

## **The Death of CAPM: A Critical Review**

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### **I. Introduction**

Most behavioral sciences based on rationality have simplistic assumptions; and the same is true about consumption or investment decisions. The aim of such studies is to maximize either utility or wealth. The entire 'financial economics' theory revolves around an investor who wants to maximize his return at some given level of risk. To determine the optimal return at a given level of risk or an optimal risk for a given level of return has been widely discussed in the financial literature consequently raising the issue of asset pricing in financial markets.

Asset pricing is one of the dominant themes in modern finance. The basis for asset pricing leads back to Bachelier's (1900) dissertation of "Theorie de la Speculation" submitted at the University of Paris (Sorbonne). He, in his classical work, recognizes that past, present and even discounted future events are reflected in market prices of financial assets, but often show no apparent relation to price changes. He concluded that if the market<sup>1</sup>, in effect, does not predict its fluctuations, it does assess them as being more or less likely, and this likelihood can be evaluated mathematically. This gives rise to an analysis that anticipates not only Albert Einstein's subsequent derivation of the Einstein-Wiener process of Brownian motion, but also many of the analytical results that were rediscovered by finance academics in the second half of the twentieth century. The full potential of Bachelier's theory was only realized some 50 years later by Mandelbrot (1963) and Fama (1965). Their findings that the variance of returns is not constant over time (heteroscedasticity) and that the distribution of price changes were not Gaussian but leptokurtic, are among the foundations of modern financial theory. Fama concluded that the

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<sup>1</sup>The markets referred to in this paper are financial markets unless otherwise mentioned.

empirical distributions of share prices followed not a Gaussian but a Stable Paretian distribution with characteristic exponent less than 2, that is, with finite mean but infinite variance.

Following Bachelier, Markowitz (1952) proposed the idea of Portfolio Selection with variance of returns as a measure of risk. Building on Markowitz's work Tobin (1958) presented his separation theorem. According to Tobin, if an investor holds risky securities and is able to borrow or lend at risk free rate, then the efficient frontier is a single portfolio of risky securities plus borrowing and lending. Such an efficient frontier dominates any other combination of securities. Tobin's Separation Theorem separates the portfolio selection problem into first finding that optimal combination of risky securities and then deciding whether to lend or borrow, depending on investor's preference towards risk. He then showed that if there were only one risky portfolio plus borrowing and lending, the optimal portfolio would be the market portfolio. Markowitz and Tobin's modern portfolio theory (MPT) and its resultant asset pricing models have attempted to displace fundamental analysis as the only "truly scientific" approach to investment analysis, disregarding the emphasis on individual security appraisal.

Motivated by the quantitative logic of MPT, and its foundational quantitative specifications of utility and risk aversion, Fama's formulation of an equilibrium based efficient market hypothesis (EMH), and extensions utilizing aggregate market data such as Tobin's two-fund separation theorem, the advocates of economic positivism continued their search for an ultimate asset-pricing model. Sharpe (1964), Mossin (1966), and Litner (1965) brought us the first asset-pricing models based on EMH and MPT assumptions. Their work resulted in the capital asset pricing model (CAPM), which specifies the relationship between financial security return and risk (defined by the covariance of a security's historical return series with that of a representative risky market proxy). The relationship between risk and return specifies the appropriate market-clearing price. The CAPM contends that a security's required return has little or nothing to do with company and industry specific events, such as dividend announcements, stock splits etc, for these sources of risk are simply immaterial as they are easily diversified away by investors, all of whom are assumed to "rationally" hold Markowitz efficient portfolios. Although the academic advocates of the "scientific" approach to portfolio and investment management continue producing research to support the asset pricing models, the inherent deficiencies in the empirics lead to conflicting results. Under the CAPM framework, the relevant risk is the market risk that measures the returns sensitivity of a particular risky security or a portfolio of risky securities, to the returns of market portfolio. The CAPM is based on two fundamentals; a

true market portfolio and the market risk. The market portfolio, in its true sense, must include every marketable asset such as real estate, gold, ornaments, antiques etc. However, most of the empirical studies use stock indexes as a proxy for market portfolio. The inherent assumption behind this practice is that every event in the economy has an impact on the market index performance and consequently the return on index is a replication of return of true market portfolio. The use of proxy market portfolio and the behavior of market risk are very controversial, questioning the validity of CAPM.

