



Risk-Return Trade-off in Emerging Markets: Evidence from Dhaka Stock Exchange Bangladesh

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Abstract

This paper attempts to measure the risk and return relationship in Dhaka Stock Exchange (DSE). The study reports a statistically significant positive relationship between risk and return both at the individual security level and at the portfolio level, confirming the theoretical predictions and empirical findings on this issue in developed markets. Although portfolio risk and returns are found to be significantly positively related in general, some inconsistencies were revealed in the context of relative risk for high risk portfolios, suggesting the existence of some anomalies or mispricing in high risk assets. These findings have important implications for investment decisions at the DSE in that the investors may be able to create profitable investment strategies using the mispricing information.

Keywords: Risk-Return trade-off, Mean-variance CAPM Model, Systematic risk, Portfolio beta, Emerging market, Dhaka Stock Exchange

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Introduction

Risk-return trade-off is an important topic in finance. It plays a crucial role in most financial decision-making processes of a firm - its asset valuation, investment, financing and distribution decisions. The expected return of an asset rises with risk/ uncertainty because investors hold a risky asset (security) if they are compensated with commensurably higher returns. In the capital asset pricing model (CAPM) framework, systematic risk or beta is the only relevant risk of an asset and it can be measured by the covariance of the asset return with the market return or by the covariance with other common factors related to investors' marginal utility in Merton's (1973) intertemporal capital asset pricing model (ICAPM). If market portfolio (index) is the asset, the risk can be measured by the conditional variance of market return. Beta is the only asset/security specific parameter that influences the equilibrium return on a risky stock (Mandelker & Rhee, 1984).

Empirical evidence for this contention, however, is inconclusive. Fama and MacBeth (1973) find support for the risk-return relationship in a cross-section of companies. However, empirical evidence in the 1990s (e.g. Fama & French, 1992, 1996; Jegadeesh, 1992) indicates that betas are not statistically related to returns. Indeed, Fama and French (1992) reveal a negative relationship between risk and return in terms of single factor CAPM and suggest that a multi-index model as the more realistic approach for measuring the risk in the market. Their work stimulated a significant amount of research in the area, especially in estimating portfolio risk and returns. Bartholdy and Peare (2004) find that the ability of beta to explain differences in returns in subsequent periods ranges from a low of 0.01% to a high of 11.73% across years and is at best 3%, on average. Further, the Fama and French three factor model does not do much better; although the size factor is found to be significant with the R-square at around only 5%. The low explanatory power of the simple estimation technique- for both the CAPM and the Fama and French model - suggests that neither model is useful for estimating cost of equity, at least for the simple estimation techniques used in the study. The finance practitioners, however, seem to prefer CAPM for estimating cost of equity (see, for example, Bruner et al., 1998 & Graham & Harvey, 2001). In the context of market portfolios, Darrat et al. (2011), Bali et al. (2009), Bali and Peng (2006) and Ghysels et al. (2005) lend statistically significant support for a positive relationship, while Goyal and Santa-Clara (2003), Harvey (2001) and Glosten et al. (1993) fail to detect any positive relationship. In fact, Harvey (2001) and Glosten et al. (1993) reported a reverse relationship.

Most prior research focuses on mature markets such as those in the U.S. and Europe (see, for instance, Nawalkha & Schwarz, 2004; Jagannathan & McGrattan, 1995). Although the tests of CAPM are extremely sensitive to the use of market proxy since the market portfolio needs to be ex-ante mean variance efficient (Focardi & Fabozzi, 2004), the model has been used in developed and emerging markets alike. The issue of relating risk and return in the emerging markets, however, differs from that of developed markets since emerging markets are characterized by: (i) high volatility, (ii) low integration and correlation with the world market, and consequently (iii) high diversifiable risk (Harvey 1995a, 1995b). Surprisingly, a few of the studies found evidence to support the validity of CAPM despite imperfect nature of those emerging markets, contradicting the theoretical prediction of the model in such markets (e.g., Guy, 1977; Hawawini & Mitchel, 1982; Sauer & Murphy, 1992; and Amanulla & Kamaiah, 1998). A non-trivial number of studies, however, failed to establish a linear risk-return relationship in emerging markets. For example, for a group of 19 emerging markets, including Pakistan, using eight year data from 1986 to 1993, Claessens et al. (1995) conclude that while similar factors govern the cross-section of emerging market

return, the signs of most of the coefficients are contrary to those found in developed markets. It is interesting to note that in their study, Pakistan was the only country with a significant negative beta risk premium. Estrada (2000) concludes that betas and stock returns in emerging markets do not seem to be related. Bark (1991) and Huang (1997) report a negative risk/return relationship for three Asian markets - Singapore, South Korea and Taiwan, respectively. Cheung et al. (1993) also report a weak risk/return relation for South Korea and Taiwan. Cheung and Wong (1992) find a weak relationship between risk and return in the Hong Kong market. Molla and Mobarek (2009) using the daily returns and Dimson corrected beta, suggested that the overall market movements did not influence the share returns in the Botswana Stock Exchange for the period of 2000-2005. Ward and Muller (2012) found that portfolios constructed on the basis of ranked beta exhibited a monotonic inverse relationship to what the CAPM prescribes, for most of the time series. They suggested that the use of the single beta CAPM is therefore inappropriate.

