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Fama-French's CAPM: An Empirical Investigation on DSE

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Abstract: In this study an attempt has been made to investigate and done an empirical study where the CAPM is still alive in DSE with the consideration of two more variables. This study also attempts to take into account whether the Fama-French's CAPM model is applicable in Bangladesh DSE with the consideration not only the beta factor but also the factors such as book to market value and size (market capitalization and sales), involve to determine the stock return in an emerging market like Bangladesh and minimize the gap between theoretical and empirical studies.

INTRODUCTION

The origin of the asset pricing theory lies with Markowitz (1952) 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. Later, the implications of this theory have been investigated for the equilibrium structure of asset prices that have led to the development of a theory, popularly known as CAPM. The model usually attributed to 1990 Nobel Laureate Sharpe (1964), was also developed by other researchers (Fischer, 1972; Lintner, 1965; Mossin, 1966). This model has a tremendous impact on modern finance theory and practice.

The average return anomalies of the CAPM suggest that, if asset pricing is rational, a multifactor version of (Merton, 1973) international CAPM or Ross (1976) Arbitrage Pricing Theory (APT) can provide a better description of average returns. Fama *et al.* (1989) identified two useful variables for forecasting expected asset returns: the default and term spread, which depend upon the monetary environment founded by Michael (1993) who showed that the CAPM model is a good description of returns on portfolio formed on size and book to market equity. Fama *et al.* (1994) used the model also to explain industry returns.

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 have been little tests of this model in the Bangladesh environment despite the existence of an organized capital market. Moreover, the applicability of the western theories to Bangladesh capital markets is suspect 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 with in the CAPM framework for a developing capital market such as Bangladesh.

This study basically supports the Fama and French's three-factor model and reveals the factors affecting the stock return in Bangladesh stock market. 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 studies and empirical study. To have a better understanding about the CAPM and after an intensive review of the previous

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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.

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 and to 209 in 1997 and to 248 in 2003. So, it is observable that the listed companies of the DSE are increasing very 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.

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 numbers of companies are excluded from the sample because either all have 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 company 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

Brief description of the variables

Name of the variables	Proxies	Calculations
Stock Market Return	Natural Log of Stock Return	$LN(I_t-I_t/I_{t-1})$
Beta	Scholes and William's (1977) and Dimson's (1979) 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)

collected from the published from the published reports of National Board of Revenue of Bangladesh.

MODEL SPECIFICATION AND ASSUMPTIONS

Fema 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:

- The excess return on a broad market portfolio (R_m-R_f)
- The difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks (SMB, Small minus big)
- 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 is,

$$R_i-R_f = \alpha+b_i[(R_m)-R_f]+s_i(SMB)+h_i(HML)+\epsilon_i$$

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's 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 (Scholes and William, 1977) 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.

EMPIRICAL FINDINGS

The average stock return in the DSE over the period of 1999-2003 is close to zero. While the book to market value is quite acceptable for the DSE as an emerging market although the book value is lower than the market value due to inefficiency of the market where the developed markets responding to the market in terms of the stock price.

For analyzing the data used for this study of the DSE in considering the stock return, market beta, book to market value and size (sales and market capitalization) we can have quick look at these variables below:

Natural log of stock return: The mean and the standard deviation of the natural log of stock return are zero means from year 1999-2003 the DSE market has not that much deviation. And the maximum and minimum value is (0.01) to 0.04, which indicates the less deviation in market return (Table 1).

Beta: Mean beta is 0.59, which indicates the moderate risk and means the stock market is assigned a beta of 0.59 by comparison, a portfolio which has a beta of 0.59 will tend to participate in broad market moves, but only 0.59 times as much as the market overall. So from year 1999-2003 the DSE stock market has not that much market risk (Table 1). The standard deviation of beta is also 0.59, which supports the issue of less fluctuation of market risk. From the aspect of range the highest value of beta is 3.25, implies some companies move more than the average and severely affected by the market movement. Whereas the minimum beta value is (1.63), implies some companies move less than the average and totally out weigh the market movement.

Book to market value: Mean Book to Market value is 1.14 which implies the average book value of the stock is higher than the market value of the stock and the market is not performing well because the share holders not attained the capital gain from the market and the book value is higher by 14%. And the Standard deviation is not much oppressive in the aspect of beta and stock return movement (Table 1). From the aspect of range the highest value of BV/MV is 9.04, implies some companies are in worse situation and market is not responding well as it is required to reflect the effect on market price due to inefficiency of the DSE market and the price movement is less than the average market price. Whereas the minimum BV/MV is (2.74), implies some companies move more than the average market price or the book value drastically fall due to overburdening of debt or consecutive loss for the years and due to inefficiency the price is not decreasing, as much that is required to respond the market.

Sales: The mean value of size is 2.20 and the standard deviation is 0.64, which again shows the less fluctuation in sales. From the aspect of range the highest value of sales is 4.20, implies some companies have gained from the market due to increase in demand of the product but there is very little effect on the market price due to higher book price than the market price (Table 1). Whereas the minimum size (sales) is 0.01, implies some companies have less demand of their product than the average market demand.

Market capitalization: The average is 4.32, which shows the market potential from the aspect of price increase and the standard deviation is 2.10, which support the increase in volatility regarding price movement. From the aspect of range the highest value of market capitalization is 9.37, implies some companies have gained from the market due to increase in price and the price movement is more than the average market price (Table 1). Whereas the minimum BV/MV is negative (2.95), implies some companies move less than the average market price and the price are falling down. Here we see discrepancy about the market price. In one aspect the book to market value is high, means that the market price is lower than book price. Again the market capitalization is high, means that the average market price is higher than the book price of the stock.

