risk since many researchers have revealed that distribution of returns of an asset follows asymmetric and non-normal distribution. The researcher proposed the use of semivariance against variance to measure risk. The same is defended by showing high correlation between variance utility function and semivariance utility function.

Cross-sectional test computed by Estrada provides evidence of downside beta. Additionally, returns calculated by D-CAPM were higher than those calculated by CAPM by 2.5% on average.

4.3.2 Global Capital Asset Pricing Model

Buckberg (1995) [11] suggested a model which is based on the premise that emerging markets have become more integrated with the global economy, therefore "emerging market returns should be proportional to the market's covariance with a world market portfolio" (Buckberg (1995); p. 56) [11].

4.4 Market derived Capital asset pricing model

The models used to estimate cost of equity or return of asset involved pre period data that is it uses historical data to forecast future returns. Also, the risk measuring parameter called beta depends upon the correlation among asset and market. A firm with low correlation leads to smaller beta and hence smaller expected returns, and converse is true for high correlation. This is preferred by an investor who requires diversifying the risk associated with portfolio.

Mcnulty *et al*. (2002) [37] develop the market derived capital asset pricing model (MCPM) which uses risk premium from market traded options to forecast future asset returns. The volatility from option pricing captures market expectations. Christoffersen, Jacobs and Vainburg (2007), Siegel (1995),and Santa-Clara and Yang (2010) also proposed the use of option pricing for forecasting expected returns as it captures the changes in firms operations which were not included in historical data.

The method of market derived CAPM vanquish the problem of using pre period data for risk measurement. Many researchers had shown that beta is time sensitive that is it changed with change in time period, hence a time varying measure of beta was proposed by Jagannathan and Wang (1996) [28]. Mcnulty *et al*. (2002) [37] suggested three risk an investor need to take care of:

- National confiscation risk includes risk associated with changes in value of investment induced by changes in national policies;
- Corporate default risk includes risk that company will default due to carelessness of management;
- Equity returns risk includes risk of equity investors because of secondary claim on company's income to debt holders.

5. Research Methodology

The process of MCPM requires calculation of equity risk premium considering all three risks associated with asset defined by Mcnulty *et al*. The calculation of risk premium involves four steps.

5.1 Estimate Forward breakeven price

Return on equity is arithmetic summation of capital gain on share price and dividend yield which is equal to ratio of dividend and current share price.

$$R_{equity} = R_{capital\ gains} + R_{dividend}$$

Since the risk associated with equity investor is greater than that with bond investor, hence higher returns are expected by the former. Hence the minimum capital gain return earned by equity investor is equal to difference between bond yield and dividend yield.

$$IR = R_{bond} - R_{dividend}$$

Where, IR represents the minimum capital gain return.

Hence break even stock price (SP_T) at time T is given

$$SP_T = SP_0*(1+IR)^T$$

5.2 Estimate the stock future volatility

Since stock price is known, probability of stock price not reaching the expected needs to be calculated as compensation is required. This could be measured using option prices and volatility. The higher the unpredictability of a firm to reach expected returns higher will be its volatility.

5.3 Estimate the cost of downside insurance

Premium paid by investor for protection in opposition to stock price going below break-even price is the value of a put option. The researcher (Mcnulty *et al*., 2002) [37] state that premium reflect the extra risk of equity over debt.

5.4 Estimate the annualized excess equity returns

The put option price represents the excess equity return for all the three risk owned by equity investors.

$$\text{Excess Return}=\{(\text{Price of put option}) / (\text{Stock shot price})\} / \{(1/R_{bond})-[(1/R_{bond})*(1/(1+R_{bond})^{T})]\}$$

Now Cost of equity can be estimated by adding the excess return to bond rate.

6. Conclusion

Capital Asset Pricing Model developed by Sharpe is most widely used model due to its strong economic and theoretical background. Many researchers have shown weak empirical demonstration with various deviations that are not included by the model. Few of these are discussed in literature review of the research. Many variants of this model were proposed by researchers for better estimation of the cost of equity. One of these is three factor model developed by Fama and French (1992, 1993, 1996) which include effect of size and value. Though the model has strong empirical demonstration but it has very weak theoretical and economical background.

All variants of CAPM as well as Three Factor model use historical data to forecast future returns. Mcnulty *et al*. (2002) [37] propose the use of option prices to estimate cost of equity capital so as to predict future returns by using ex-ante data only. Option volatility includes market expectation of firm's performance, hence can be used for forecasting excess returns. Researchers state that minimum return earned by an equity investor is equal to return earned by debt holders. Hence, expected return of an asset can be estimated by adding premium on option price to bond yield of firm. The model used is Market Derived Capital Asset Pricing Model (MCPM).

It is suggested to use MCPM as an additional tool to calculate cost of equity by corporate officials as it considers the market expectations and also doesn't require a risk free return.

7. Limitation of Study

MCPM is relatively difficult to measure due to requirement of option price volatility availability of which is difficult. Also it cannot be applied to firms which either does not have option trading on their stocks or they do not issue corporate bond. Also the empirical study on the model is very less. It also does not have a strong theoretical backing in opposition to the CAPM model.

The model does not consider trading cost and market frictions such as liquidity. Also it does not take care of anomaly of time variant risk measurement as suggested by Jagannathan and Wang (1996) [28].

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