This paper focuses on Dhaka Stock Exchange (DSE) in Bangladesh. It is important to explore the risk-return relationship of companies listed on DSE for various reasons. First, Bangladesh is a rapidly emerging market in South Asia and currently is experiencing low liquidity and market capitalization ratio, thin trading, lack of institutional investors, limited number of mutual funds and investors indicating their preference for short-term outcomes (and exuberantly so). Bepari and Mollik (2008) find that Bangladesh stock market is still at an early stage of its growth path with a small market size relative to GDP and is characterized by poor liquidity and high market concentration. These apparently contradict with the assumptions of CAPM and market efficiency under which the CAPM operates. However, the widespread use of CAPM beta as the reference of company specific risk worldwide, including emerging markets makes it interesting to examine how the risk and return behave in emerging markets like DSE. Second, the DSE may be important for international diversification in that emerging markets have great potential for equity risk diversification and they also offer higher average returns than the developed markets (Harvey, 1995). The benefit from international diversification, however, is much reduced if the returns to emerging markets are driven by factors originating outside of the market, and this would be the case when the market under consideration is more closely integrated with the world markets (Wolf, 1998). To date, DSE was one of the stock markets least affected by the recent global financial crisis (GFC). In fact, while most of the world markets declined during the global financial crisis, stock prices in DSE continually rose, suggesting it was less integrated with the developed markets and therefore more potential for international diversification with higher average returns than the developed markets. The extent of diversification benefits and the risk premium, however, are subject to formal investigation, warranting empirical evidence specific to a particular emerging market. The findings of the study will be of great value to national and international portfolio investors in DSE.

Earlier researches on DSE (for example, Rahman & Baten 2006, Alam et al. 2007, Ali et al. 2010, and Hasan et al. 2011) have reported mixed evidence regarding risk-return relationship, using various different models and data sets. Rahman and Baten (2006) tested the validity of CAPM applying the Fama-French (1992) Three-Factor model to a data set of 123 DSE listed non-financial companies. They found the beta and size (sales) to be statistically significantly related (beta was inversely related) to returns in their cross-sectional models. They used five-yearly average cross-section and pooled time-series and cross-section models log of daily frequency of returns, including lag and lead, to estimate the individual equity beta. Alam et al. (2007) showed an inverse risk and return relationship in the DSE plugging in the simple average of market returns over 1994 to 2005 periods and Bangladesh

T-bill rate as risk-free rate of return in the famous single index market model equation. Their analysis is too simplified to establish the findings and the average return calculation could be biased downward by including the period of market crash in 1996, therefore, re-enforcing the inverse relationship. Ali et al. (2010) test the validity of CAPM in the Dhaka Stock Exchange (DSE) using Fama and Macbeth (1973) approach to 160 companies for the period from July 1998 to June 2008. They find a positive, but non-linear and statistically insignificant relation between 24-months rolling monthly risk (beta) and return. They commented that beta cannot be used as the main and only source of risk. Hasan et al. (2011) investigated the risk-return relationship in DSE under CAPM framework using monthly stock returns for 80 non-financial companies for the period of January 2005 to December 2009. They observed that the intercept term is significantly different from zero and a positive, but insignificant relationship between beta and share return. They further observed the existence of linearity of the security market line and the unique risk and the interaction were insignificant during their study period. Faruque (2012) investigated the performance of Arbitrage Pricing Theory (APT) and found one significant macroeconomic factor, exchange rate, as being priced in DSE out of seven macroeconomic variable tested. He used monthly data sets of 23 most actively traded stocks and macroeconomic variables covering the period from December 1995 to November 2010.

Considering the fact that betas of individual stocks in DSE are unstable and the instability increases with the holding periods (Mollik & Bepari, 2010) and that two recent studies (Ali et al., 2010 & Hassan et al., 2011) revealed a positive, but inconsistent relationship between beta and return using the data sets of different sample periods and frequencies, this study re-examines the issue in a more comprehensive manner for evidence of risk and return relationship in DSE. We used a separate and relatively stable sample period of 2000-2007. We reported results based on a different method of portfolio formation, in addition to the conventional beta-ranked portfolios and individual stocks. We applied the simple standard CAPM model.

The rest of the paper is organized as follows: the next section briefly discusses the development of asset pricing models and risk-return relationship and the objectives of the study. In sections 3 we discuss the data and methodology. In section 4 we present the results and discussion. Section 5 concludes the paper indicating limitations and further research prospects.

2.1. Models of Asset Pricing and Risk-return relationship

Researchers have used various models to explain the risk-return relationship of an asset in several different markets in the world. The famous Capital Asset Pricing Model (CAPM) (independently developed by Sharpe, 1964; Lintner, 1965a; Mossin, 1966 & Black, 1972) is the fundamental model that first establishes a linear relationship between risk and return of an asset and states that beta or systematic risk is the only relevant risk measure of an asset in this context. The riskiness of a stock relative to the risk of the market portfolio is termed as its beta or systematic risk. The model suggests a positive trade-off between beta and expected returns. Based on some simplifying assumptions, the CAPM is expressed as a linear function of a risk-free rate, beta and the expected risk premium as follows:

$$R_i = R_f + \beta_i(R_m - R_f)$$

where, R_i = expected return on asset i ; R_f = risk-free or zero-beta rate of return; β_i = beta of company i ; R_m = the market return and $(R_m - R_f)$ = the market risk premium.

However, the inability of the single market factor (index) CAPM to explain the cross-sectional spread in average returns, as discussed earlier, has led to the development of alternative asset pricing models. Ross (1976) suggested the arbitrage pricing theory (APT), as an alternative, including other factors in the model to explain the cross-sectional return variations. The APT, however, provided no specific clue about the factors, their number and/or the identification. Researchers, therefore, have used models including various empirical factors based on the pricing anomalies by the CAPM. Fama and French's (1993) three-factor and five-factor models are the most prominent ones among them. They suggested a three-factor model containing the market factor, SMB, and HML, and a five-factor model including additional two bond factor portfolios, term spread and default spread, with the three-factor model. Unsurprisingly, Fama and French's (1993) models were also not above criticism as many researchers found a number of other variables to be related to beta and returns. Among others, Kim (2006) suggested a two-factor model containing the market factor and the earnings information uncertainty risk factor. Chen et al. (2010) suggested a three-factor model containing the market factor, an investment factor, and a return on asset factor, suggesting that their model outperforms traditional asset pricing models in explaining anomalies associated with short-term price continuation, accruals, and stock valuation ratios. In Fama and French (2004) and Strugnell et al. (2011) some share characteristics such as size (market capitalization), price to earnings (value versus growth) and resources versus non-resources shares have been shown to be associated with share returns.

