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An Empirical Testing of Capital Asset Pricing Model in Bangladesh

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Abstract: Capital Asset Pricing Model (CAPM) provides an equilibrium linear relationship between expected return and risk of an asset. The purpose of this study is to investigate the risk-return relationship within the CAPM framework. The study also aims at exploring whether CAPM is a good indicator of asset pricing in Bangladesh. For this the period 1999-2003 have been considered. Fama-French (1992) methodology on five variables-Stock market return, Beta, Book to market value, Size (Market capitalization) and Size 1 (Sales) are used to test this model. In this study the findings on the CAPM we have shown that the variables we have taken have significant relationship with stock return is still too alive on this ground.

Key words: Capital Asset Pricing Model, Risk-return, Beta, Book to market value

INTRODUCTION

Under certainty the saving can be invested in one kind asset for certain but in case of uncertainty, which appears to be unavoidable in the real world, anyone must have to undertake the liability of risk due to uncertain future earnings on assets or securities. The potential investors, individual or corporation are faced with a capital market of considerable sophistication offering a wide range of investment opportunities.

The Capital Asset Pricing Models (CAPM) describe an equilibrium relationship between expected return and risk in the securities market under the assumption that uncertain future returns of securities can be described in terms of moments of their probability distributions. The most common version is the mean-variance CAPM in which two moments are assumed to be relevant. The relationship between expected return and risk is the central theme of the asset pricing theory. It is with the problems surrounding choice under uncertainty that Markowitz[1] and Tobin[2] first concerned themselves. The origin of the asset pricing theory lies with Tobin[2] who was a pioneer in demonstrating formally that diversification of security holdings reduces the risk, unless the returns to the securities are perfectly correlated. He theorized that investors could diversify away all sorts of risks except the risk that comes with holding stocks in general. The CAPM model usually attributed to 1990 Nobel Laureate[3], was also developed by many researchers[4-6]. In general the CAPM provides an equilibrium linear relationship between expected return and risk associated with an asset. The average return anomalies of the CAPM suggest that, if asset pricing is rational, a multifactor version of international CAPM[7] or Arbitrage Pricing Theory (APT) can provide a better description of average returns[8]. Fama *et al*.[9] was the first reported study in America of the linear relation as predicted by the CAPM. They reported statistics for the slope coefficients as being between 0.7 and 1.73 for the years 1946-55 and 1956-68, respectively. Ball *et al*.[10] reported evidence of a robust positive linear relationship between risk and returns in Australia. Ariff and Johnson[11] found a strong linear relationship in the Singapore share market, thus suggestions that portfolio risk and returns are positive and linear. Their reported coefficient of variation was high as 70% especially over long period tests of 18 years, but both the slope coefficient and the coefficient of variation in tests done in short periods were insignificant. Fama *et al*.[12] identify two useful variables for forecasting expected asset returns: the default and term spread, which depend upon the monetary environment founded by Michael[13]. He shows that the CAPM model is a good description of returns on portfolio formed on size and book to market equity. Fama *et al*.[14] reported that the relationship between beta and average returns disappeared during the 1963-1990 period. They found that there is a simple positive relationship between average return and beta during the pre-1969 period; no significant relationship was found for 1963-1990 period. Fama *et al*.[15] used the model also to explain industry returns. Gupta and Sanjay[16] reported the relationship disappeared between expected return and risk of an asset during the 1979-1989 period. He observed that CAPM model is a good indicator of asset

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pricing expect-during recession. However, he found that CAPM does not show a linear (non-linear) risk-return relationship, perhaps due to volatility and comparatively more regulated Indian Capital markets. Rahman and Baten[17] found that CAPM model show the negative correlation between the beta and the stock return.

