



Application of Capital Asset Pricing Model

Empirical Evidences from Chittagong Stock Exchange

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Abstract

Most of the investors all over the world use CAPM to measure the expected stock returns for its simplicity and accuracy. Investors in Chittagong Stock Exchange (CSE) also use it extensively. This study aims to find the applicability of CAPM in CSE. Closing prices of top 30 different companies from 2008 to 2012 have been considered. The basic model developed by William Sharpe (1964) and other authors in different times is used to serve the purpose. The research finds no applicability of CAPM in CSE as the difference between expectations and the actual results is very high at normal risk level.

Keywords: CAPM, Beta, Returns.

Background:

Capital Asset Pricing Model (CAPM) has been accepted as a simple and widely used theory of asset pricing for more than 40 years. This model was originally proposed by Sharpe (1964) to explain how the weighing of risk and expected return helps to determine securities prices. This theory is widely applied today in the finance literature and influencing the decisions of government agencies, bankers, brokers, and millions of investors worldwide. A review of studies supports the validity of CAPM for various capital markets in the world. But, studies on stock market and CAPM were few in Bangladesh. As the capital market of Bangladesh is a developing one, that's why we may find a suspicious result if the western theories are applied here. This paper attempts to examine the validity of the CAPM in CSE- one of the stock exchanges in Bangladesh.

Expansion of CAPM:

Several scholars including Eugene Fama, Michael Jensen, John Lintner, John Long, Robert Merton, Myron Scholes, William Shaepe, Jack Treynor and Fischer Black have contributed to develop a model which will describe the pricing of capital assets under condition of market equilibrium. Treynor and Sharpe (1964) worked independently to develop the Capital Asset Pricing Model (CAPM) while Lintner (1965) and Mossin (1966) extended and clarified it further, which marks the birth of asset pricing. In 1952, Markowitz focused on how investors use risk and return assessments in forming mean-variance efficient portfolios. In his paper, he emphasized on diversification that is required to obtain the optimal trade-off between risk and return. Sharpe (1964) worked on that effort and developed a model which explains how markets incorporate risk in pricing capital assets. Later, Fama (1968) clarified that their models were, in fact, equivalent. The equation they derived has later been named as the Capital Asset Pricing Model (CAPM). Before the CAPM is introduced, there were no asset pricing models that gives clear testable predictions about the tradeoff between risk and return. By Fama and French (2003), the attraction of the CAPM is its powerful simple logic and intuitive predictions about how to measure the relation between expected return and risk. After about four decades, the CAPM is still widely applied to determine the cost of equity capital for firms and to evaluate the performance of managed portfolio (Burton, 1998; Fama and French, 2003).

Test of CAPM in Different Countries:

The model is based on some simplifying assumptions including - all investors are risk-averse and price takers and have homogenous expectations about asset returns, they may borrow or lend unlimited amounts at the risk-free rate from a fixed quantity of assets where all assets are marketable and perfectly divisible, the asset markets are frictionless and perfect (there are no taxes, regulations, or restrictions on other selling) and all the information is costless, symmetric and available to the investors. However, many investors and financial analysts were interested on applicability of this model in different capital markets of the world. Consequently, it has been applied in many recent studies, including: Lahore Stock Exchange (Iqbal and Brooks, 2006); Australia Stock Exchange (Galagedera, 2006); Latin American Stock Exchange (Grandes, Panigo and Pasquini, 2006); Spanish Stock Market (Ferruz et al., 2007); Oslo Stock Exchange (Qin and Poyry, 2007); Iceland Stock Exchange exchange (Senol and Ozturan, 2008); Shanghai Stock Exchange (Xu song and Cheng-qi, 2008); Sao Paulo Stock Exchange (Rogers and Securato, 2009); Vietnam Stock Exchange (My and Truong, 2011); Taiwan Stock Exchange (Lin and Liang, 2011) and Indian Stock market (Gunasekaran and Ramaswami, 2011). But, studies related to Bangladesh stock market and CAPM were few. The CAPM is questioned by several empirical studies as the variables other than the estimated covariance can be used to explain the risk premium of the individual assets. Ross (1978) found that, the expected return can be explained by variables like- the firm size, the own variance and the month of January. Black et al. (1972), Fama and MacBeth (1973) were supportive to the implications of the CAPM. They all agreed that, the average return of low beta stocks was lower than the average high beta stocks. They found a roughly linear relationship and a slope that was too flat to strongly support the CAPM (Campbell, 2000). On the other hand, there are several extensions to the model which has been tested. Some of that models are- the after tax CAPM, Conditional Capital Asset Pricing Model (CCAPM), the International Asset Pricing Model (IAPM) and the international CAPM. In early twenty first century Ocampo (2003) applied an alternative method to test the CAPM that helped to explain the role of beta in estimating returns in the Philippine markets. At present, researchers concentrate on