The paper is organized as follows. Section II will provide a brief description of CAPM and its major assumptions. Section III will describe the empirical constraints, possible biases in estimation and some of the Beta correction methods. Section IV will describe a theoretical review on the validity of CAPM and Section V will provide some tentative conclusions.

## **II. Capital Asset Pricing Model – The Basics**

The CAPM is a *ceteris paribus* model and is valid under a certain set of assumptions. Sharpe and Lintner assumed that all investors are risk averse individuals, having homogeneous expectations, who maximize the expected utility of their end of period wealth. Thus all investors have identical opportunity sets. They further assume that there exists a risk free asset and investors may borrow or lend unlimited amounts of this asset at a constant rate: the risk free rate and assets' returns are normally distributed. More importantly they assumed that all assets are perfectly divisible and priced in a perfectly competitive market. Another implicit assumption of CAPM is that there are no imperfections in the market such as taxes, regulations and restriction on short selling and the markets are frictionless with costless information available, simultaneously to all investors.

Although these assumptions appear to be too stringent to hold in the real world, but the criticism of CAPM cannot be attributed solely to its assumptions – though these assumptions have questioned the validity of the model from its onset. However, some studies have concluded that CAPM might hold even if some of the assumptions are relaxed. The study by Black, Jensen and Scholes (1972) has shown that even if the assumption of riskless borrowing and lending is violated, still a linear relationship was obtained between assets return and its relevant risk. This formulation of CAPM is known as zero Beta CAPM. Fama (1970), under certain assumptions, showed that the one period utility function is equal to the multi period utility and consequently the CAPM holds over time. Although the results suggested in favor of multi period CAPM, the underlying assumptions were more

inflexible than that of CAPM itself, making the issue more questionable. The assumptions underlying CAPM were not that critical in nature that could have led to impracticability of the model. Rather the model is criticized on its non conformity with reality and the inherent weaknesses in the empirical tests.

The CAPM framework is very simple under ideal conditions. The model states that the expected returns of an asset are a positive function of three variables: Beta, the risk free rate and the expected market return.

A simple CAPM equation can be written as

$$R_i = R_f + (R_m - R_f)\beta_i \dots\dots\dots(1)$$

Where  $R_i$  = Return on Stock  $i$ ,  $R_f$  = Risk free rate,  $R_m$  = Return on market portfolio and  $\beta_i$  = systematic risk (Beta) of stock  $i$ .

This above equation of CAPM can be written as a simple time series model that is normally used to estimate Betas in the CAPM context. This regression interpretation is

$$R_{it} - R_{ft} = \alpha_i + \beta_i \gamma_{it} + e_{it} \dots\dots\dots(2)$$

where  $\gamma_{it} = R_{mt} - R_{ft}$  and is known as market risk premium.

If the CAPM holds, the regression coefficient  $\alpha_i$ , in the above time series model, must be zero. From the above equation, it is evident that systematic risk, attributable to its sensitivity to macroeconomic factors, is reflected in  $\beta_i$ ; non-systematic risk, the unexpected component due to unexpected events that are relevant only to security, is reflected in  $e_{it}$ . The expected return on an asset depends only on its systematic risk. No matter how much total risk an asset has, only the systematic portion is relevant in determining the expected return on that asset.

The CAPM appears to be a simple model for estimation of expected returns or Beta coefficients but it becomes complicated when it is applied to investment practice. CAPM is one of the most extensively tested financial models in the literature. The major focus of these tests has been to check whether returns are statistically positively related to Betas. Hence, Beta is the *problem child* in the risk return relationship presented by Sharpe. The systematic risk as measured by Beta is mathematically the covariance of asset returns and market returns divided by the variance of the market returns.

Although Beta is a widely used concept yet it is still debated whether Beta is an appropriate measure of systematic risk.