The capital asset pricing model in its various forms has been extensively tested for the developed capital markets such as those of USA, Europe and Australia and to a lesser extent for the developing capital markets. It is needless to say that there has been very little tests of this model in the Bangladesh environment despite the existence of an organized capital market for a long period. Moreover, the applicability of the western theories to Bangladesh capital markets is suspecious owing to several differences between the developed capital markets and the developing ones. There are economic and institutional differences, size related variations, liquidity conditions, disclosure requirements, integration of the financial system etc. Thus, the motivation for the study is to generate comparative test results within the CAPM framework for a developing capital market such as Bangladesh.

This study aims at testing the applicability of the model to describe risk-return relationship on the Bangladesh capital market. This study explores whether the CAPM is a suitable description of asset pricing in Bangladesh context.

Data description: This survey was conducted to investigate the Fama-French's CAPM in developing countries especially in Bangladesh based on the sources of information from Dhaka Stock Exchange (DSE) emphasizing only on non financial sector. The data range is from 1999 to 2003. We incorporate non-financial sectors for analyzing the applicability of Fama-French's CAPM in DSE and judge the multifactor variable effect on DSE.

Sample size: The final sample consists of 123 Dhaka Stock Exchange listed non-financial companies.

Sample period: Five years period (1999-2003) is considered for this study. There were 93 companies listed in the DSE in 1988 but that increased to 105 in 1989, to 116 in 1990, to 209 in 1997 and to 248 in 2003. So, it is observable that the listed companies of the DSE are increasing every year because of new listed companies. This study considered all the DSE listed non-financial companies for the 5 years period 1993-1997 as the sample, i.e., it conducts panel study, however, as the sample size is not same for every year but rather the sample size increases every year. This study conducts five yearly average cross-section models and pooled models (time-series and cross-section together). So, there is no problem to conduct pooled regression analysis would be ((Sample size*Number of years) Missing cases) because of the unbalanced panel data.

Empirical part: Testing Fama-French's Capital Asset Pricing Model on the DSE data: The Dhaka Stock Exchange listed all non-financial sector companies over period of 1999-2003 are primarily considered the sample of this empirical phase. However, as we have already been mentioned earlier, a few number of companies are excluded from the sample because either all of the company or market data of those companies are unavailable. So, the sample size became smaller than the actual companies listed in the DSE. Therefore, the final sample consists of 123 DSE listed non-financial sector companies for this research. All the companies data are collected from the annual reports of the listed non-financial sector companies of the period of 1999-2003. The market data (1999-2003) are collected from the DSE price database. However, the macro-economic data are collected from the published reports of National Board of Revenue of Bangladesh.

Brief description of the variables:

Name of the variables	Proxies	Calculations
Stock market return	Natural log of stock return	LN (I_i-I_i/I_{t-1})
Beta	Scholes and William's[18] and Dimson's[19] beta factor	Using regression model
Book to market	Book value/Market value	Book value/Market value
Size	Market capitalization and sales	LN(market capitalization and sales)

Justification of choosing the analysis technique in empirical phase: This phase considered multiple regression analysis approach to identify the determinants of Capital Asset Pricing Model in an emerging market. This method best suits this study because we took the CAPM theories, which comprises of beta of the stock and we take this on the day. The day before and the next day are considering for computing marketing beta. Not only that we also consider book to market value and size both in the market capitalization and sales aspect.

As this study considers the CAPM theories to identify the determinants of stock return, this is completely new in this area, which adds new value to the research and also attempts to minimize the gap between theoretical studies and empirical studies. However, this study brings the dividend theories into the empirical investigation, which will obviously help to minimize the gap between theoretical and empirical study.

As previous researchers suggest that averaging works very well with the unbalanced panel data, which motivates to conduct five yearly average cross-section and pooled multiple regression analysis for this study. However, multiple regression analysis is more suitable to deal with the research problem and data set for the current research.

To have a better understanding about the CAPM and after an intensive review of the previous empirical studies on the CAPM, we found interesting to conduct a study on the Fama-French's CAPM. However, as we know that a number of studies conducted on the CAPM but a very few are in the developing markets and virtually no study on the DSE, therefore, this is indeed right attempt to conduct such a study on the DSE data.