different time scale to see the applicability of the CAPM. The studies on different markets of the world show a positive relationship between the return on a stock and its associated beta with the increase in the time scale. Based on different time scales Rhaiem et al. (2007) studied the estimation process of CAPM for French's stock market and finally concluded that, in a multi-scale framework the CAPM is more relevant at a medium term horizon. A further research done by Rhaiem et al. (2007), established that, as compared to other time horizons CAPM is more relevant at short and long time horizon in a multi-scale framework. A test by Gursoy and Rejepova on Turkey market found no meaningful relationship between ex-post risk premium and beta coefficients under the Fama and MacBeth (1973). But with the Pettengill et al. (1995), they found strong beta-risk premium relationships.

Literature Review:

Investors take their decisions based on the relationship between risk and return of investment (Kevin, 2001). Returns depend upon the degree of risk and investors can reduce the variability through the diversification of the investments. This nature of investors gives birth of portfolio from a particular set of securities or assets. Among the portfolios, all are not efficient at a time. So, investor needs to choose the efficient securities from the portfolio to maximize profit as well as to reduce risk. The capital asset pricing model was conceptualized by William Sharpe in 1964 and John Lintner in 1965. This theory later on gave birth of asset pricing theory. William Sharpe won Nobel Prize in 1990 for inventing CAPM. Decades later, the CAPM has extensive applicability in estimating cost of capital and evaluating the performance for managed portfolios (Fama & French, 2004). Diversification helps to reduce risk, but the portion of risk can never be pulled down to zero (Kevin, 2001). Not all stocks are diversifiable, few are subject to systematic risks which can never be diversified by any decisions, this risk is called beta risk. A rational investor expects the return on a security to be commensurate with the risk of that stock. Therefore, a standard Capital Asset Pricing Model (CAPM) indicates the relationship between systemic risk and expected return of a security (Lintner, 1965; Mossin, 1966; Kerr, 1997; Elton et al., 2007). Wonyi et.al (2012) found positive relationship between risk and return in Nigerian stock market and they recommended that to manage the risks investors should improve the

methods of analysis to optimize the portfolios as the market significantly rewards market risks. Investment in stock market is always risky as the market is seriously volatile. Since the risk is high, the return is also high in this sector. There is a positive relationship between the risk and the return. More the risk, higher the return. In order to reduce the risk level of investment, an investor can diversify the risk of its investment by investing in different assets. Every investor expects return which compensates risk. The Capital Asset Pricing Model (CAPM) helps us to determine the risk and return of a particular investment.

Jalilian (2011) studied the relationship between company size and systematic risk based on the CAPM on accepted companies in Tehran stock. Their study included 112 Tehran companies in stock market. The study covered the period of five years. The results revealed was a significant relationship between company size and systematic risk based on the CAPM in accepted companies in Tehran stock markets.

Gorjizadeh (2010) studied the relationship between benefit growth and systematic risk of accepted companies in Tehran stock market. He proposed three hypotheses and chose 114 firms from accepted companies in Tehran stock markets for the period of six year from 2001 to 2007. He calculated the variables of margin, gross growth, operating benefit growth, net profit growth, and systematic risk. The results revealed that there was a significant relationship between systematic risk and benefit increase of accepted companies in Tehran stock markets.

