IMPACT OF CAPITAL ASSET PRICING MODEL

Impact of capital asset pricing model (capm) on pakistan;

(The Case of KSE 100 Index)

This paper has been presented in the

3rd International Conference on Business Management February 27-28, 2013

organized by

School of Business and Economics

University of Management and Technology, Lahore, Pakistan

ABSTRACT

In this dissertation two estimated return on stock models i.e. standard Capital Asset Pricing Model (CAPM) Three Factor Model are compared to know which determine better estimates the return on stock in Pakistani capital market. For this purpose time series monthly data from secondary sources for a period of 2003 to 2007 has been taken. CAPM were tested for the five size and book to market portfolios from Karachi Stock Exchange. Pakistan T-bill rate is taken as risk free rate. However basic problem with (CAMP) was predictive power Predictive power and Robustness of results. For this purpose CAPITAL ASSET PRICING MODEL WAS APPLIED. Dependent variable portfolio represented by ER_{p_t}. The excessive return shows the return above that of the risk free rate R_f that is required by the investor for taking additional risk. while independent variables was market risk premium.

Research Findings are as follows:

CAPM better estimated the return in Pakistani capital market as compared to Fama and French Three Factor model

1. In case of CAPM, it was able to show the existence of risk premium as the only factor affecting the stock return.

CAPM better estimates the return on equity in the context of Pakistani capital market so it is preferable to use, however, caution should be exercised in generalizing the applying the result on other stock markets because F&F model has estimated well in most stock markets of the world.

Key Words; CAMP, Market portfolio, KSE, Risk Premium, Fama & French 3 factor model

1. INTRODUCTION

Estimation of expected return or cost of equity for an individual stock is central to many financial decisions such portfolio management, Capital budgeting and performance evaluation. So many models have been developed to facilitate financial managers and investors to predict the expected return on a stock. The two main alternative available for this purpose are a single factor model (CAPM: Capital Asset Pricing Model) developed by William Sharpe (1964) and John Lintner in 1965 for which William Sharpe was given Nobel Price in 1990 and a three factor model suggested by Fama and French (1992), in fact this model was developed after CAPM was heavily criticized on number of grounds. As James Davis (2006) said CAPM "is the most well known asset pricing model" and "the use of CAPM is a favorite because it is a model with only one risk factor, the underlying logic is powerful, and it is well known and widely understood" and the Fama and French three factor model is "Perhaps the most promising alternative" and "the most widely used model of stocks return in the academic finance literature". Both of the models have been criticized on different grounds for example CAPM talks of market portfolio which is assumed to consist of all assets in all the markets which is practically impossible because they may include not only traded financial assets but also consumer durables, real estate. Second CAPM says that there is only one significant beta but in practice many significant

1.2.1 CAPM Assumptions

1. CAPM assumes that capital markets are efficient, all securities and assets are correctly priced and there are no arbitrage opportunities. Investors are risk-averse and mean-variance optimizers. For a specific level of risk they will prefer higher returns and for a specific expected return they will prefer lower risk. The choice of assets is based only on the risk preference and preferences toward markets or assets are excluded.
2. The market portfolio is assumed to consist of all assets in all markets, but many assets such as real estate, human capital and others are not included. Thus the market portfolio is a limited version of the real market portfolio.
3. Another assumption of CAPM is that there are many investors and all investors are price takers i.e. their transactions have no effect on the market.
4. Investors plan to invest over the same time horizon and are interested in only one period ahead. They make their investment decisions at the beginning of the period and there are not any changes during the investment horizon.
5. There is a risk-free asset that pays interest rate Rf in zero net supply. Investors can borrow and lend at a fixed risk free rate over the investment horizon.

6. There are no taxes on returns or transactions costs such as commissions, service charges. In reality, the income from interest, dividends or capital gains is taxable and commissions and fees can be collected. This can affect the choice of the investor with regard to stocks and portfolios.
7. Information is freely available to everyone; hence all investors have the same information and homogeneous expectations about the distribution of returns. Assumes that returns are distributed normally and specified by mean and standard deviation, the latter being a measure of risk. Usually that is not the case and returns might follow different distribution, which in turn refutes the assumption that the standard deviation is the appropriate measure of risk.

The equation for the CAPM model which describes the expected return on portfolio or stock i follow as:

$E(R_i) = R_f + \beta_i[(E(R_m) - Rf]$ ---------- (1)

Where

$E(R_i)$ is the expected return calculated based on its risk to market portfolio.