Another popular model of estimating Betas is the market model or single index model. The studies of stock price behavior shows that when the market, as measured by a market index, rises most stocks' prices tend to increase. Similarly when the market is on a downside, the stocks in general lose their value. This observation suggests that the reason the stock returns are correlated might be because of a common response to the stock market. This correlation could be obtained by relating the return on stock to return on market index. Mathematically this could be expressed as

$$R_i = \alpha_i + \beta_i R_m + e_i \dots\dots\dots(3)$$

The  $\alpha_i$  and  $e_i$  are the components of return of security  $i$ , and are independent of the market. They are random variables representing the returns insensitive to or independent of markets. We can relate this single index model to a portfolio also. Using the simple index model and replacing security  $i$  with a portfolio of securities P, we can represent the return on portfolio by

$$R_P = \alpha_P + \beta_P R_M + e_P \dots\dots\dots(4)$$

The return of a portfolio is the weighted average return of all the individual assets in the portfolio; so  $R_P = \sum_{i=1}^n w_i R_i$ , the formula will be as follows for an equally weighted portfolio

$$\begin{aligned} R_P &= \frac{1}{n} \sum_{i=1}^n R_i = \frac{1}{n} \sum_{i=1}^n (\alpha_i + \beta_i R_M + e_i) \\ &= \frac{1}{n} \sum_{i=1}^n \alpha_i + \left( \frac{1}{n} \sum_{i=1}^n \beta_i \right) R_M + \frac{1}{n} \sum_{i=1}^n e_i \dots\dots\dots(5) \end{aligned}$$

Comparing equations (4) and (5), we can conclude that the portfolio return has sensitivity to the market returns, given by:

$\beta_P = \frac{1}{n} \sum_{i=1}^n \beta_i$ , which is the average of the individual securities  $\beta_s$ , and has a non-market return component of a constant intercept:

$$\alpha_P = \frac{1}{n} \sum_{i=1}^n \alpha_i,$$

which is the average of the individual alphas, and has zero mean variable:

$$e_P = \frac{1}{n} \sum_{i=1}^n e_i,$$

which is negligible when  $n$  gets large.

If the portfolio P has all the stocks held in the market index and are held in the same proportion then the expected return on P must be  $R_p = R_m$ . If we look at the equation (3) of single index, without a standard error  $e$ , the only values for which we can have a guaranteed  $R_p = R_m$ , for any choice of  $R_m$ , is the intercept  $\alpha_p$  equal to zero and a  $\beta_p$  equal to one. Thus, we can conclude that Beta of the market is one and the stocks riskiness, with respect to the market, will depend on their Beta values. If Beta of a stock is higher than one, it would be termed as more risky while if it has a Beta less than 1 it will be regarded as less risky than the market.

Beta is a measure of risk in equilibrium in which investors maximize a utility function that depends on the mean and variance of returns of their portfolio. The variance of returns is a questionable measure of risk for at least two reasons: First, it is an appropriate measure of risk only when the underlying distribution of return is symmetric. Second, it can be applied straightforwardly as a risk measure only when the underlying distribution of returns is normal. However, both the symmetry and the normality of stock returns are seriously questioned by the empirical evidence on the subject. The stability of Beta has also been a controversial issue in the literature. In reality only the historical returns are available to estimate Beta, which as a result will also be the historical Beta. There is a big question mark on using the historical Beta as an estimate of future Beta because empirically evidence shows that Betas on individual stocks have not been stable over time. A number of studies emerged to investigate the stability of Beta. The studies by Blume (1971), Baesel (1971), Roenfeldt *et al.* (1978) used different sets of data over various time periods and observed the change in Beta estimates through time. Their outcomes, in general, indicate that stock Betas are not stable. Furthermore, the evidence in 1990s (Fama and French, 1992, 1996; Jegadeesh 1992) indicates that Betas are not statistically related to returns, and concluded that Beta is dead and suspected the validity of Beta in measuring risk.