Model specification and testable hypotheses: Fama and French introduced three factors CAPM model. Their model assumes that the expected return of a portfolio in excess of the risk-free rate $[E(R_m)-R_f]$ explained by the sensitivity of its return to three factors:

(i) The excess return on a broad market portfolio (R_m-R_f)
(ii) The difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, small minus big) and
(iii) The difference between the return on a portfolio of high-book-to market stocks and the return on a portfolio of low-book to market stocks (HML, high minus low). Specifically, the expected excess return on portfolio i is:
$R_i-R_f = \alpha-b_i\,[(R_m)-R_f]+s_i\,(SMB)+h_i\,(HML)+\varepsilon_i$

Where, $[E(R_m)-R_f]$, E(SMB) and E(HML) are expected premiums and the factor sensitivities or loadings, b_i, s_i, h_i are slopes in the time series regression.

One thing that is interesting is that Fama-French still see high returns as a reward for taking on high risk; in particular that means if returns increase with book/price, then stocks with a high book/price ratio must be more risky than average-exactly the opposite of what a traditional business analysis would tell that the difference comes from whether one believe in the efficient market theory. The business analyst doesn't believe it, so they would say high book/price indicates a buying opportunity; the stock looks cheap. But if we do believe in EMT then we believe cheap stocks can only be cheap for a good reason, namely that investors think they're risky! So, we are interested to see whether Fama-French's variables are valid for the Bangladesh market or not. The proposed Fama-French's model considers[18] beta factor, book or market value and size (market capitalization and sales) for the Bangladeshi market.

The proposed model is:

$$R_i-R_f = \alpha-b_i\,[(R_m)-R_f]+s_i\,(Size)+h_i\,(BM)+\varepsilon_i$$

Where, it is same as before the factor sensitivities or loadings, b_i, s_i, h_i are the slopes in the time series regression.

In this regard we take the natural log of daily return with the consideration of lag and lead. In case of beta we take the daily beta of the stock. In this regard the form is like this:

$$R_i = \alpha_i + \beta_1 R_{m(t-1)} + \beta_2 R_{mt} + \beta_3 R_{m(t+1)}$$

Where, α is intercept and β_1 is the coefficients of the day before (t-1) the stock return and β_2(t) is the coefficients of the current day the stock return and β_3 is the coefficients of the day after (t+1) the stock return. Through regression we get the â of the stock. Again we take daily market value and in terms of size we take the natural log of both the market capitalization and sales. In this regard we take both the cross sectional and regression analysis to the data set 1993-1997.

In equilibrium, the CAPM specifies expected returns as a linear function of risk in the form:

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

Where:

- i indicates any asset that is expected to produce a cash flow,
- m: indicates the market for a set of similar assets traded in an asset market,
- f: the yield on a default-free asset with identical interval of time as the asset and
- R: represents the returns over intervals of time.

Equation 1 is in terms of expected returns. But implications must be tested with data on period-by-period security or portfolio returns.

Given the stochastic generalization of (1) the present study attempts to test the following hypothesis:

a) A positive relation between expected return E(R) and the systematic risk β_i is hypothesized, i.e., the slope of the CAPM equation (1) is positive.
b) The slope is equal to the difference between the expected return on the portfolio and the risk-free rate.
c) The expected return on any β=0 asset is the risk-free return R_f i.e. the intercept of CAPM Eq. 1 is R_f.
d) The relationship between expected return and risk (β_i) is linear.

e) Only β_i is important in differentiating among security returns, i.e., there are no terms other than the risk-free-rate and the premium for β_i that determine expected returns. In other words, the market will not price the residual risk of any stock.

