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Capital Asset Pricing Model (CAPM) Works in the Stock Market of Bangladesh: Empirical Evidence from Sector-Wise Index of Chittagong Stock Exchange (CSE)

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***Abstract* - The present study examines the Capital Asset Pricing Model (CAPM) in Chittagong Stock Exchange (CSE) with special orientation to 10 different sector indexes. They are such as Banking sector index, Energy sector index, Ceramic sector index, Food sector index, General Insurance sector index, Life Insurance sector index, Cement sector index, Leasing and Finance sector index, Textile sector index, ICT sector index of Chittagong Stock Exchange (CSE). Data were gathered from the Chittagong Stock Exchange (CSE) website (www.cse.combd) for the time frame of July 2016 to June 2019. From Bangladesh's central bank website (www.centralbank.combd), the risk-free return (Rf) has been gathered. The study uses year-end closing price and dividend for 92 listed companies. The expected return is measured through Capital Asset Pricing Model (CAPM), which is developed by William Sharpe (1964). For analysis the data, Mean, percentage, ANOVA, 't' test are used as statistical tools. Descriptive and Regression analysis have been done to find the results. The study is only confined to CSE. So, there is an avenue for further researchers to add Dhaka Stock Exchange (DSE) in their research project. This approach is applicable to both investors and issuers when exchanging shares of securities on the stock market. The study concludes that the CAPM is not applicable to the 10 distinct sector indices of the CSE because, at a typical level of risk, the gap between expected and actual returns is quite large. Hence, CAPM was tested separately for each year of the five years period and the results in the mentioned tables did not support the CAPM applicability.**
Keywords: **CAPM, Beta, Returns, Sector-Wise Indexes of CSE**

I. INTRODUCTION

Lack of knowledge among investors, failure to explain the connection between risk and return, price manipulation, and the ensuing bursting of price bubbles all contributed to the long-term loss of many investors as well as harm to the overall functioning of the capital market (Choudhary, 2018). The function of finders will thus be diminished.

The expected return of an asset is offered in a capital asset pricing model that takes into account the systemic risk of each asset and provides an estimate of that return. By using these models, it will be possible to create the best portfolio and manage resources while taking certain calculated risks.

The CAPM model is predicated on the idea that investors who understand portfolio theory would lower unsystematic risk through diversification. CAPM model is a response to how to quantify asset risk and how to establish a link between risk and the anticipated return of investors. Therefore, Brealey, (2012); Khan, (2012); Gitman, (2015); Jones, (2004) are the assumptions of the CAPM model. First, there is a risk-free asset where investors can borrow and lend an unlimited amount of money at a rate that is the same for all investors. Second, there are no taxes, fees associated with transactions, limitations on borrowing, selling, or other market restraints. The quality of all fixed assets is the third factor, and all assets are transferable and divisible. The study uses the CAPM formula.

Various reviews of literature supports the test of CAPM over the world such as Australian Stock Exchange (Galagendera, 2006), Latin American Stock Exchange (Grands, *et al.,* 2006), Sanghai Stock Exchange (Xu song and Cheng-qi, 2008), Indian Stock Exchange (Gunasekaran and Ramaswami, 2011), Taiwan Stock Exchange (Lin and Liang, 2011). However, validity of CAPM on stock market in Bangladesh is not significant still now. Because stock market in Bangladesh is developing stage now. For this reason, if we apply CAPM model (the western theories) in this market then we get a doubtful findings. Therefore, the validity of the CAPM model will be examined by the authors on the CSE.

II. CONCEPTUAL FRAMEWORK OF THE STUDY

The CAPM expands upon the portfolio theory model created by Markowitz (1952). He demonstrated how a portfolio has risk and expected return. While risk is more complicated, expected return is connected to the securities' expected return. Risk is a complicated concept that many find difficult to manage since it is tied to the risks of the individual components in the same way that correlations are related to hazards. Additionally, he recommended that "all the eggs should not be placed in the same basket."

The Capital Asset Pricing Model (CAPM) was created later by Sharpe (1964) and Lintner (1965). The CAPM splits the risk influencing an asset's anticipated return into two categories. The first kind is unsystematic risk or particular risk, and the long-term average returns for this type of typical risk should be zero. Another kind of risk is systematic risk, which CAPM claims is priced by rational investors since it cannot be avoided by diversification when an investor owns a market portfolio because each item in that portfolio carries a unique risk. This sort of risk is linked to general economic uncertainty. Beta may be used to calculate systematic risk. When determining an investment's appropriate pricing, the CAPM model is used to attempt to characterize the connection between an investment's risk and projected return. The anticipated return of a stock is calculated using the CAPM formula, which is the expected excess return of the market portfolio multiplied by the risk-free rate plus the portfolio's beta.