### **III. Estimation Biases and Limitations**

#### ***a. Econometric Limitations***

Whenever Beta is estimated there are certain methodological problems associated with the estimation. The three most basic econometric issues related with Beta estimation are:

1. The systematic risk or Beta estimates are based on *ex-ante* risk premiums, which are not directly observable. These estimates are based on rational expectations for an investor. Under rational expectation, the realized rates of return on assets in a given time period are drawings from the *ex-ante* probability distributions of returns on those assets. However, no logical justification can be given that investors will be rational over time.
2. Betas are normally estimated using linear regression. The underlying assumption for these estimates is the normal distribution of returns. However, in reality the normality of returns is not necessary. This gives rise to the issues of hetroskedasticity.
3. The third major problem relates to the observation of the proxy of market portfolio. In fact, many assets are not marketable and the proxies used for return on market portfolios exclude major classes of assets such as human capital, private businesses and private real estate. The most common assumption used to overcome this problem is by assuming that the disturbance terms from regressing the asset returns, on the return of the market proxy portfolio, are uncorrelated with the true market portfolio and that the proxy portfolio has a unit Beta. If the market proxy is a portfolio constructed from the individual assets or portfolios contained in the test sample, this assumption is equivalent to assuming that the market proxy is the minimum variance unit Beta portfolio of the set of all feasible portfolios constructed from the assets in the test sample.

#### ***b. Estimation Bias in Beta Coefficient***

Beta is a measure of volatility between security returns and market returns. Beta is the security's responsiveness to market movements. The higher the fluctuation between the security returns and the market returns, the higher the systematic risk. The estimation of Beta using the CAPM framework or market model is not difficult. However, there are some issues

related to the goodness of the measure. The Beta estimates using the above mentioned models will be a suitable measure only if the stocks are actively traded. The active trading in the market helps the Beta coefficient to explain the risk associated with the particular stock. One important point to note is that it is not only the stock that has to be traded actively, but also the markets should be active. If, on the contrary, the stock is not actively traded or the markets are thin trading markets, the estimated Beta will not be a good estimation of the systematic risk of the stock. This requires correction of estimated Betas.

The use of the single-index model calls for estimates of Beta values for each stock that is a potential candidate for inclusion in a portfolio. Analysts could be asked to provide subjective estimates of Beta for a security or a portfolio. On the other hand, estimates of future Beta could be arrived at by estimating Beta from past data and using this historical Beta as an estimate of the future Beta. Beta is believed to have a value close to one, as figured from the market Beta value. A market Beta value is the weighted average of security Beta values in the market. If it is unbiased, the market Beta value will be equal to one. The market Beta value is calculated from equation (3), which assumed that the portfolio is the market itself. Testing the bias of Beta values can be accomplished by determining whether the market Beta value is close to one or not.

Beta commonly is obtained by using the Ordinary Least Square (OLS) estimation. In the OLS model, returns on a given security  $i$  are regressed against the concurrent returns of the market. Basically, such estimation has a disadvantage because it gives unstable and biased Beta (Scott and Brown [1980]). Biased Beta usually happens in thin-trading market. Thin-trading phenomenon that makes biased Beta is identical with non-synchronous trading that is caused by infrequent trading. In this sense, there might be some sleeping stocks. Non-synchronous trading problems arise in securities due to the time lag between the setting of market clearing prices for securities and the market index computed at the end of a discrete time interval, known as the intervaling effect. The OLS is a weak method of producing better Beta estimators (Berglund, Liljeblom and Loflund [1989]). Despite the common opinions, the supporters of the OLS Beta estimator still exist. Using New Zealand securities, Bartholdy and Riding (1994) concluded that OLS Beta estimates are found to be less biased, more efficient, and as consistent when compared with Dimson or Scholes-Williams estimators.

The adjustment to Beta values for non-synchronous trading activities is necessary. Most of the non-synchronous trading phenomenon happens in



emerging stock markets because in those markets the trade is low (thin). In most practices, not all securities are traded in the same interval, and some of them are not traded for a period of time. If there is no security transaction in a certain day, the security closing price for that day is actually the price from the previous day, which was the price the last time the security was traded. It could be two days ago, three days ago, or may be weeks ago. When such a price is used to calculate the market index of a day, the market index actually reflects the trading value of its previous days. If Beta is calculated using returns of a security and returns of a market index formed from security returns from different trading periods, the Beta will be seriously biased (Hartono and Suriyanto [2000]).