Table 1: Descriptive statistics

| Variables | Number of valid observations (List wise) = 419 | | | | |
	Mean	Std dev	Minimum	Maximum	Valid N label
LNSHRT (Natural log of stock return)	0.00	0.00	(0.01)	0.04	482
Beta	0.59	0.59	(1.63)	3.25	474
BM (Book to market value)	1.14	1.35	(2.74)	9.04	452
Size 1 (Sales)	2.20	0.64	0.01	4.20	454
Size (Market capitalization)	4.32	2.10	(2.95)	9.37	481

Table 2: Correlation coefficients

Variables		LNSHRT	Beta	BM	Size	Size 1
LNSHRT	Coefficient	1.0000	-0.1145	-0.0533	0.0403	0.1058
	Cases	482.0000	474.0000	451.0000	481.0000	438.0000
	2-tailed significance (P)	0.0000	0.0130	0.2590	0.3780	0.0270
Beta	Coefficient	-0.1145	1.0000	-0.2076	0.2786	0.2159
	Cases	474.0000	474.0000	443.0000	473.0000	432.0000
	2-tailed significance (P)	0.0130	0.0000	0.0000	0.0000	0.0000
BM	Coefficient	-0.0533	-0.2076	1.0000	-0.3127	-0.1146
	Cases	451.0000	443.0000	452.0000	450.0000	426.0000
	2-tailed significance (P)	0.2590	0.0000	0.0000	0.0000	0.0180
Size	Coefficient	0.0403	0.2786	-0.3127	1.0000	0.5281
	Cases	481.0000	473.0000	450.0000	481.0000	437.0000
	2-tailed significance (P)	0.3780	0.0000	0.0000	0.0000	0.0000
Size 1	Coefficient	0.1058	0.2159	-0.1146	0.5281	1.0000
	Cases	438.0000	432.0000	426.0000	437.0000	454.0000
	2-tailed significance (P)	0.0270	0.0000	0.0180	0.0000	0.0000

Correlation coefficient: Pearson's correlation matrix shows the expected relationship of all the independent variables with stock return expect beta, the market risk factors due to inefficiency of the market. However, the correlation matrix also shows the correlation between the independent variables are either low degree or moderate degree, which suggests the absence of multicollinearity between independent variables.

In correlation coefficient analysis we see (Table 2), this is abnormal behavior of DSE that there is negative correlation with the stock return and beta. But the rational behavior should be positive. So in this case the abnormality cases the CAPM not to be valid in the aspect due to inefficiency the DSE market, where CAPM depict the positive correlation between stock return and Beta. Stock return comes from the accumulation of two-aspect dividend and capital gain. Here we see the market value is less due to price so there is no capital gain. In one case there is zero increase in stock return and due to decrease in capital gain caused by decreased in price, the market value decrease caused by the same effect of decrease in price. Here the negative relation holds the normal phenomenon CAPM that if the stock return decrease, there should be a decrease in market value of Stock and should be the negative relation due to book value effect. Again there is an insignificant positive correlation between stock return and market capitalization. Market capitalization comes from the multiplication of stock price and outstanding number of shares. So there should be a positive correlation between stock return and market capitalization and our results shows the insignificant correlation between the stock return and market capitalization. From the aspect of stock return and Size (sales) there is a positive correlation between stock return and sales (Table 2). The sales is the sales revenue. So there should be a positive correlation between stock return and sales and our results shows the moderate correlation between stock return and market capitalization. Because increase in sales causes the increase the expectation of market return of the stock.

We analyze the relationship among the beta, book to market value and market size based on both the capitalization and sales. In the first occasion we see there is negative correlation (0.2076) between the beta and book to market value (Table 2). Here if we back to basic issue that increase in beta increase in return through increase in capital gain and that is conform with the market negative move and then reducing the risk from the aspect of investors. The normal scenario is higher the beta higher the stock return from the aspect of both the capital gain and dividend. So in this regard since the market value is lower then the book value so the investors not attain the capital gain through increase in price and in consequence the beta have the negative correlation. But here again the notion of CAPM that higher the risk higher the return is established. Again if we see the relation between beta and market capitalization we get the moderate positive relation 0.2786 between them. So increase in risk is compensated by the increase in capital gain, through increase in market price of the stock. Lastly we see the moderate positive correlation 0.2159 between stock return and market size based on sales. Increase in sales supported by the increase in return materialize the issue of CAPM higher the risk higher the return.

We analyze the relationship between the book to market value and market size based on both the market capitalization and sales. In first step, we see there is a negative correlation (0.3127) between the book market value and size based on market capitalization. But it should be positive relation because increase in book to market value decrease in market capitalization due to decrease in market price compare to book value of the stock. In second step, we see there is a negative correlation (0.1146) between the book to market value and size based on sales. But it should be negative relation because increase in book to market value means lower market price due to decrease in sales. So when sales increase the book to market value needs to decrease. This also supports the notion of CAPM.

Increase in sales increases the market price. We see the high positive correlation 0.5281 between these two variables (Sales and market capitalization) (Table 2).

CONCLUSIONS

Market inefficiency is the major drawbacks for developing countries like Bangladesh where the regulatory system and information transparency is not certainly proficient to get the confidence of the investors and provide the sufficient basis for analyzing the data without anomalies. As 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 many 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 analysis 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. The results of the empirical investigation strongly support the relationship among the variables to determine the stock return and evidenced that beta is not only the factor to determine the stock return but the other variables as taken also significantly important. The results show the negative correlation between the beta and the stock return, that is reason for inefficiency of the market where

the assumptions behind the CAPM model is not supported.

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