Considering the static single-period nature of the CAPM and that its failure in explaining the variations in cross-sectional average returns could be attributed to this static nature, some multi-period or continuous time dynamic models have also been suggested as alternatives by several researchers. Consumption-based CAPM (CCAPM) of Rubinstein (1976), Lucas (1978) and Breeden (1979) and the Intertemporal CAPM (ICAPM) of Merton (1973) models belong to this string of dynamic asset pricing models. The ICAPM requires including some state factors additional to the market index factor. Merton (1973) argues that when there is stochastic variation in investment opportunities, there will be risks associated with innovations in the state variables that describe the investment opportunities. Several ICAPM-motivated models (for example, Campbell, 1996; Vassalou, 2003; Kim et al., 2011) have been suggested according to the choice of such state variables. Campbell (1996) used the relative Treasury-bill rate, the dividend yield, the growth rate in real labor income, and the term spread as the state variables, while Vassalou (2003) and Kim et al. (2011) suggested future GDP growth and future labor income growth respectively as the state variables. Jagannathan and Wang (1996) suggested a conditional CAPM, which is different from typical conditional models and does not depend on instrumental variables.

Although the extant literature suggests a number of alternative methods of estimating beta and return, the single index CAPM model is still the most theoretically sound and practically appealing approach of them. It is a core construct of modern finance. The CAPM relies on a number of explicit/implicit assumptions about investors and their opportunity set such as: (1) capital markets are perfect⁴; (2) all investors are single-period, risk averse maximisers of the expected utility of their terminal wealth; (3) they have access to unlimited borrowing and lending at a risk-free rate; (4) their best portfolio decisions are made solely on the basis of expected values (the means) and standard deviations of the probability

⁴ In a perfect capital market (a) all agents are, individually, price-takers, (b) access is free (no transaction cost), and there is no 'friction' preventing the free trading of securities, (c) information has no cost and is available to all, (d) taxes are nonexistent (i.e. no external drains on wealth), and (e) capital assets are infinitely divisible.

distributions of the returns on their portfolios (i.e. terminal wealth). This implies either that the investors' utility functions are quadratic or that the portfolio returns have a multivariate normal distribution; (5) they all have the same planning horizon, and over this period the mean and standard deviation of the probability distributions exist; and (6) they have homogeneous expectations with respect to the mean and standard deviation of each portfolio return distribution. Thus, the CAPM is operationalized based on some important assumptions such as homogeneous expectations of all investors about return, no transaction cost, large number of small investors and market equilibrium.

2.2. Objective of the Study

The primary objective of the study is to test the relationship between risks and returns in DSE both at individual security and portfolio levels. Using the CAPM beta as the measure of risk, the hypotheses being tested are:

H₁: *There is a statistically significant positive beta (risk) for each individual securities/stocks listed in DSE, i.e. stock betas are positive and significantly different from zero.*

H₂: *There is a statistically significant linear relationship between beta and return of individual stocks in DSE, i.e. higher return is associated with a higher risk. The stock beta is significantly different from zero with positive risk premium.*

H₃: *There is a statistically significant linear relationship between portfolio beta and portfolio return in DSE, i.e. higher portfolio return is associated with commensurable higher risk.*

3. Data and Methodology

The data set consists of monthly realized returns of 110 stocks included in the DSE General Index for the period January 2000 to December 2007. Monthly returns were used. The natural logarithmic differences in prices are used to measure the stock returns. The return is expressed in percentage form for ease of comparability. Symbolically, the returns have been expressed in percentage form as follows:

$$R_{it} = \text{Ln} \left(\frac{P_t}{P_{t-1}} \right) * 100$$

Where R_{it} is the return on stock i in time period t , P_t is monthly closing price of stock i and P_{t-1} is the monthly opening price of stock i . The market return was calculated as follows:

$$X_t = \text{Ln} \left(\frac{I_t}{I_{t-1}} \right) * 100$$

Where X_t is the return on the market index I_t is the monthly closing number of market index and I_{t-1} is the opening number of the market index.

The famous market model (CAPM) beta was used as the measure of risk and was estimated using the following regression model:

$$E(R_{it}) = \alpha_i + \beta_i X_t + e_{it}$$

Beta (β) was estimated by regression of monthly security returns on the returns of the market index.

Alpha (α) represents a constant intercept, indicating minimum level of return that is expected from security i , if the market remains flat.

Where α_i is the constant intercept of security i , β_i is the slope (systematic risk) of security i and e_{it} is error term representing the residuals of security i . e_{it} represents non market (diversifiable) risk of security i .

Scholes and Williams (1977) and Dimson (1979) reported that the CAPM beta is biased upwards for frequently traded securities and downwards in case of thin trading. Literature suggests two or three types of alternative estimators to reduce the thin trading bias. Scholes and Williams (1977) suggested beta estimator accounts for non-trading that last at most for one period. Dimson (1979) proposed a multiple regression with leading and lagging market returns as additional regressors, where Dimson's beta is the sum of all these multiple coefficients. These two approaches are widely used (see for example, Mollah & Mobarek, 2009 and Ward & Muller 2012 for recent application in emerging market beta analysis). Another alternative is to measure returns at lower frequencies e.g., weekly holding-period returns rather than daily ones. The advantage of using the longer holding-period returns is that while the noise generated by thin trading is not affected, the true returns become larger, implying a better signal-to-noise ratio (see e.g., Stoll & Whaley, 1990). We hope that our estimates of betas using lower frequency (longer holding-period) monthly returns are reasonably free from thin trading bias that existed in DSE. Also, thin trading may be unrelated to the risk-return relationship (Iqbal & Brooks, 2007). We also tested the Dimson beta, with no improvement in results, therefore not reported.