This phenomenon happens in almost all the emerging Stock Exchanges raising doubts on the estimation of Beta. The major problem is that shares listed on these exchanges are thinly-traded, thus leading to the problem of non-synchronous trading where the market's prices at the end of a period cannot be accurately matched with the prices of a thinly-traded share. Consequently, estimates of systematic risk of these shares will be biased. If the estimate of  $\alpha_i$  and  $\beta_i$  is biased, the estimate of  $e_i$  will also be biased, and the extent of the bias will be more serious for more thinly-traded shares.

Barnes (1986) researched on this issue on the Kuala Lumpur Stock Exchange. He concluded that low-trading-volume market makes it hard for traders to react to new information. It will only make time for the market to absorb the full information.

Thin trading is a function of level of efficiency or vice versa. If a market has thin trading phenomena, it could be suspected to be at a lower degree of efficiency. Even so, some experts believe that non-synchronous trading problem is not as serious as some researchers contend. They think that the synchronous data are found to be less normal and has significant serial autocorrelation even though they exhibit significantly less heteroskedasticity, skewness, and kurtosis than non-synchronous data (Berry, Gallinger, and Henderson [1987]).

Upon pros and cons, the potential for bias in the OLS  $\beta_i$  due to non-synchronous trading has been recognized. For securities traded with trading delays different than those of the market, OLS  $\beta_i$  estimates are biased. Likewise, for securities with trading frequencies different than those of the market index, OLS  $\beta_i$  estimates are biased.

### ***c. Beta Correction Methods***

In an efficient market where prices are continuously formed, the problem of non-synchronous trading should not exist as every stock in the market would have registered a market clearing price at the discrete time of observing the market index, which is the average of all prices at that instant. A significant proportion of the stocks in a market, however, trades so infrequently that prices may be cleared on a few days in a typical month. This is the general behavior in developing countries. Consequently, the measured market prices and the market return deviates from the prices and returns of continuous trading.

Non-synchronous trading makes Beta biased. If the market Beta value obtained from the weighted average of individual Beta values is not equal to one, the adjustment to the Beta values is obviously necessary. There have been many methods suggested by researchers ((see Blume [1971], Vasicek [1973], Klemkosky and Martin [1975], Scholes and Williams [1977], Dimson [1979])) to adjust or correct the biased Beta. However, we will explain only three most widely recognized methods.

#### **» Scholes - Williams Technique**

Scholes and Williams (1977) developed a technique to correct the biased Beta caused by non-synchronous trading in a thin market. According to Scholes and Williams (1977), the problem in estimating Betas from daily returns lies in the observation that securities are not traded on a continuous basis. There are periods during which trading is halted for the day and also periods where the stock is inactive. In addition, these periods of inactivity are not distributed evenly over time. To compound the problem, some securities trade frequently while others infrequently, relative to the average security. These trading issues cause a “lag” effect in the true returns. In other words, observed returns will lag behind true returns when thin trading is present. As a result, Betas estimated from such returns are biased downwards. On the flip side, other securities trade about as frequently as the average security (i.e, the index against which the security’s returns are measured). This situation causes a “lead” effect, and thus the estimated Betas are biased upwards. To correct the problem, Scholes and Williams determined that in order to estimate the true Beta, both the lead and lag effects must be taken into account. This is accomplished by calculating using OLS regression not only the observed Beta during period  $t$  (the time frame of interest) but also calculating the Beta during  $t - 1$  (the lag Beta) and  $t + 1$  (the lead Beta). In addition, the market lead Beta is also included in the

analysis. Once these regression estimators are found, the Scholes-Williams technique can determine a consistent, less biased estimator for the true Beta.