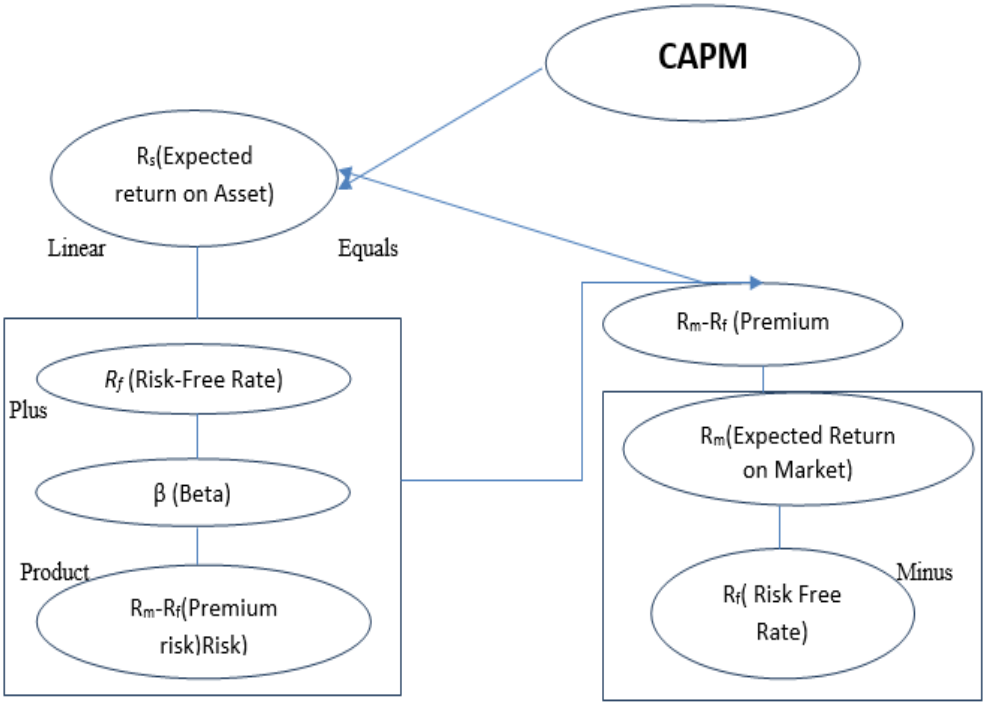

Fig. 1 Concept of CAPM

Economists have previously questioned and criticized the CAPM (Black, 1972). The version of the CAPM, which can adjust to trade off average return for market beta, had some success in the early empirical test. However, in the latter, research starts to unearth elements that contribute to the interpretation of average returns offered by beta, such as varied price ratios and size. There are numerous evident drawbacks of explaining the model, according to a significant number of recent empirical testing of the CAPM. Additionally, they contended that rather than a calculated beta, the stock returns are more logically correlated with the overall variability and book value of the stock.

III. REVIEW OF LITERATURE

Since its introduction by Sharpe (1965) and Lintner (1964), the Capital Asset Pricing Model (CAPM) has been one of the fundamental model that is widely utilized today. This model provides a positive linear relationship between a stock's predicted returns and risks, allowing investors and financial managers to effectively assess individual stocks and portfolios. For creating CAPM, William Sharpe received the Nobel Prize in 1990.

First to report significant empirical backing for CAPM's applicability in equities markets was Black, *et al.,* (1972). The equities included in their sample were all of those that changed hands on the NYSE during the years of 1931 and 1965. They created 10 portfolios rather than utilizing individual stocks to investigate the linear relationship between portfolio returns and betas, and they used monthly returns data to do so. By forming portfolios, risk that can be diversified is reduced, which enhances beta estimation, which is based only on non-diversifiable risk. As they noted a nearly linear relationship between returns and betas, their findings were in line with the theory of the CAPM. Fama and McBeth (1973) also attested to the existence of this connection. However, Sharpe-Lintner CAPM does not hold in the presence of an inefficient portfolio of proxy markets. The claim is that the proxy portfolio, which excludes some assets but includes all others.

Lakonishok and Shapiro, (1986) did a study and discovered that business size has no impact on UK securities returns and comes to the conclusion that only market risk (beta) can legitimately account for cross-sectional variance in security returns. Contrarily, Basu (1983) discovered that firms with

higher earning to price ratios with high E/P earn higher returns that are risk-adjusted than firms with lower earning to price ratios. The size effect also vanishes when the difference in risk and earning to price ratio is adjusted and controlled for the return of security.