4. Results and Discussion

4.1. Risk-Return Relationship for Individual Securities: Characteristics Line

The statistical summary of risk and return measures for all the stocks in terms of SIM are provided in Appendix A. Out of 110 securities, 58 have statistically significant beta at 1 percent significance level, 12 have beta significance at 5 percent level, and 16 have beta significance at 10 percent significance level. This means that the market wields a relevant influence on an individual stock's performance and beta is a good measure of risk in DSE. We can therefore reject the null hypothesis that there is no relationship between individual stocks' risk and return. Out of 110 securities, 8 securities have beta value exceeding market beta value of 1, and 9 securities have negative beta values. The remaining securities have beta values between 0 and 1.

Table 1 shows the risk-return matrix for 110 securities. When classified in terms of mean risk (0.519) and mean return (0.679 %), 34 securities belong to the high risk and high return class, 19 securities belong to the high risk and low return category, 17 securities lie in low risk and high return class while the residual 40 securities constitute the low risk and low return group. When classified in terms of market risk and market return, 4 securities fall under high risk and high return class, 4 securities belong to the high risk low return class, 11 securities lie in low risk high return class, while 91 securities are classed as representing the low risk and low return subset.

Table 1: Risk-Return Matrix

		Based on Mean Security Return Mean = 0.68		
		High	Low	Total
Based on Mean Security Risk (Beta) Mean= 0.52	High	34	19	53
	Low	17	40	57
Total		51	59	110
		Based on Market index return =1.93		
		High	Low	Total
Based on Market Risk (Beta) =1	High	4	4	8
	Low	11	91	102
Total		15	95	110

Spearman’s correlation coefficient value of 0.614 between beta values and expected return of individual securities and 0.544 between total market risk and expected return of individual securities indicate a high degree of relationship. However, Spearman’s correlation coefficient between non-market idiosyncratic risks and expected return of individual securities is merely 0.011 and is not statistically significant even at 10 percent level. These correlation coefficients between measures of risk and expected return of individual securities support the proposition of the single index model that high risk yields high return and low risk yields low return. Figure 1 plots the expected returns of individual securities against their beta.

Figure 1: Relationship between beta and expected return of individual securities

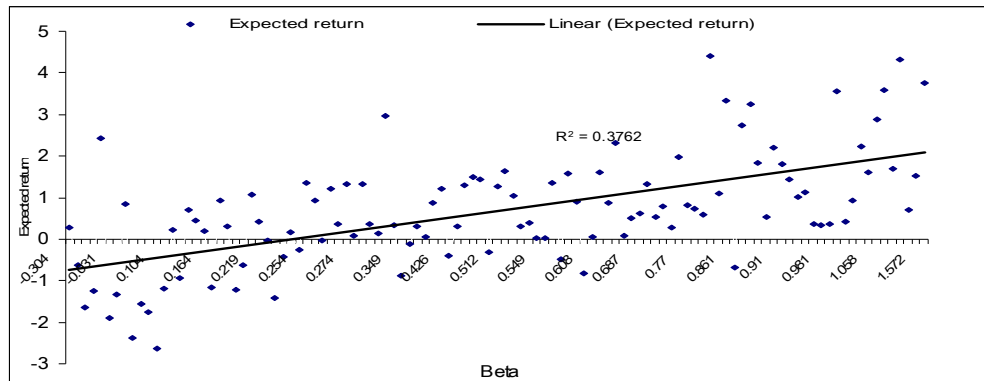


Table 2 depicts the summary statistics of the different variables used in the analysis to demonstrate the risk-return relationship concerning different securities. Coefficient of determination (R^2), which measures how much variation in stock return is explained by variation in index return, has the highest value of .473, while the lowest R^2 is close to 0 for number of securities. Average R^2 is 12.6 percent. This lower level of average coefficient of determination runs counter to the findings of Morck et al. (2000), who found that stocks tend to have large coefficients of determination (R^2) using a market model in emerging markets. Among the 110 stocks the highest beta is 1.572 and the lowest beta is -0.304 with the range

of the beta being 1.876. The average beta is 0.519. The highest expected return is 4.405 percent and the lowest expected return is -2.628 percent with a range being 7.033 percent. The average expected return is 0.679 percent. Similar variations are also evident in summary statistics of all other variables (Table 2).

Table 2: Summary statistics of risk-return relationship data of individual securities

<i>Summary statistics</i>	Variance _{st}	B _i	α	B _i ² σ _x ²	e _i ²	β _{SE}	R ²	Expected return
Mean	171.65	0.51	-0.33	17.00	155.23	0.18	0.13	0.68
Standard Deviation	216.99	0.37	1.07	20.04	209.50	0.07	0.12	1.36
Sample Variance	47088.14	0.13	1.16	401.92	43894.07	0.01	0.01	1.84
Kurtosis	53.55	-0.35	0.33	4.95	50.87	19.14	-0.34	0.58
Skewness	6.71	0.28	0.50	1.89	6.55	3.58	0.78	0.32
Minimum	10.42	-0.30	-2.79	0.00	10.19	0.07	0.00	-2.63
Maximum	2041.43	1.57	2.83	108.93	1932.50	0.69	0.47	4.41
Range	2031.01	1.87	5.62	108.93	1922.31	0.62	0.47	7.03
Observation	110	110	110	110	110	110	110	110

To test the linear risk-return relationship, a cross-sectional regression of an individual security’s return on its beta (β) estimate is carried out. Lintner (1965), Douglas (1969), and Fama and MacBeth (1973) suggested that the residual variance in the first stage regression may have additional explanatory power describing the return (dependent variable) in the second pass regression. Taking their suggestion into account, this study performed a cross-sectional regression that included the log of residual variance as an additional independent variable along with beta (β). The results from these regressions are reported in Table 3.

The evidence in Table 3 shows that individual securities beta (β) values are significantly positively related to returns in all four regression models. Hence there exists a significant relationship between market risk and return in DSE. The coefficients of beta-square are not statistically significant in any of the two models. Values in the parentheses are the t-values calculated based on White’s corrected standard errors. It has been found that White’s correction does not significantly change the results. So, the results confirm that beta is linearly positively related to returns. When the log residual variance is added as an independent variable with beta (β), and beta-square (β²), its coefficient becomes statistically significant, but the explanatory power of the model increases only marginally (R² increases from 0.42 to 0.43 and adjusted R² increases from 0.41 to 0.43). Therefore residual variance from the first stage regression or the firm-specific idiosyncratic risk has only little explanatory power of individual securities return.