Masihe et al. (2010) estimated systematic risk in different periods and utilized wavelet method in newly established Persian Gulf stock markets. Seven Persian Gulf stock markets were analyzed from 2007 to 2008. The result of the study showed that there was a significant difference in beta average coefficient in countries member in GCC. This issue was in accordance to various theoretical expectations of stock market investors in different periods. This difference was the result of various business strategies.

Alan and Bojang (2009) investigated the beta stability as systematic beta index using CAPM. Their study included 50 Malaysian companies stock. The study covered the period of seven years from January 1994 to December 2001. The result indicated that two models of Fama and CAPM explain negative and positive increase of financial resources and occasionally revenue. However, the results of these models are dramatically different.

Vaez et al. (2008) investigated the possibility of predicting stocks price in Tehran stock markets using CAPM. The researcher selected companies non-metal mineral industries, brokers and car industries. These companies were active from 1999 to 2003. The results disclosed that the impact of stock value is associated with stock intrinsic value, which was impractical during the study period.

Chariton and Constantinidis (2004) studied the size and factors like book-to-market in earnings. Their results indicated that if the market factor alone used in the capital asset pricing model, R² of the model would be between 60 to 93 percent, added the company's size and BE / ME factors, R² will be 84 to 97 percent, which means that multi-factor model is better than the single-factor model.

Ahmadpour (2000) studied the Tehran markets to get the effects of financial leverage, operating leverage and company size on systematic risk of listed companies. The results revealed that there was a significant relationship between financial leverage, company size and systematic risk. However, no significant relationships between operating leverage, sale and systematic risk were found.

Rahman, et al. (2006), found strong support to explain the relationship among the variables for determining the stock return shown that beta is not the only factor to determine the stock return but there are other variables which can be considered significantly important. In this research they found the impact of time and as they see that variability in time may cause the stock return to vary and with the time factor all variables become significant so, not only the variables like- beta, size and book to market value but also the time impact is significantly important. This study on the CAPM is also done on that ground which shows that, stock return is significantly related to the variables we have considered. We also found that, in Bangladesh capital market time impact and year impact plays a significant role which can be seen as a new issue for CAPM.

Baten et al. (2006), identifies market inefficiency as the major drawbacks for Bangladesh capital market where information transparency and the regulatory system is not certainly proficient. As a result investors get poor confidence and insufficient basis to analyze the market without understanding. The DSE is a newly established emerging market, the regularity system and the trading mechanism are not operating smoothly in

comparison to the well equipped developed markets. However, as we hardly find empirical studies conducted on emerging markets, this study has implications for the participants and regulators.

Firstly, "beta is not dead and multifactor variables determine the stock return" the researchers could use this study as a benchmark for further research, Secondly, this study will obviously be used as a source of reference for further research and the researchers will get proper guideline from this study, Thirdly, this study will help all the interested parties of the market such as investors, policy making and regulatory bodies and portfolio analysts of the emerging markets by providing some directions. Hence, it is an important issue to concentrate on the legal aspects of the emerging markets regarding information disclosure requirements, protection of outside investor's interests. As the Dhaka Stock Exchange (DSE) is a member of one of the emerging market and as thin market, DSE seems a risky financial market. So the risk related to variables affecting returns would be effective and significant. For determining the stock return, the results of the empirical study strongly supports the relationship among the different variables used. It is evidenced that, except beta there may be other important variables that can be used to get the stock return. The results give a negative correlation between stock return and the beta due to market inefficiency which is beyond the assumption of the CAPM model.

Objectives of the Study:

The objective of this study is to examine the applicability of CAPM in Chittagong Stock Exchange. It will also check the relationship between risk and return in the same.

Methodology:

To test the applicability of CAPM in the CSE, daily adjusted close prices of 30 best performing companies have been chosen for the period from January 1, 2008 to December 31, 2012. The Risk Free Return and the Market Return have been collected from the website of Stock Bangladesh Limited. CAPM formula has been used to know the beta of stocks for stipulated period. After getting the beta values, estimated prices have been generated applying the beta for the same period. Six Portfolios have been created taking five companies in each. For every portfolio both actual and expected values have been used to find out

the relationship between the variables and other statistical relationship between and among the variables.