Fama and French (2004) detailed the development of the capital asset pricing model since the 1970s. According to the available data, the risk measure (beta) of a stock is not related to cross-sectional volatility in its returns. The validity of CAPM was investigated by Yang, Xu, and Hellström (2006), for the Chinese stock market. In the years 2000 to 2005, they looked at 100 companies that were listed on the Shanghai Stock Exchange. However, they discovered that the intercepts were not equal to zero and that the risk-return relationship is still linear.

The association between the factors used to calculate stock return has significant support according to Rahman, *et al*. (2006). Additionally, it demonstrated that other factors that may be regarded as being considerably essential also played a role in determining the stock return in addition to beta. In this study, the impact of time was discovered, and it was discovered that temporal variability may affect stock return, making all other variables more important as a result. Therefore, the impact of time is just as essential as factors like beta, size, and book to market value.

Rahman, and Baten (2006) further illustrated their CAPM findings that the factors have a strong correlation with stock return and are still too relevant on this subject. In Bangladesh's market, which is a recent problem for the CAPM model, it is also discovered that the impact of time and the impact of the year create relevance.

Alan and Bojang (2009) examined the beta stability as a systematic beta index. 50 Malaysian companies' stocks were included in their investigation. The seven-year study spans from January 1994 to December 2001. Two models of the FAMMA and CAPM were found, according to the outcome. These models' outcomes, though, are remarkably dissimilar.

According to Li, (2013) the model is easy to use and frequently used in studies on the mechanism of equilibrium price as well as the correlation between the expected rate of return on assets and the risk associated with asset investments. For a number of anomalies in financial markets, the Capital Asset Pricing theory is not entirely relevant.

Al-Quisi, and Al-Batayneh, (2018) examined the type of relationship between stock beta and profit. The study illustrates how important it is to check the compatibility before using the capital asset pricing model. On the other hand, Anghel, and Paschia, (2013) investigated this model that was represented by the beta coefficient, which determined how sensitive a financial instrument was to systematic risk.

Higher risk (beta) is correlated with higher levels of return, according to Choudhary, and Bhatnagar (2018).The intercept should equal zero, according to the theory, and the slope should equal the excess returns on the market portfolio. The allure of CAPM is its effective, straightforward, and rational technique of predicting how to gauge risk and expected return. Bonds, shares, futures, and option prices can all be estimated with the use of this procedure.

IV. OBJECTIVES OF THE STUDY

The main objective of this study is to examine the applicability of Capital Asset Pricing Model (CAPM) in the Chittagong Stock Exchange (CSE) with reference to different types of sector wise indexes. To accomplish the main objective, the following specific objectives have been covered.

1. To investigate the CAPM's applicability to the index for the banking industry
2. To investigate the utility of CAPM in the energy sector index
3. To determine whether the ceramic sector index is a good candidate for the CAPM.
4. To investigate the applicability of CAPM in the food industry index.
5. to investigate the general insurance industry index and the CAPM's applicability.
6. to investigate whether CAPM may be used to the life insurance index.
7. To determine whether the CAPM is applicable to the index for the cement industry.
8. To assess the CAPM's applicability to the leasing and finance industry index
9. To assess the CAPM's applicability to the textile sector index.
10. To assess the CAPM's applicability to the ICT industry index.

V. RESEARCH METHOD AND MATERIALS

A. Population and Sample Design

All of the companies listed under the different types of CSE index are employed as the study's population in order to evaluate the applicability of CAPM in the CSE.

10 different sector wise indexes have been taken from the 18 sector wise indexes of CSE by using convenient sampling method. Total 92 listed companies are picked up from the all listed companies under 10 different sector wise indexes by using random sampling method. The sampling procedure under 10 different sector wise indexes is shown in the Table I.

TABLE I SCENARIO OF SAMPLE SIZE

Sl. No.	Name of Sector Wise Index	Sample Size	Population
1	Banking Sector	15	29
2	Ceramic Sector	5	5
3	Food Sector	10	12
4	Energy Sector	10	17
5	General Insurance Sector	10	30
6	Life Insurance Sector	10	12
7	Cement Sector	6	6
8	Leasing and Finance Sector	10	22
9	Textile Sector	10	13
10	ICT Sector	6	6
	Total	92	152

Source: www.cse.combd

B. Data Collection

Based on data from the Chittagong Stock Exchange (CSE), with a focus on listed companies, this survey is being done to look into the Capital Asset Pricing Model (CAPM) in developing nations, particularly Bangladesh. The data collected from Chittagong Stock Exchange (CSE) for the period of July 2016 to June 2019 (www.cse.combd). The study uses year-end closing price for total 92 companies. The market return is calculated by using year-end closing price and cash dividend (yearly).