Scholes and Williams showed that the consistent Beta estimator which corrects for thinness of trading in a market when  $R_{jt}$  leads and lags  $R_{mt}$  ( $t$  being the time of measurement of the market returns) by  $n$  period is given by:

$$\beta_j = \frac{\beta_j^{-n} + \dots + \beta_j^{-2} + \beta_j^{-1} + \beta_j^0 + \beta_j^{+1} + \beta_j^{+2} + \dots + \beta_j^{-n}}{1 + 2\rho + 2\rho^2 + \dots + 2\rho^n}$$

where,

$\beta_j$  = Beta stock  $j$

$\beta_j^0$  = Beta estimated by OLS regression

$\beta_j^{-n}$  = Beta lag  $n$      $\beta_j^{+n}$  = Beta lead  $n$

$\rho$  = First order serial correlation coefficient between  $R_{mt}$  and  $R_{m,t-1}$

$R_{mt}$  = market rates of return at time  $t$

All the  $\beta_j^{-n}$ ,  $\beta_j^{+n}$ , and  $\beta_j^0$  are obtained from several OLS regressions within the estimation period with  $R_{m-n}$ ,  $R_{m+n}$ , and  $R_m$  as variables.

### » Dimson procedure

Dimson (1979) developed another method to adjust the Beta. This method simplifies the Scholes-Williams method by only using one multiple regression equation. He took a radical departure from these data intensive procedures by specifying lags and leads in a multiple regression as follows:

$$R_{jt} = \alpha_j + \beta_j^{-n} R_{m,t-n} + \dots + \beta_j^{-1} R_{m,t-1} + \beta_j^0 R_{m,t} + \beta_j^{+1} R_{m,t+1} + \dots + \beta_j^{+n} R_{m,t+n} + e_{jt} \quad (6)$$

The corrected Beta value is the sum of multiple regression coefficients, so the method is also known as the Aggregate Coefficients Method (ACM). An important point to note is that the procedure is more efficient as there is no need for a series of simple regressions (as explored by Scholes and Williams).

$$\beta_j = \beta_j^{-n} + \dots + \beta_j^{-2} + \beta_j^{-1} + \beta_j^0 + \beta_j^{+1} + \beta_j^{+2} + \dots + \beta_j^{+n}$$

The Dimson Beta regression model shows that the unbiased Beta is the sum of the slope coefficients in a regression of stock returns on lead, lag, and contemporaneous market returns. The number of lags and leads required in Dimson's procedure is determined by the convergence of the aggregated Betas to the expected value of one.

#### » Fowler - Rorke method

Fowler and Rorke (1983) developed a biased Beta correcting method which is enhanced from Dimson's. They argued that the Dimson's procedure will not provide consistent and unbiased estimators if the coefficients in equation (6) are simply aggregated without scaling them by weights. Therefore, the Fowler-Rorke method multiplies all the regression coefficients, resulting from Dimson's, each with the weighting factor before adding the regression coefficients.

The weighting factors to multiply  $n$  periods of regression coefficients are calculated as follows:

$$w_n = \frac{1 + \rho_1 + \rho_2 + \dots + \rho_{n-1} + \rho_n}{1 + 2\rho_1 + 2\rho_2 + \dots + 2\rho_n}$$

The values for  $\rho_n$  are generated from a regression equation as follows:

$$R_{mt} = \alpha_j + \rho_1 R_{mt-1} + \rho_2 R_{mt-2} + \dots + \rho_n R_{mt-n} + e_t$$

The corrected Beta values using Fowler-Rorke method is gained from:

$$\beta_t = w_n \beta_j^{-n} + \dots + w_1 \beta_j^{-1} + \beta_j^0 + w_1 \beta_j^{+1} + \dots + w_n \beta_j^{+n}$$

All these three methods are meant to seek market Beta value close to one. The adjustment techniques proposed by Scholes-Williams, Dimson, and Fowler-Rorke found that these techniques reduce a portion of the bias in  $\beta_i$  arising from thin trading and delays in price adjustments. For some researchers, particularly those who do research in emerging capital markets, the Fowler-Rorke method is believed to be the strongest one in reducing the bias.

Hartono and Surianto (2000) found that Fowler-Rorke's four lags and four leads is the best method in correcting Betas on the Jakarta Stock Exchange, after doing several tests with different lags and leads each.