Table 3, Panel A depicts the results of risk-return relationships when the sample companies are grouped based on beta (high and low beta), beta-return (high-beta-high-return and low-beta-low-return, high-return and low return and so on. It can be seen that all the coefficients of beta are statistically significant at 1% to 5% level of significance, except two un-usual cases where companies having high betas have low returns and having low betas have high returns. The results are logical and confirm the positive risk-return relationship reported above. Table 3, Panel B reports the results of the same models as in Panel A, but

with beta-square (β^2) as an additional independent variable to test the non-linearity of beta with returns. Beta is found to be significantly positively related to returns in the models of high-beta, high-beta-high-return, high-beta-low-return and low returns. In high-beta-low-return group the result of positive coefficient does not logically fit, can be disregarded. However, beta-square has been found to be significantly positively related to returns of low beta, low-beta-low-return and low-beta-high return groups, suggesting that in low-beta portfolios may have non-linear risk-return relationships. This is an interesting new finding which needs to be confirmed by further research.

Table 3: Cross-sectional regression results of individual security return on β and log of residual variance

Models	Constant	Beta (β)	(β^2) (Non-linearity)	Log Residual variance	R ²	Adjusted R ²
1. Without β^2 and Residual Variance	-0.48* (-2.70)	2.24* (6.93)	-	-	0.37	0.37
2. With β^2	-0.49** (-1.92)	2.28* 2.67	-0.04 (-0.06)	-	0.37	0.36
3. With Log Residual Variance	-1.58** (-1.05)	2.31* (6.95)		-0.44 (-2.92)	0.42	0.41
4. With β^2 and Log Residual Variance	1.91* (2.72)	1.63** (1.93)	0.60 (0.77)	-0.49* (-3.54)	0.43	0.42

Panel A $R_i = \alpha_0 + \alpha_1 \beta_i + e$			
Beta-return category	Beta-return relationship (linear) β_i	Beta- return relationship (non-linear) β^2	Adjusted R square
High beta	2.61*	n/a	.21
Low beta	2.70*	n/a	.18
Highbeta - high -return	1.69**	n/a	.11
High -beta - low -return	0.77	n/a	.04
Low -beta - low -return	1.90*	n/a	0.14
Low -beta - high -return	0.09	n/a	-.07
High return	1.13*	n/a	.15
Low return	1.25*	n/a	.28

Panel B $R_i = \alpha_0 + \alpha_1 \beta_i + \alpha_2 \beta_i^2 + e$			
High beta	5.06*	-1.31	.20
Low beta	1.29	4.71**	.21
High -beta - high -return	5.13*	-1.72	.10
High -beta - low -return	3.46*	-1.78	-.02
Low -beta - low -return	0.76	5.74**	.22
Low -beta - high -return	-1.29	2.63**	-.12
High return	0.31	0.59	.15
Low return	1.40*	-0.19	.26

Figures in the parenthesis indicate t-ratios (White's corrected); * Significant at 1% level, **Significant at 5% level

4.2. Relationship between Portfolio Return and Risk

Following Sharpe and Cooper (1972), Amanulla and Kamaiah (1998) and Dhankar and Kumar (2006), we construct 11 portfolios of 10 securities each on the basis of beta values of 110 individual stocks. Portfolios with high betas can be considered as high risk-return class while portfolios with low betas are low risk return class (Sharpe & Cooper, 1972). We construct portfolios consisting of stocks in descending order of their beta values. The total number of companies are arranged in descending order of beta and grouped into 11 portfolios of 10 securities each. This is done to achieve the diversification required to reduce effect of unique risk as done in above studies. Table 4 reports the summary statistics for portfolio risk and returns. The beta values of 10 out of 11 portfolios are significant at 1 percent level. The remaining one is significant at 5% level of significance, suggesting a close relationship between portfolio risk and returns. Spearman’s correlation coefficient between portfolio beta and portfolio expected return is found to be 0.938, while the correlation coefficient between portfolio market risk and portfolio expected return is 0.887. Both the coefficients are significant at 5 percent level of significance. Risk measures (i.e. total risk, total market risk and beta) of portfolios indicate consistency in all cases as one moves from a high beta portfolio to a low beta portfolio. Although not consistent in all cases, R² (coefficient of determination) is demonstrating an overall declining trend in the portfolio beta values and market risks.

Table 4: DSE Portfolio returns and risks

Portfolio	No. of Stock	Var	β_p	α	$\beta_p^2 \sigma_x^2$	σ_{ep}^2	β_{SE}	R ²	E(R _p)	Return per unit of market risk	Return per unit of total risk
P1	10	92.87	1.17*	0.03	60.18	32.69	0.24	0.65	2.28	0.04	0.03
P2	10	51.62	0.95*	-0.56	39.46	12.15	0.17	0.77	1.27	0.03	0.03
P3	10	48.44	0.85*	0.18	31.52	16.92	0.19	0.65	1.80	0.06	0.04
P4	10	32.21	0.72*	-0.60	22.55	9.66	0.15	0.70	0.78	0.04	0.02
P5	10	28.42	0.59*	-0.49	15.51	12.92	0.17	0.55	0.65	0.04	0.02
P6	10	20.42	0.50*	-0.06	10.99	9.43	0.15	0.54	0.90	0.08	0.04
P7	10	16.05	0.37*	-0.26	5.95	10.10	0.15	0.37	0.45	0.08	0.03
P8	10	14.59	0.27*	0.05	3.23	11.37	0.16	0.22	0.57	0.18	0.04
P9	10	14.27	0.21*	-0.46	1.91	12.36	0.17	0.13	-0.06	-0.03	0.00
P10	10	18.30	0.11*	-0.98	0.56	17.74	0.20	0.03	-0.77	-1.38	-0.04
P11	10	24.08	-0.08**	-0.47	0.22	23.87	0.26	0.01	-0.56	-2.61	-0.02
Average		32.84	0.51	-0.33	17.90	15.38	0.18	0.42	0.66	-0.32	0.02
Spearman Correlation Coefficient			Between portfolio beta & portfolio expected return							0.94*	
			Between portfolio market risk & portfolio expected return							0.89*	