R_f is the risk-free interest rate,

$E(R_m)$ is the expected return on the market portfolio,

And β_i, the CAPM risk of stock i, is the slope in the regression of its excess return on the market's excess return.

The equation for the time series regression can be seen in (2) with the excess return on portfolio i as the dependent variable and the excess return on the market as the independent variable:

$R_i - R_f = \alpha + \beta_i[R_m - R_f] + \mathrm{E}_i$ ---------- (2)

In the CAPM model β_i or Beta is the sole factor when it comes to pricing risk. We can intuitively see why people initially embraced this model, and it was due to its simplicity. In the context of the CAPM, an investor is only rewarded for systematic or non-diversifiable risk which is represented by β. The excess premium that is afforded to portfolio or stock i is solely a function of its volatility to the expected market risk premium, or the β factor, multiplied by the expected market risk premium. The advantages of this model were that given historical returns on the portfolio, and the selection of another variable such as the KSE 100 as a proxy for the market, that it is very simple to calculate β for a time series regression. If CAPM is used then and estimate for beta is obtained using simple OLS regression and this estimate is multiplied by an estimate for the risk premium on the market to obtain an estimate for excess/or less return on equity for that stock. So CAPM uses only one variable that is “risk premium on the market”

to estimate the return on equity for a stock, which may cause some problems. For example, the CAPM says that the risk of a stock should be measured relative to a comprehensive "market portfolio" that in principle can include not just traded financial assets, but also consumer durables, real estate and human capital. Even if we take a narrow view of the model and limit its preview to traded financial assets, is it legitimate to limit further the market portfolio to common stocks (a typical choice), or should the market be expanded to include bonds, and other financial assets, perhaps around the world. The CAPM's empirical problems may reflect theoretical failings, the result of many simplifying assumptions. But they may also be caused by difficulties in implementing valid for tests of the model.

1.2.2 Problems with CAPM:

1. Predictive power:

Academic research has identified persistent deviations from the predictions of the CAPM about asset price behavior. A number of 'anomalies' have emerged that cannot be explained within CAPM framework- in particular, the impact of firm specific characteristics (size, leverage, book-to-market ratio) and of past returns (short term momentum effect and success of contrarian strategies over the long term) on future returns.

2. Robustness of results:

The results of CAPM are sensitive to change in specific data characteristics. In particular, the estimation of beta parameter may change significantly according to the time horizon, data frequency and benchmark used.

2.1 LITERATURE REVIEW:

It is a global phenomenon "Higher the risk higher will be the return". If we take the same statement for financial markets then this can be restated as higher the risk of the financial assets higher the return demanded. But the problem is how to quantify the risk so as to measure the return demanded for it. If this can be solved it will be of great help in problems like capital budgeting, cost benefit analysis, portfolio selection and for other decision relating to the knowledge of risk and return.

2.1.1 Studies supporting CAPM:

A survey was conducted by Graham and Harvey (2001) that 73.5% of 392 US CFO's relies to some extent on CAPM when estimating the cost of equity. Brounen, Abe de Jong and Koedijik (2004) conducted a similar survey for 313 European firms and around 45% of on average relies on the CAPM.

One of the assumptions of CAPM is that there is a risk free asset and investors can borrow and lend at a fixed risk free rate over the investment horizon. If however, they cannot borrow and lend at the risk free rate, they can pick any portfolio that is on the efficient frontier according to the risk they are willing to take. Thus the market portfolio may not be mean variance efficient any longer; hence the relationship between the expected return and beta as defined by CAPM may not characterize the market equilibrium.

2.1.2 Studies challenging CAPM:

In 1977, Roll questioned the testability of CAPM, his main critique being that the CAPM cannot be tested or applied until the structure of the true market portfolio is known and all securities are included. Using a proxy incurs two problems, namely the proxy might be efficient when the true market portfolio is not and the reverse, the proxy might not be efficient when the market portfolio is. Furthermore, there is a possibility of benchmark error as using different proxies' yields different results and conclusions and inappropriate proxy might be taken. In addition, in reality, the return on the market Basu (1977) studied common stock and made clear that when stocks are sorted based on E/P (earning/Price) ratios, the future returns on higher E/P ratio stocks are higher than predicted by CAPM and future returns on Lower E/P ratio stocks are lower than predicted by CAPM.