The risk free return (Rf) was gathered from Bangladesh Bank's website (www.centralbank.combd). The CAPM formula has been used to determine the anticipated return of equities over a specified time period. The covariance approach is used to calculate stock beta, or market risk. Following the acquisition of the beta values, estimated prices for the same period were produced using the beta.

C. Data Process and Analysis

The Statistical Package for Social Science (SPSS, 21 versions) and Microsoft Excel (MS.2010) are used to process the obtained data. For analysis the data, Mean, percentage, ANOVA, 't' test are used as statistical tools. Descriptive and Regression analysis have been done to find the results.

D. Models Used in the Study

The study used CAPM Equation. The equation is such as $E(R_i) = R_f + \beta_i(R_m - R_f)$ Where, R_i = Return on Asset I,R_f= Risk free rate,R_m= Return on the market portfolio, β = Beta factor(market risk) and $\beta_i = \frac{\sigma_{im}}{\sigma^2{}_m}$;

Where, σ_{im} = Covariance between market and individual security,$\sigma^2{}_m$=Variance of market, $\sigma_{im} = \frac{1}{N-1}\sum_{t=1}^{N}(R_i - \overline{R_i})(R_m - \overline{R_m})$, $\sigma^2{}_m = \frac{1}{N-1}\sum_{t=1}^{N}(R_m - \overline{R_m})^2$.

VI. FINDINGS AND ANALYSIS

A. Descriptive Analysis

This study is based on the data of CSE under different 10 indexes from July 2016 to June 2019. The procedure of calculating expected, and actual return is already mentioned in the methodology section. Each stock's beta coefficient is calculated using its yearly returns and a regression equation. 92 companies are represented by 10 separate sector-based indexes.

The authors predicted future index security prices based on the calculated betas. Finally, it is demonstrated that market risk is taken into account when valuing the actual and predicted returns. The following results (Table II to Table XI) on each index are found.

TABLE II APPLICATION OF CAPM IN THE BANKING SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	0.73	43.01	42.96	0.05	Over	0.47
2017	0.95	58.61	53.08	5.53	Over	
2018	1.33	61.14	67.62	-6.48	Under	
2019	0.99	49	47.42	1.58	Over	

Source: Researchers' own calculation

TABLE III APPLICATION OF CAPM IN THE CERAMIC SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	1.66	51.65	44.83	6.82	Over	0.17
2017	1.45	54.28	36.78	17.5	Over	
2018	3.15	183.38	366.01	-182.63	Under	
2019	2.25	129.08	174.651	-45.571	Under	

Source: Researchers' own calculation

TABLE IV APPLICATION OF CAPM IN THE FOOD SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.4	363.04	350.12	12.92	Over	0.48
2017	2.91	407.46	438.59	-31.13	Under	
2018	3.47	465.47	451.07	14.4	Over	
2019	3.22	479.32	477.53	1.79	Over	

Source: Researchers' own calculation

TABLE V APPLICATION OF CAPM IN THE ENERGY SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.44	569.06	504.05	65.01	Over	0.18
2017	3.11	638.39	659.26	-20.87	Under	
2018	3.11	616.885	641.84	-24.955	Under	
2019	2.63	555.04	165.62	389.42	Over	

Source: Researchers' own calculation

TABLE VI APPLICATION OF CAPM IN THE GENERAL INSURANCE SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.07	26.54	29.61	-3.07	Under	0.23
2017	2.72	42.6	37.34	5.26	Over	
2018	2.06	31.97	31.97	0	Applied	
2019	4.09	57.77	53.49	4.28	Over	

Source: Researchers' own calculation

TABLE VII APPLICATION OF CAPM IN THE LIFE INSURANCE SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	4.40	251.45	369.4	-117.95	Under	0.06
2017	6.40	247.2	471.63	-224.43	Under	
2018	6.09	230.67	426.96	-196.29	Under	
2019	2.62	256.01	219	37.01	Over	

Source: Researchers' own calculation

TABLE VIII APPLICATION OF CAPM IN THE CEMENT SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.18	430.925	440.38	-9.45	Under	0.49
2017	3.33	446.9	459.72	-12.82	Under	
2018	3.60	369.55	385.28	-15.73	Under	
2019	2.85	294.65	255.34	39.30	Over	

Source: Researchers' own calculation

TABLE IX APPLICATION OF CAPM IN THE LEASING & FINANCE SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.81	73.25	79.55	-6.3	Under	0.32
2017	2.88	97.13	79.64	17.49	Over	
2018	3.13	87.54	89.38	-1.84	Under	
2019	2.98	82.2	81.03	1.17	Over	