Ariff (1987) examined Betas at Singapore Stock Exchange and suggested that given a reasonably large data set, the Dimson's method with Fowler Rorke's corrections is feasible for estimating unbiased Betas in thinly traded markets.

#### **IV. On the Application of CAPM**

The systematic risk or the Beta has been in the limelight since its inception in the 1960s. For the last 30 years academics and practitioners have been debating the merits of CAPM, focusing on whether the Beta is an appropriate measure of risk. Moreover, the stability of Beta has always been a concern in empirical studies. The test of CAPM is the observation of existence of a positive linear relationship between Beta and returns. Although the model postulates a positive trade off between Beta and expected returns, researchers, in general, always found a weak but positive relationship between Beta and returns over the sample period. Hence, they claimed that the results are inconsistent with the positive linear relationship between Beta and returns as prescribed by CAPM and the validity of CAPM is in question, questioning Beta as an appropriate measure of systematic risk.

Fama and MacBeth (1973) tested the validity of CAPM using a three step approach. In the first period, individual stocks' Betas are estimated and portfolios are formed according to these estimated Betas. In the second period, Betas of portfolios that are formed in the first period are estimated. In the final step, using data from a third time period, portfolio returns are regressed on portfolio Betas (obtained from the second period) to test the relationship between Beta and returns. They found a significant average excess return of 1.30% per month and on an average, for the period 1935 through 1968, a positive relationship exists between Beta and monthly returns. They concluded that the results support the CAPM in the US stock market and consequently Beta is a valid measure of systematic risk.

However, Fama and MacBeth (1973) only provided very weak support for a positive risk return trade off since the positive risk return relationship found is not significant across sub periods. Furthermore, when considering seasonal behavior of their results, the t-statistics for the study period becomes highly suspect and the basic risk return trade off virtually disappears. Reinganum (1981) found that the cross sectional differences in portfolio Betas, and the differences in average portfolio returns are not

reliably related. Thus the returns on high Beta portfolio are not significantly higher than the returns on low Beta portfolios, casting doubts on the Beta's behavior and CAPM.

Tinic and West (1984) found that January has a larger risk premium than the other months and further that the significant relationship between risk and expected returns only exist in January. When data for January months are excluded from the analysis of the risk return trade off, the estimates of risk premiums are not significantly different from zero. Thus, they concluded that their results reject the validity of CAPM. Lakonishok and Shapiro (1986) examined the monthly returns of all stocks traded on the New York Stock Exchange (NYSE) and found that return on individual security is not specifically related to its degree of systematic risk, but is significantly related to the market capitalization value. They concluded that the traditional Beta as well as the alternative (standard deviation) risk measure is not able to explain the cross sectional variation in return; only size can significantly explain it.

Haugen and Baker (1991) examined the risk and return characteristics of 1000 US stocks that have large capitalization over all US stock exchanges and markets between 1972 and 1989. They found that the market portfolio is not efficient because low risk stocks seem to have abnormally high returns, contradicting the relationship between Beta and returns as prescribed by CAPM. Fama and French (1992) studied the monthly average returns of NYSE stocks and found an insignificant relationship between Beta and average returns. They concluded that CAPM cannot describe the last 50 years of average stock returns and only market capitalization and the ratio of book value to market value have significant explanatory power for portfolio returns.

The stability of Beta has been another issue in the empirical literature. By stability it is meant that historical Beta can be used as an estimate for future Beta. Most of the studies on the stability of beta have somewhat similar conclusions. Levy (1970) examined individual US stocks, based on weekly returns, listed on NYSE and concluded that the Beta was not stable for individual stock over short periods. On the other hand, he observed that, in the case of a portfolio, the stability of Beta increased significantly. Further he concluded that the longer the period (over 26 weeks), the more stable is the Beta of the portfolio. The correlation he found among the Betas for 50 stock portfolios over a period of 26 weeks, was 0.91 and the Betas tended to regress toward the mean. Similar results were found by Fielitz (1974). They agreed that the stability of the risk, i.e. the Beta, substantially increases with an increase in portfolio size.