Empirical findings: We analyze through 5 yearly average cross sectional analysis and pooled multiple regression analysis for this study. There are two types of Ordinary Least Squares (OLS) regression run to applicability of three factor Fama-French[20] model and the justification of CAPM in DSE as a representative of emerging markets in developing countries: one, five yearly (1999-2003) average cross section regression model and two, pooled regression model. 4 years (5-1) dummies are considered for 5 years (1999-2003). In average cross sectional analysis we interchange the proxy variables sales and market capitalization. In poolled regression we take the impulse as dummy 1999 year as 1 (one) and other 2003-year as (0) zero. In all aspect the years are significant which indicates the impact of time on the model as well as the size (both the market capitalization and sales). As time have the impact on the model, so incorporation of year dummy has rather improve the overall significance of the regression model.

From the cross section and regression analysis we get the different focus. In first case (Table 1) the stock return is taken as dependent variable and the independent variables are size (market capitalization) market beta and book to market value. The CAPM relates the sensitivity of an individual company's stock returns to the returns of the market as a whole. Estimating a model for a particular firm requires data on the market rate of return, the risk-free rate of return (usually a short-term treasury bill) and stock returns from the non-financial institutions. The data for this example consist of daily observations from January 1999 through December 2003 on the market return, the risk-free rate. Risk premium is the excess return of a security over the risk-free rate or, rather, the extra return that investors require for bearing risk. The R^2 value of 0.02039 means that about 2% of the variation in the stock return can be explained by the independent variables of the market. The correlation among the dependent and independent variables is 0.14278, which shows the interdependency among the variables.

The F_{score} for cross sectional analysis and significant at 2% level and the beta is significant at 1% level other variables BM and Size (market capitalization) are not significant to explain the dependent variable. So we can say that beta have the relationship with the stock return.

In Table 2, again when stock return is taken as dependent variable and the independent variables are Size (sales) market beta and stock to market value. The R^2 value of 0.03396 means that about 3% of the variation in the stock return can be explained by the independent variables of the market.

Table 1: Five yearly average cross sectional analysis: (Size, Beta, BM) variables in the equation (General value)

Variable	B	SE(Standard Error Beta) B	Beta	T	Sig T
Beta	-0.000858	0.00029724	-0.142996	-2.887	0.0041
BM	-0.0000665	0.00013026	-0.02573	-0.511	0.6097
Size	0.00001159	0.000082879	0.071537	1.399	0.1626
(Constant)	0.0004987	0.00046666	0	1.069	0.2858
Multiple R	0.14278	R^2	0.02039	Adjusted R Square	0.01368
F-statistic	3.03836	Signif F	0.0289		

Table 2: Five yearly average cross sectional analysis: (Size 1, Beta, BM) variables in the equation (General value)

Variable	B	SE(Standard Error Beta) B	Beta	T	Sig T
Beta	-0.0008821	0.00029161	-0.152316	-3.025	0.0026
BM	-0.00007058	0.00012269	-0.028433	-0.575	0.5654
Size 1	0.00074918	0.00025915	0.143261	2.891	0.004
(Constant)	-0.0004829	0.00062148	0	1.043	0.2975
Multiple R	0.18428	R^2	0.03396	Adjusted R Square	0.02699
F-statistic	4.87446	Signif F	0.0024		

Table 3: Pooled regression analysis: (Size, 1999 impulse dummy) variables in the equation (General value)

Variable	B	SE(Standard Error Beta) B	Beta	T	Sig T
Beta	4	-0.683	0.4951		
BM	5.07338E-06	0.00010104	0.001962	0.05	0.96
Size	0.000119022	0.000062629	0.07345	1.9	0.058
Dum 94	0.002432	0.000044815	0.266548	5.428	0
Dum 95	-0.00017910	0.00045652	-0.020945	-0.392	0.695
Dum 96	0.002879	0.00044035	0.354637	6.538	0
Dum 97	0.003234	0.0004431	-0.403555	-7.299	0
(Constant)	-0.00026976	0.00045409	0	-0.594	0.5528
Multiple R	0.68384	R^2	0.46763	Adjusted R Square	0.45905
F-statistic	58.0273	Signif F	0.0000		