Source: Researchers' own calculation

TABLE X APPLICATION OF CAPM IN THE TEXTILE SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	0.16	38.85	19.66	19.19	Over	0.09
2017	2.89	59.88	99.37	-39.49	Under	
2018	3.67	71.55	105.46	-33.91	Under	
2019	-2	-3	79.34	-82.34	Under	

Source: Researchers' own calculation

TABLE XI APPLICATION OF CAPM IN THE ICT SECTOR INDEX

Time	Beta	Actual Return	Anticipated Return	Difference	Over/Under Valued	Sig
2016	2.07	51.6	44.51	7.09	Over	0.36
2017	4.24	63.25	81.13	-17.88	Under	
2018	2.99	56.1	57.39	-1.29	Under	
2019	2.59	72.5	46.55	25.95	Over	

Source: Researchers' own calculation

From the above tables mentioned results, it is found that there is a difference between expected and actual securities returns. There are 10 different sector wise indexes in the year 2016 to 2019. In some years, securities are overvalued and other years, they are undervalued. Therefore, the application of CAPM is not present in all types of sector wise indexes. In the year 2016 to 2019, there are 40 packages in the 10differentsector wise indexes. Out of them, total 19 packages are overvalued and 20 are undervalued. Nevertheless, only 01 package (in 2018, General insurance sector index) in which CAPM is applicable. On the other hand, the one sample t test finds only two differences (in the life insurance and textile sectors) to be statistically significant (at the 10% level). Although CAPM produces different results from the majority of the aforementioned packages. Thus, it can be said that CAPM was examined separately for each year of the five-year period, and the findings in the aforementioned tables did not support the applicability of CAPM. These results supported those of Michailidis *et al*., (2006) to a certain extent.

B. Regression Analysis

For the multiple regression analysis, stock beta and excess market return are chosen as the independent variables, and the dependent variable is excess actual return. The results of the regression analysis are shown in the following tables (Table XII to Table XIV).

TABLE XII ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	338207.693	2	169103.846	55.719	.000[b]
	Residual	21244.764	7	3034.966		
	Total	359452.457	9			
a. Dependent Variable: excess actual return						
b. Predictors: (Constant), stock beta, excess market return						

Source: SPSS (21 version) output

TABLE XIII MODEL SUMMERY

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.970[a]	0.941	.924	55.09053	2.204
a. Predictors: (Constant), stock beta, excess market return					
b. Dependent Variable: excess actual return					

Source: SPSS (21 version) output

Here, the value of R Square = 0.970 and adjusted R Square = 0.941 (from Table XIII). It suggests that other independent variable is not necessary be added. For 2 and 7 degrees of freedom, the value of F = 55.719 (from Table XII) is significant at the 1% level. So, it can be said that this model is significant, and the application of CAPM is not valid in the CSE.

TABLE XIV COEFFICIENTS

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.115	48.466		.807	.446
	excess market return	1.142	.118	1.044	9.683	.000
	Stock beta	-29.491	19.852	-.160	-1.486	.181
a. Dependent Variable: excess actual return						

Source: SPSS (21 version) output

Here, excess market return of CSE (β_1) = 1.044. The statistical significance of the value of 't' statistics is 1%, or 't' = 9.683 with 9 degrees of freedom. Overall, it can be claimed that the CAPM does not apply to any index on the

Chittagong Stock Exchange (CSE), but Matteev (2004) observed that the CAPM is supported in the Bulgarian stock market.

VII. CONCLUSION

All over the world, all most investors measure the expected security return by using CAPM equation. Because the equation of CAPM is very accurate and is also free from mathematical complexities. For this reason, investors of CSE are interested in applying the CAPM model (Alam*, et al.*, 2015). To do this, the authors have tested CAPM model on 10 different sector wise indexes of CSE. Closing year end returns of 92 companies for 4 years have been analyzed. The authors found that there is a difference between anticipated and actual security returns at normal level of market risk and it is not significant statistically in most of the cases. Therefore, it can be said that CAPM does not work in CSE. The no applicability of CAPM is also supported in this study such as: Afolabi (2017), Gursoy and Rejepova (2007), Javid and Ahmed (2008), Fama and French (1992), Davis (1994), Miles and Temmermann (1996).Therefore, it can be recommended that any result on CAPM may be misguided the investors of CSE to forecast the further movements of securities. The study is only confined to CSE. So, there is an avenue for further researchers to add Dhaka Stock Exchange (DSE) in their research project.

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