Another important factor that counts is how many months have been used to calculate the Beta. Baesel (1974) found that in the case of individual securities, the stability increases as the length of the estimation period increases. Altman, Jacquillat and Levasseur (1974) tested the Beta on French data with a different test period. They, in their comparative study with US markets, concluded that Beta was stable and stationary in the French market despite the market being smaller and less liquid. They also found an average correlation of 0.91 with portfolios as compared to 0.58 for individual securities. Moreover, as the test period increased the correlation also increased. The market model explained the same amount of variability of returns in US as well as French markets. A stable Beta can be observed by using a test period of over 120 months. However, for this, he assumed that Beta does not shift over time.

Ross (1976) suggested a multifactor model (arbitrage pricing theory) for asset pricing with far simpler assumptions than CAPM. He commented that asset pricing should not be attributed solely to a single factor (Beta of CAPM) rather it is a function of various economic factors. Arbitrage Pricing Theory (APT) holds that the expected return of a financial asset can be modelled as a linear function of various macro-economic factors, where sensitivity to changes in each factor is represented by a factor specific Beta coefficient. The model derived rate of return is then used to price the asset correctly - the asset price should equal the expected end of period price discounted at the rate implied by the model. If the price diverges, arbitrage should bring it back into line.

The APT differs from the CAPM in that it is less restrictive in its assumptions. It allows for an explanatory (as opposed to statistical) model of asset returns. It assumes that each investor will hold a unique portfolio with its own particular array of Betas, as opposed to the identical "market portfolio". Additionally, the APT can be seen as a "supply side" model since its Beta coefficients reflect the sensitivity of the underlying asset to economic factors. Thus, factor shocks would cause structural changes in the asset's expected return.

All the above studies suggest very weak or no relationship of Beta with the expected return. The most important point to be considered is that all these studies have been testing the "synthetic CAPM" and due to non observation of the real market portfolio, it is impossible to test the actual CAPM. The use of the proxy portfolio can be seriously flawed if the proxy index is dominated by some stocks. In this case the return of the index portfolio is performance of such heavy weights and does not reflect the performance of the true market portfolio. Furthermore the bias

intervention and difference in estimation methods of Beta across various financial markets makes the model more controversial.

## **V. Some Tentative Conclusions**

Despite all the arguments and evidence against the CAPM, it is very difficult to give an unambiguous conclusion. On the one hand there is strong evidence against the model while on the other hand the inability to observe the true market portfolio leaves us with a synthetic CAPM. Thus all the evidence against CAPM actually discard synthetic CAPM as original CAPM per se is not testable. The Anti CAPM club, led by Fama, is a major setback in itself; because Fama, till the early 90's, has been a great supporter of CAPM. The failure of the CAPM has fuelled an ongoing debate over the correct paradigm of asset pricing. Even if we disregard the fact that prices are determined by subjective valuations of individuals and cannot be measured by cardinal numbers, diligent work has continued to (1) Salvage CAPM by reformulating it (i.e. Intertemporal CAPM), (2) Create new equilibrium models based on far different assumptions (Arbitrage Pricing Theory) or (3), Show that human behavioral constraints limit the ability of investors to act rationally and call for efforts to create a new or radically modified asset pricing paradigm.

Another factor contributing towards the “reports of death of CAPM” is that empirical and market tests of quantitative models provide little support for usefulness in real world applications. Utilizing a world of certainty (evenly rotating economy) for deducing crucial economic insights is a valuable tool for testing economic theory, but wrought with problems when considered descriptive of actual human actions. When economists attempt to supplant human based systems with artificial quantitative models they encounter a host of insurmountable methodological problems due to the variability and complexity of past, present, and future economic environments. Nevertheless, financial economists persist in assuming that the real world can be replicated in asset pricing models. What are especially troubling are the methodological violations in formulating these so-called theories of asset pricing in spite of the continued failures of such models in applications.

However, despite all this, the investment analysts, mutual fund managers, researchers etc, will still have to work with the proxy index, some form of Intertemporal CAPM or APT for the foreseeable future till a model can be suggested that is free from methodological, estimation and calculation biases.



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