Table 4: Pooled Regression Analysis: (Size, 1997 impulse dummy) variables in the equation (General value)

Variable	B	SE(Standard Error Beta) B	Beta	T	Sig T
Beta	-0.00016	0.00023697	-0.026964	-0.683	0.4951
BM	5.07338E-06	0.00010104	0.001962	0.05	0.96
Size	0.000119022	0.000062629	0.07345	1.9	0.058
Dum 93	0.003234	0.0004431	0.330486	7.299	0
Dum 94	0.005666	0.0003871	0.620925	14.638	0
Dum 95	0.03055	0.0003641	0.357245	8.39	0
Dum 96	0.006113	0.0003564	0.753013	17.152	0
(Constant)	-0.0035	0.00042836	-	-0.179	0
Multiple R	0.68384	R^2	0.46763	Adjusted R Square	0.45905
F-statistic	54.46134	Signif F	0.0000		

Table 5: Pooled regression analysis: (Size 1, 2003 impulse dummy) variables in the equation (General value)

Variable	B	SE(Standard Error Beta) B	Beta	T	Sig T
Beta	-0.00014	0.00023036	-0.024634	-0.619	0.536
BM	5.61E-06	0.000094626	0.002259	0.059	0.9528
Size 1	0.00061	0.00018867	0.116724	3.235	0.0013
Dum 93	0.002983	0.00043249	0.313761	6.897	0
Dum 94	0.005497	0.00037319	0.620938	14.729	0
Dum 95	0.002862	0.0003537	0.340956	8.092	0
Dum 96	0.006149	0.00035124	0.762851	17.508	0
(Constant)	-0.0425	0.00049851	0	-8.515	0
Multiple R	0.70459	R^2	0.49645	Adjusted R Square	0.48789
F-statistic	58.0273	Signif F	0.0000		

The F_{score} for cross sectional analysis and the beta and Size 1 (sales) is significant at 1% level and variables BM is not significant to explain the dependent variable. So we can say that beta and Size 1 (sales) have the relationship with the stock return.

The multiple R is 0.68383 and R square is 0.46763. Here we highly impact of year over the independent variables. The R^2 value of 0.46763 means that about 47% of the variation in the stock return can be explained by the independent variables of the market. Here we see the impact of year (Table 3).

The overall F_{score}=3.038 and 58.0273 for cross-sectional and pooled regression models respectively with the consideration of Size (market capitalization) and year 2000, 2002, 2003 are significant at 1% level but the other variables BM and the year 2001 are not significant.

The multiple R is 0.68383 and R square is 0.46763. Here we found the significant impact of year over the independent variables. The R^2 value of 0.46763 means that about 47% of the variation in the stock return can be explained by the independent variables of the market. Here we see the impact of year (Table 4).

The overall F_{score}=54.46134 for pooled regression analysis and the Size (market capitalization) is significant at 5% level and the variable beta and BM is not significant to explain the dependent variable. So we can say that Size (market capitalization) have the relationship with the stock return. In pooled regression models respectively with the consideration of Size as Market capitalization and taken year 2003 as impulse dummy. Here we see that Size (market capitalization) and year 1999, 2000, 2001, 2002 are significant at 1% level but the other variables BM and the year 1995 are not significant.

The multiple R is 0.70459 and R square is 0.49645. Here we highly impact of year over the independent variables (Table 5). The R^2 value of 0.49645 means that about 50% of the variation in the stock return can be explained by the independent variables of the market. Here we see the impact of year.

The overall F_{score}=58.0273 for pooled regression analysis and the Size 1 (Sales) is significant at 5% level and the variable beta and BM is not significant to explain the dependent variable. So we can say that Size 1 (Sales) have the relationship with the stock return. In pooled regression models respectively with the consideration of Size 1 as Sales and taken year 2003 as impulse dummy. Here we see that Size 1 (Sales) and year 1999, 2000, 2001, 2002 are significant at 1% level but the other variables BM and beta are not significant.