*Significant at 1 % level; **Significant at 5% level; R² equals market risk divided by total risk

Table 5: Risk-Return Matrix of portfolio of securities

		Based on Mean Security Return Mean = 0.66		
		High	Low	Total
Based on Mean Security Risk (Beta) Mean= 0.51	High	4	1	5
	Low	1	5	6
	Total	5	6	11
		Based on Market index return =1.93		
		High	Low	Total
Based on Market Risk (Beta) =1	High	1	0	1
	Low	0	10	10
	Total	1	10	11

It is evident in Table 5 that an investor can choose from these 11 portfolios with different levels of risk and expected return with risk and return having a positive relationship in that high risk yield high expected a return and vice versa. However, in Table 4 relative measures in terms of return per unit of total risk and return per unit of market risk are not showing consistency. P8 offers the highest return per unit of market risk and for this reason a conservative investor will choose this portfolio. On the other hand P1 provides the highest return in absolute terms although it is not offering the highest return in relative terms. It is expected that the portfolio with high beta will be associated with high return and low beta with low return. This systemic pricing pattern is not observed across all the portfolios in Table 4. Hence we conclude that although portfolio risk and return in DSE are positively linearly related in general, higher risk does not always offer higher return, indicating that market anomalies exist. This implies that investors will have to search for efficient portfolios to maximize return for a given level of risk in DSE.

As noted in the portfolio theory, the error term in the first stage regression refers to security-specific risk and this can be avoided by combining securities in one portfolio. Thus portfolio return will be linearly and positively related to portfolio beta. Pursuing this line the present study regress the portfolio returns on portfolio beta. Portfolio return is also regressed on portfolio beta and portfolio residual variance in the log form. The results are reported in Table 6.

Table 6: Cross-sectional regression results of portfolio return on β and log residual variance

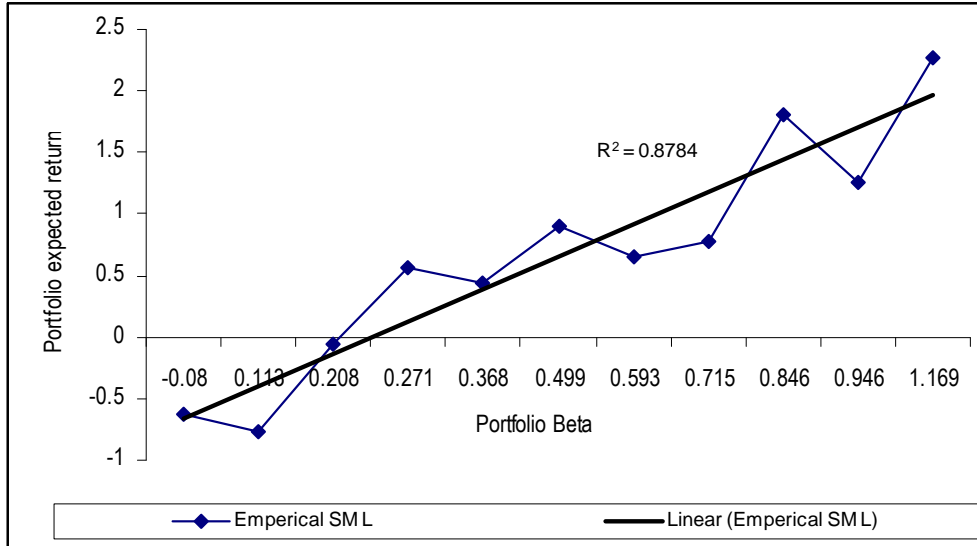
	Constant	Beta(β)	Residual variance	R ²	Adjusted R ²
Without residual variance	-0.50** (-2.79)	2.26* (8.01)	-	0.88	0.86
With log residual variance	-0.64 (-0.83)	2.25* (7.47)	0.13 (0.85)	0.88	0.85

Figures in the parenthesis are t-ratios; * Significant at 1% level, **Significant at 5% level

Table 6 supports a highly positive linear relationship between portfolio beta and portfolio return. While the coefficient of beta is statistically significant at 1% level of significance, the coefficient of the log of residual variance is not statistically significant even at 10 percent level. Thus portfolio non-market risk is not relevant for portfolio return.

4.3 Empirical Security Market Line (SML)

An efficient market provides rewards for risk. High return is associated with high risk and low return with low risk. The security market line helps to determine the required level of return for a given level of risk. Figure 2 depicts the observed security market line (SML) which has been constructed to demonstrate the relationship between portfolio expected return and portfolio beta.

Figure 2: Relationship between portfolio beta and portfolio expected return

There seems to be a highly positive and linear relationship between portfolio expected return and portfolio market risk, which validates the efficient market hypothesis in DSE in that investors earn high expected return by investing in high beta portfolios in general, and vice versa (theoretically incorrect statement). However, the deviation of empirical SML from linear SML implies that there are mispriced stocks (portfolio), some under-valued and some over-valued, in the DSE.

5. Conclusion

This paper investigates the risk-return relationship of both individual securities and portfolio of securities and the effect of diversification on non-market risk of portfolios in DSE, Bangladesh, using the DSE Single Index Model. Security returns exhibit statistically significant positive movements in tandem with market movements. Portfolio risks and returns are also highly positively related in that portfolio beta values are statistically significant in the portfolio risk-return models. The results also reveal that when companies are grouped based on betas (high and low betas) and beta-returns (high-beta-high-return and low-beta-low-return and son), the groups with low betas have statistically significant non-linear beta-return relationships. However, the highest beta assets are not always associated with the highest return, suggesting the existence of market anomalies. These findings validate the efficient market hypothesis in DSE in terms of risk-return trade-off in general, which have important implications for investment decisions. Investors should hold efficiently diversified portfolios to maximize their return for a particular level of risk because they will be rewarded only for systematic risk.