Hypothesis:

H₀: Stock return does not depend on degree of risk

H₁: Stock return and risk are correlated

Justification of the Model:

Capital Asset Pricing Model calculates the total return comprising risk free return and the risk premium. Risk premium depends on the degree of risk taken (beta coefficient). The relation between risk and the return is linear and correlated. Higher the risk, higher the return as risk free return is constant. CAPM equation is based on the assumptions of several factors like investors are risk-averse, market is frictionless, information are available but asymmetric in nature, investors can borrow unlimited amount at risk free rate and financial assets are perfectly divisible and have marketability (Copeland et al., 2004) The CAPM equation is as follows;

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

Where,

R_i = Return on asset I

r_f = Risk free rate

R_m = Return on the market portfolio

β = Beta coefficient

Beta coefficient is determined by;

$$\text{cov} \left(\frac{R_{ix} R_m}{\text{var}(R_m)} \right)$$

This study based on the data of CSE-30 index from January 2008 to December 2012. The procedure is followed as already mentioned in the methodology.

Empirical Findings:

Table: I

Stock	ME	MED	SD	KU	SK	MIN	MAX
ABBANK	988.63	897.30	846.39	3.48	1.69	0.00	4349.00
RECKITTEN	874.56	817.00	415.50	-0.29	0.71	325.20	1940.00
AFTABAUTO	670.95	372.50	697.28	0.74	1.43	0.00	2954.50
APEXTANRY	992.48	1124.00	571.22	-0.84	-0.35	0.00	2331.00
PHOENIXFIN	746.49	514.80	591.34	-0.04	0.80	0.00	2522.50
BEXIMCO	198.38	190.20	110.18	-1.29	0.10	34.70	467.20
BXPHARMA	118.74	118.50	41.80	-1.38	-0.13	48.50	196.50
BRACBANK	568.65	594.30	351.22	0.01	0.10	0.00	1595.80
CONFIDENCEM	597.30	339.80	668.13	3.22	1.90	78.30	3431.50
DHAKABANK	254.76	313.00	207.16	-1.45	0.19	0.00	711.80
MTB	317.89	346.00	183.47	-0.57	-0.26	0.00	811.80
FAREASTLIF	1678.89	2270.00	1404.53	-1.53	0.15	100.40	4770.50
GQBALLPEN	184.68	178.00	52.67	-0.50	-0.04	0.00	301.50
HEIDELBCEM	1769.26	1451.30	1148.17	-1.17	0.19	0.00	4267.50
ISLAMIBANK	1569.66	550.80	2402.29	0.86	1.64	0.00	7917.50
JAMUNAOIL	74.30	71.80	25.61	-0.13	0.48	28.20	162.10
KEYACOSET	231.08	200.20	133.55	-0.34	0.79	0.00	548.20
LANKABAFIN	922.08	751.90	418.61	0.00	0.72	187.10	2173.50
PADMAOIL	271.88	299.80	150.01	-0.37	-0.42	0.00	668.80
MERCANBANK	254.76	325.80	201.10	-1.40	0.07	0.00	704.50
NCCBANK	369.19	445.00	284.97	-1.34	0.05	0.00	994.30
PRIMEBANK	363.89	386.50	315.53	-1.23	0.40	0.00	999.00
PUBALIBANK	2619.77	2100.00	2069.59	0.27	0.97	0.00	8331.30
SINGERBD	2714.93	3091.50	1426.05	-0.40	-0.76	0.00	5519.00
SQURPHARMA	128.76	118.40	34.34	2.46	1.75	86.00	253.40
SQUARETEXT	497.10	523.00	292.16	-0.69	-0.25	0.00	1103.00
CITYBANK	607.51	581.30	548.03	-1.55	0.34	0.00	1674.30
SUMITPOWER	1335.06	1116.00	1363.23	0.66	1.08	32.70	5831.00
UTTARABANK	808.16	675.00	866.75	2.21	1.69	72.00	3944.30
UTTARAFIN	1335.06	1116.00	1363.23	0.66	1.08	32.70	5831.00

The above table shows the descriptive statistics of returns on 30 stocks. Skewness shows very few stocks have symmetrical returns while most of the stocks have asymmetrical returns and it is also evident in kurtosis. However, we can conclude from this analysis that stock market is truly volatile and stock returns are not good indicator as useful tool for forecasting.