Banz (1981) documents a size effect. Benz studied firms on the NYSE during the period 1936-1975 and estimated the cross sectional relation between the average return, beta and the relative size of the firms. He found that the average return on stocks of large firms were smaller than those of the stocks of smaller firms and concluded that there is a large and statistically significant size effect. When stocks are sorted on market capitalization (price times shares outstanding), average returns on small stocks are higher than predicted by the CAPM.

Statman (1980**)** showed that "value" stocks or stocks with high book-to-market equity ratios had returns that were not captured by market betas.

Several studies questioned the validity of beta; more specifically they claimed that beta calculated on the basic of historical data might not predict well the variance of future returns. Harvey (1989), Ferson and Harvey (1991, 1993), and Ferson and Korajczyk (1995) found that betas similar to expected returns are time varying.

3.1 RESEARCH METHODOLOGY

In 1991 KSE started as an open market but the volume of traded securities remained low till the start of 2002, within this period the investment activity remained low and no noteworthy foreign investment was seen, but in the start of the new millennium environment changed and

KSE started to show signs of activity which increased with time till 2008. The world financial crisis 2008 and political instability started making all its previous bull rallies into bearish. KSE 100 index on several instances broke its previous records which was a sign of investors confidence (In April 17, 2006 market capitalization in KSE was about US $ 57 Billion which was 46% of Pakistan GDP for the year 2005-2006). Pakistan was seen as an emerging market and foreign investors were encouraged to invest in it(In 2002 KSE was declared as the best performing stock exchange in the world in terms of percentage increase in local market index value).

3.2 CAPITAL ASSET PRICING MODEL

3.2.1 Model Specification:

The model used for CAPM and will be as;

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

Where

$E(R_i)$ is the expected return on stock calculated based on its risk to market portfolio.

R_f is the risk-free interest rate,

$E(R_m)$ is the expected return on the market portfolio,

β_i, the CAPM risk of stock *i,* is the slope in the regression of its excess return on the market's excess return.

In the CAPM model β or Beta is the sole factor when it comes to pricing risk.

CAPM shows expected returns for individual stocks. This models can be transformed to show expected returns for a portfolio by rearranging as

$ER_{pt} = \alpha_p + \beta_t(RP_t) + E_t$ For CAPM

Where $ER_{pt} = R_{P_t} - R_f$ and

R_{p_t} = average return of equally weighted portfolio.

3.2.2.1 Dependent variable:

The dependent variable for both CAPM a is the excess return of the portfolio represented by ER_{p_t}. The excessive return shows the return above that of the risk free rate R_f that is required by the investor for taking additional risk.

3.2.2.2 Independent variables:

The independent variable for CAPM is the market risk premium. Market risk premium is measured as difference between the returns of market portfolio and risk free rate, represents excessive return that investor could earn if invest in market portfolio instead of risk free asset.

3.2.3 Hypothesis:

$$ER_{it} = \alpha_i + \beta_t(R_m - R_f) + E1$$

$$H_1 : \alpha_i \equiv 0 or \alpha_i \neq 0$$

But statistically insignificant

$$H_2 : \beta_t \neq 0$$

3.4 SAMPLE SELECTION AND CRITERIA:

To test the CAPM and Fama and French three factor model using monthly data of KSE stocks taken from different sectors, data from the period of Jan 2003 to Dec 2007 is taken. Updated data could not be taken because stock exchange in Pakistan was freezed from 27 August 2008 to 12 Dec 2008 and data of consecutive 60 months is required for these models. The following are the list of criterion that was employed to select stocks from these individual sectors.

1. All selected stocks are public limited companies listed on Karachi Stock Exchange.
2. For selected companies, monthly closing price data was used.
3. The selected companies must have the price data for the period Jan 2003 to Dec 2007.
4. Companies having negative equity for the period were ignored e.g. Wazir Ali industries and Pakistan International Air line.
5. KSE 100 index of 2007 was sorted both on the basis of market capitalization and B/M ratio.
6. A sample of 20 companies were selected for the study, 20 top and bottom companies on the basis of market capitalization, 20 top, 20 middle and 20 bottom companies were selected on the basis of B/M ratio.

4. EMPIRICAL RESULTS AND ANALYSIS

4.1.1 CAMP ILLUSTRATED:

How CAMP is used for calculation of expected return will first be illustrated with simple supposed data for understanding and then applied to original data.

EXAMPLE:

Let us consider an example. The estimated rates of return and Beta coefficients of some securities are as given below.