The findings of the study are limited to the use of standard mean-variance CAPM model. Further studies, using other multi-variate asset pricing models e.g., AP, Fama-French Three-factor to Five-factor models can reconfirm the findings in DSE and other emerging markets. Since we have used low frequency monthly data, future studies using higher frequency (i.e., daily or weekly) data for a longer period can be attempted to revalidate the

findings in emerging markets, including DSE. The non-linearity of beta in low beta assets classes is a new finding, which needs to be supported by further rigorous research in the area.

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Appendix A: Risk-return relationship of individual security

Company name [check proper nouns in these names]	Variance _{st}	β_i	α	$\beta_i^2 \sigma_x^2$	e_i^2	β_{SE}	R ²	Mean return
Rupali Bank ltd.	2041.438	1.57**	0.731	108.930	1932.508	0.687	0.053	3.758
NCCBL	214.915	1.49*	-1.321	97.506	117.409	0.167	0.473	1.512
Beximco Pharma	149.464	1.20*	-1.586	62.900	86.564	0.145	0.421	0.714
Uttara Bank	246.434	1.13*	2.193	55.928	190.506	0.216	0.227	4.326
Soutuheast Bank	191.036	1.12*	-0.436	54.992	136.043	0.181	0.297	1.700
AB bank	169.754	1.10*	1.459	53.726	116.028	0.168	0.316	3.585
Lafarge Surma Cement ltd.	150.269	1.06*	0.299	49.348	100.921	0.189	0.411	2.875
Prime bank ltd.	195.701	1.05*	-0.402	48.402	147.299	0.190	0.247	1.616
Apex Food	126.990	0.99*	-0.985	43.111	83.880	0.143	0.339	0.919
Pubali bank ltd.	400.675	0.99*	0.328	43.126	357.549	0.295	0.108	2.232
BD Lamps	120.610	0.99*	-1.492	42.898	77.712	0.138	0.356	0.407
Dutch Bangla Bank Ltd.	210.062	0.98*	1.659	42.529	167.533	0.207	0.222	3.566
Heidelberg cement	151.235	0.98*	-1.522	1.170	150.065	0.163	0.280	0.367
Bangladesh General Ins.	142.646	0.97*	-1.523	41.676	101.269	0.157	0.290	0.343
Niloy cement	206.325	0.95*	-1.465	39.611	166.713	0.202	0.192	0.360
Olympic industries ltd.	208.259	0.94*	-0.648	38.863	169.396	0.203	0.187	1.124
Apex Tannery	128.471	0.92*	-0.325	37.365	91.107	0.149	0.291	1.448
Meghna cement	127.618	0.92*	-0.752	37.400	90.219	0.148	0.293	1.021
Square Pharma.	140.671	0.91*	0.040	36.478	104.194	0.159	0.259	1.792
Usmania Glass	133.304	0.90*	0.464	36.033	97.217	0.154	0.270	2.205
Singer Bangladesh Ltd.	97.589	0.90*	-1.190	35.522	62.067	0.123	0.364	0.538
The City bank ltd.	221.344	0.89*	0.095	35.620	185.724	0.213	0.161	1.826
IFIC Bank	236.437	0.88*	1.551	2.175	234.262	0.222	0.145	3.246
National life insurance	120.702	0.86*	1.068	32.895	87.807	0.146	0.273	2.731
Shine Pukur Holdings Ltd.	637.622	0.86**	-2.343	32.697	604.926	0.384	0.051	-0.684
National Bank ltd.	111.132	0.83*	1.740	30.666	80.466	0.140	0.276	3.345
Keya Cosmetics	160.284	0.82*	-0.264	29.524	130.760	0.187	0.210	1.094
UCBL	149.130	0.82*	2.835	29.293	119.837	0.171	0.196	4.405
MiracleIndustries	125.286	0.81*	-0.963	29.203	96.083	0.153	0.233	0.604
Prime textile spinning mills	116.730	0.78*	-0.766	27.024	89.705	0.148	0.232	0.742
Green delta life insurance	148.620	0.77*	-0.669	26.137	122.482	0.173	0.176	0.813
ACI Ltd.	67.552	0.76*	0.509	25.462	42.090	0.101	0.377	1.972
Janata insurance	152.784	0.73*	-1.133	23.666	129.188	0.177	0.155	0.278
Rupali Insurance Co.	93.438	0.73*	-0.622	23.645	69.793	0.130	0.253	0.788
Phoenix insurance ltd.	114.468	0.72*	-0.864	22.858	91.610	0.149	0.200	0.523
National tubes ltd.	187.474	0.71*	-0.038	22.246	165.228	0.201	0.119	1.330
Karnaphuly Insurance co.	86.307	0.69*	-0.697	20.784	65.523	0.126	0.241	0.625
Quasem drycell ltd.	87.390	0.69*	-0.799	20.655	66.734	0.128	0.236	0.519
United Leasing Co. Ltd.	107.139	0.68*	-1.231	20.375	149.765	0.191	0.120	0.078
AMCL	83.955	0.68*	-0.440	20.163	63.792	0.125	0.240	0.862
Eastern Bank Ltd.	143.024	0.68*	1.023	20.118	122.906	0.173	0.141	2.324
Uttara Finance & Invest.	94.896	0.66*	0.333	19.176	75.720	0.136	0.202	1.603
Lexco International	193.836	0.61*	-1.128	16.305	177.530	0.208	0.084	0.043
Aziz Pipes	192.128	0.60**	-1.962	15.584	176.544	0.208	0.081	-0.817
Raspit Inc.BD. Ltd.	67.074	0.59*	-0.248	15.354	51.721	0.112	0.229	0.888
The IBN Sina Pharma.	74.733	0.57*	0.462	14.478	60.255	0.121	0.194	1.566
Sinobangla Ind. Ltd.	168.340	0.57*	-1.589	14.278	154.061	0.194	0.085	-0.494
BOC	60.163	0.56*	0.268	13.930	46.233	0.106	0.232	1.350
GQ ball pen	226.650	0.55**	-1.023	13.286	213.364	0.228	0.059	0.034
Rahima food corporation	226.650	0.55**	-1.023	13.286	213.364	0.228	0.059	0.034
Federal Insurance Co.	118.656	0.54*	-0.649	12.924	105.732	0.161	0.109	0.393
H.R.Textiles ltd.	87.100	0.53*	-0.707	0.806	86.294	0.135	0.140	0.304
Atlas Bangladesh	124.242	0.52*	0.032	11.890	112.352	0.166	0.096	1.032
Dhaka Bank Ltd.	153.185	0.52*	0.633	11.824	141.361	0.186	0.077	1.631
Al Arafah Islami Bank	85.115	0.51*	0.401	11.549	73.565	0.137	0.139	1.258
Tripti Industries Ltd.	139.967	0.49*	-1.260	10.747	129.221	0.178	0.077	-0.309
United Insurance Co.	48.886	0.49*	0.494	10.380	38.506	0.097	0.212	1.429
National polymer industries	131.574	0.48*	0.584	10.145	121.429	0.172	0.077	1.508