Now, first step is to estimate beta coefficient for each stock using their monthly returns. The beta is estimated by regressing each stock's monthly return against market return (collected from stockbangladesh.com). Total 30 company's stocks are divided into 6 portfolio consisting with 5 each. Using the above mentioned equation, the returns of different portfolios have been calculated. Based on the generated betas, we estimated future stock prices of all portfolios. We also have tested normality of data by using ADF unit root test. Finally we examined whether the actual returns and expected returns are valued in relation to the systematic risk and found the following results for each portfolios;

Table: 2

Portfolio 1					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.012353	6.297899	6.234916	-0.06298	Under
2009	1.076189	6.693074	6.31291	-0.38016	Under
2010	1.019672	6.343975	6.244303	-0.09967	Under
2011	0.689956	4.290933	5.841422	1.550489	Over
2012	0.830168	5.164202	6.012773	0.848571	Over

Table: 3

Portfolio 2					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.028067	6.39521	6.25437	-0.14084	Under
2009	1.033361	6.429098	6.260984	-0.16811	Under
2010	1.00959	6.18123	6.212377	0.031148	Over
2011	0.6816	5.819422	6.141378	0.321956	Over
2012	0.839565	5.970696	6.170913	0.200217	Over

Table: 4

Portfolio 3					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.02105	6.152605	6.206975	0.05437	Over
2009	1.076598	6.448525	6.264877	-0.18365	Under
2010	1.001598	6.25209	6.226557	-0.02553	Under
2011	0.652711	5.125022	6.005378	0.880356	Over
2012	0.869505	4.512568	5.884865	1.372297	Over

Table: 5

Portfolio 4					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.020798	6.242941	6.224496	-0.01845	Under
2009	1.07541	6.528033	6.280492	-0.24754	Under
2010	0.998443	6.220656	6.220451	-0.0002	Under
2011	0.643822	5.688844	6.115867	0.427022	Over
2012	0.877383	5.731916	6.124065	0.39215	Over

Table: 6

Portfolio 5					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.02437	6.098824	0.980378	-5.11845	Under
2009	1.073484	6.462172	1.038975	-5.4232	Under
2010	0.988648	6.071885	0.976189	-5.0957	Under
2011	0.6292	5.666222	0.9108	-4.75542	Under
2012	0.897707	5.629024	0.904829	-4.7242	Under

Table: 7

Portfolio 6					
Year	Beta	Actual Return	Expected Return (CAPM)	Difference	Over/Under Valued
2008	1.025294	6.186597	6.213697	0.027101	Over
2009	1.06582	6.402787	6.255697	-0.14709	Under
2010	0.984631	6.04959	6.186189	0.136598	Over
2011	0.581333	5.710356	6.120311	0.409956	Over
2012	0.957347	6.108622	6.197857	0.089235	Over

From the above results it is very evident that the differences between expectations and the reality are very high. At all types of portfolios, the applicability of CAPM is absent. Out of 6 portfolios in 5 years, total 14 packages are overvalued and 16 are undervalued. The beta values are also ranging from extreme to normal. However, CAPM gives different results in most of the cases. Results of this research support many literatures conducted in the earlier section. Therefore, we conclude that CAPM has no applicability in the Chittagong Stock Exchange and the null hypothesis may be rejected. The results generated by using CAPM model may mislead the investors in pricing the underlying securities in CSE.

.....it is found that the difference between expectation and actual return is very significant at normal risk level. So, any result may mislead the investors to forecast future movement of stocks. The intensity of differences implies that CAPM has no applicability in CSE.

Conclusion:

The purpose of this research is to test the applicability of CAPM in Chittagong Stock Exchange. Closing returns of top 30 companies for 5 years have been considered and it is found that the difference between expectation and actual return is very significant at normal risk level. So, any result may mislead the investors to forecast future movement of stocks. The intensity of differences implies that CAPM has no applicability in CSE.

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