Security	Estimated return (%)	Beta
A	30	1.6
B	24	1.4
C	18	1.2
D	15	0.9
E	15	1.1
F	12	0.7

The risk free rate of return is 10 percent while the market return is expected to be 18 percent. We can use CAPM to determine which of these securities are correctly priced. For this we have to calculate the expected return on each security using the CAPM equation

Given that R_f = 10 and R_m = 18

the equation becomes $R_i = 10 + \beta_i(18-10)$

The expected return on security A can be calculated by substituting the Beta vale of security A in the equation. Thus

$R_i = 10 + 1.6(18-10)$

= 10 + 12.8

= 22.8 percent

4.1.3 Descriptive statistics:

The monthly returns between January 2003 and December 2007 were computed on five sorted portfolios. Table 1 represents the descriptive statistics of these portfolios.
Table 1: Descriptive statistics of monthly returns from period 2003-2007

Descriptive statistics of monthly returns (2003-2007)					
	A	B	C	D	E
Mean	3%	4%	0%	5%	2%
Median	3%	4%	-1%	5%	1%
Maximum	16%	31%	35%	28%	22%
Minimum	-10%	-26%	-28%	-15%	-18%
Std.Dev	6%	12%	11%	12%	9%

A= Big size with low B/M portfolio
B= Big size with Medium B/M portfolio
C= Small Size with Low B/M portfolio
D= Small Size with Medium B/M portfolio
E= small size with High B/M Portfolio.

Table 2: Correlations between sorted Portfolio returns

	A	*B*	*C*	*D*	*E*
A	100%				
B	45%	100%			
C	59%	41%	100%		
D	63%	54%	66%	100%	
E	71%	51%	60%	71%	100%

Table 3: CAPM regression

CAPM regression on portfolios					
	α	β1	t(α)	t(β1)	R-Square
Big size and low B/M	0.0094	0.7019*	1.8382	10.2222	0.65713
Big size and Medium B/M	0.0129	0.7819*	0.8617	3.9011	0.208432
Small Size and Low B/M	-0.0331**	1.0655*	-2.8503	6.841	0.458934
Small Size and Medium B/M	0.0194	1.0942*	1.6312	6.8605	0.460365
small size and High B/M	-0.0048	0.8911*	-0.5702	7.8310	0.527662

* Significant at 99% ** Significant at 95%

When a combined regression was applied to all portfolios, the result was can be seen in table 4.

Table 4: CAPM combined portfolio result

CAPM regression result				
A	β1	t(α)	t(β1)	R-square
0.000752	0.9069*	0.1501	13.5377	0.3994

* Significant at 99% ** Significant at 95%

The result was astonishingly very accurate the intercept was insignificant at 99% and 95% confidence interval and risk premium was significant at 99% and 95% confidence interval.

CONCLUSION AND RECOMMENDATIONS

Rate of return or asset pricing is one of the hottest topics for financial economists. From the past half a century they are trying to create a model that can be called the best of all and can be used universally but it is very difficult because different market have different characteristic, so a model that can be considered better in one market may not work in other environment. During this time many models for asset pricing were developed some got in the lime light while other vanished without leaving any kind of impression. We are facing a similar problem with CAPM and Fama and French three factor model CAPM. In some part of the world the CAPM has performed well while in other F&F three factor model was better. Some researchers advocate for the single factor beta as the most viable risk factor determining returns; other report that beta has been long gone. This research study tries to answer the question which model is a better predictor of expected return. However caution should be exercised because the result of the study contradicts many of the studies result conducted on Pakistani market where F&F three factor model was considered the better [Attiya Y. Javid and Etazaz Ahmad (2008), Mirza Nawazish (2008)] and many recent studies conduced abroad. It is proposed that different combinations could be tried to see existence of size and value premium like the monthly data can be replaced with daily or weekly data. The time period under consideration can be changed to include other years. It is also proposed that on the same data set the model should be tested without sorting the portfolios and its robustness should be checked for other time periods or there is a possibility to increase the sample size then may be we can have some signs of size and value premium.

Asset pricing is one of core topic in the investment decisions and continuous improvements are being made to create a robust model. But many difficulties are being faced when used to analyze the human behavior. Financial economists have encountered tremendous problems whenever they tried to model investor's psychology and the result for a particular time period might not be representative of actual investment behavior in subsequent time periods. Future is uncertain so is human thinking no one can comment for sure what thing they are going to consider important at one time period it is very complex to figure out the reaction for any change that may happen. So it is these difficulties and uncertain future environment that causes divergence between theoretical models and practices.

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