CONCLUSIONS

Fama and French's three-factor model of CAPM defines the significance of the other variables in the market. And to walk in that way, we design our CAPM model with the consideration of beta, book to market value and size (Market capitalization and sales).

The results of the empirical investigation strongly support the relationship among the variables to determine the stock return also evidenced that beta is not only the factor to determine the stock return but the other variables as taken also significantly important. In this research we found the impact of time and as we see that time variability causes the stock return to vary and all variables become significant with the time factor. So the variables beta, book to market value and Size but the time impact also has significant importance. In our findings on the CAPM we have shown that the variables we have taken have significant relationship with stock return is still too alive on this ground. Here we also found the impact of time and the year impact create importance in Bangladesh market, which is the newly issue for CAPM model.

REFERENCES

1. Markowitz, H., 1952. Portfolio selection. J. Finance, 7: 77-91.
2. Tobin, J., 1958. Liquidity preference as behavior towards risk. The Review of Economic Studies, 67: 65-86.
3. Sharpe, W.F., 1964. Capital asset prices: A theory of market equilibrium under conditions of risk. J. Finance, 19: 425-442.
4. Fischer, B., 1972. Capital market equilibrium with restricted borrowing. J. Business, 45: 444-455.
5. Lintner, J., 1965. The valuation of risky assets and the selection of risky investments in stock portfolios and capital budgets. Review of Economics and Statistics, 47: 13-37.
6. Mossin, J., 1966. Equilibrium in a capital asset market. Econometica, 34: 768-783.
7. Merton, R.C., 1973. An international capital asset pricing model. Econometrica, 41: 867-887.
8. Ross, S.A., 1976. The arbitrage pricing theory of capital asset pricing. J. Econ. Theory, 13: 341-360.
9. Fama, E.F. and J. McBeth, 1973. Risk, return and equilibrium: Empirical tests. J. Political Econ., 71: 607-636.
10. Ball, R., P. Brown and R.R. Officer, 1976. Asset pricing in the Australian industrial equity market. Australian J. Manage., 1: 1-32.
11. Ariff, M. and L.W. Johnson, 1990. Ex Ante Risk Premia on Macroeconomic Factors in the Pricing of Stocks: An Analysis Using Arbitrage Pricing Theory, Chapter 18 in Ariff, M. and L.W. Johnson. Securities Markets and Stock Pricing, Longman, Singapore, pp: 194-204.
12. Fama, E.F. and K.R. French, 1989. Business conditions and expected returns on stocks and bonds. J. Financial Econ., 25: 23-48.
13. Michael, C.J., 1993. The modern industrial revolution, exit and the failure of internal control systems. The Journal of Finance. Reprinted in the Journal of Applied Corporate Finance, (Winter 1994) 6(4) and in Finanzmarkt und Portfolio Management, (January 1993), 7(3). Reprinted in Theory of the Firm: Governance, Residual Claims and Organizational Forms, (Harvard University Press, 2000).
14. Fama, E.F. and K.R. French, 1992. The cross-section of expected stock returns. J. Finance, 47: 427-465.
15. Fama, E.F. and K.R. French, 1994. Industry Costs of Equity, Working paper, Graduate School of Business, University of Chicago, Chicago, IL. Revised July 1995.
16. Gupta, O.P. and S. Sanjay, 1993. An empirical testing of capital asset pricing model in India. Finance India, 4: 863-874.
17. Rahman, M. M. and M.A. Baten, 2005. Fama-French's CAPM: An Empirical Investigation on DSE. J. Applied Sci., (Accepted).
18. Scholes, M.S. and J. William, 1977. Estimating beta from non-synchronous data. J. Financial Econ., 5: 309-327.
19. Dimsons, E., 1979. Risk measurement when shares are subjected to infrequent trading. J. Financial Econom., 7: 187-226.
20. Fama, E.F. and K.R. French, 1993. Common risk factors in the returns on stocks and bonds. J. Financial Econ., 33: 3-56.