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Apex Spinning & Knitting	55.376	0.47*	0.381	9.838	45.538	0.105	0.178	1.291
Purbali General insurance	97.858	0.45*	-0.546	8.833	89.026	0.147	0.090	0.316
Monno Ceramic	65.183	0.43*	-1.216	8.008	57.176	0.118	0.123	-0.395
Islami bank limited	105.412	0.42**	0.385	7.924	97.488	0.154	0.075	1.210
Bata Shoe Co. Ltd.	28.732	0.42*	0.052	7.729	21.004	0.072	0.269	0.859
Standard Ceramic Ind.	116.235	0.38**	-0.693	6.435	109.800	0.164	0.055	0.043
National tea company ltd.	144.501	0.36***	-0.391	5.694	138.807	0.184	0.039	0.301
Monno Fabrics	137.578	0.36***	-0.790	5.545	132.033	0.179	0.040	-0.107
Wonderland Toys Ltd.	188.085	0.35	-1.563	5.355	182.730	0.211	0.028	-0.892
Kay Que Bangladesh ltd	118.889	0.33***	-0.291	4.709	114.180	0.167	0.040	0.339
Reneta Ltd.	64.381	0.32*	2.349	4.612	59.769	0.121	0.072	2.972
Mita Textile	101.316	0.31**	-0.451	4.266	97.050	0.154	0.042	0.148
Altex industries	302.626	0.31	-0.241	4.183	298.443	0.270	0.014	0.353
IDLC	93.704	0.29***	0.787	0.969	92.735	0.148	0.039	1.338
Immam Button	91.170	0.274***	-0.458	0.945	90.225	0.146	0.036	0.070
Sixth ICB Mutual Fund	52.422	0.272**		3.263	49.149	0.110	0.062	1.331
BATBCL	68.411	0.270**	-0.144	3.212	65.199	0.126	0.047	0.376
Third ICB Mutual Fund	62.770	0.27**	0.700	3.106	59.664	0.121	0.049	1.211
Ashraf Textile	144.657	0.26	-0.535	3.024	141.633	0.186	0.021	-0.031
Aramit Ltd.	43.780	0.26**	0.244	3.006	40.775	0.100	0.069	0.925
Orion infusion ltd.	154.323	0.25***	0.888	2.847	151.476	0.133	0.019	1.349
Wata Chemicals Ltd.	150.34	0.25	-0.757	2.826	147.514	0.190	0.019	-0.269
Shaiham Textile Mills Ltd.	100.053	0.25	-0.299	2.692	97.361	0.154	0.027	0.177
Modern dyeing	75.156	0.25***	-0.890	2.671	72.485	0.133	0.035	-0.419
Meghna shrimp	133.814	0.24***	-1.874	2.600	131.214	0.134	0.019	-1.406
Tallu Spinning Ltd.	129.559	0.24***	-0.478	2.455	127.104	0.126	0.019	-0.023
Somorita Hospital	109.507	0.22***	-0.009	2.116	107.392	0.120	0.019	0.413
Apex Finishing & Weaving	83.589	0.19***	0.690	1.616	81.973	0.110	0.019	1.058
Pharmaco International Ltd	241.461	0.18***	-0.979	1.475	239.987	0.100	0.006	-0.627
Paper processing	185.653	0.18***	-1.560	1.370	184.284	0.101	0.007	-1.221
Aramit Cement	185.489	0.18***	-0.028	1.346	184.143	0.102	0.007	0.308
Kohinoor Chemicals Ltd.	10.422	0.17***	0.796	0.225	10.197	0.101	0.022	0.934
Gulf Foods Ltd.	205.652	0.16	-1.472	2.199	203.453	0.223	0.006	-1.156
Progoti Insurance ltd.	63.730	0.15	-0.091	0.950	62.780	0.124	0.015	0.192
Mithun Knitting & Dyeing	90.675	0.14	0.190	0.839	89.836	0.148	0.009	0.455
Bangas Limited	83.504	0.13	0.442	0.749	82.756	0.142	0.009	0.693
Samata Leather	189.039	0.13	-1.182	0.688	188.350	0.214	0.004	-0.941
Rahman Chemicals	181.049	0.12	-0.004	0.614	180.435	0.210	0.003	0.223
Sajib Kintwear & Garments	198.218	0.10	-1.400	0.473	197.745	0.220	0.002	-1.200
Reckit Benkeiser ltd.	460.909	0.09	-2.793	0.322	460.586	0.335	0.001	-2.628
Mona Food Industries	134.858	0.08	-1.889	0.247	134.612	0.181	0.002	-1.745
Bangladesh Monospool	173.749	0.04	-1.638	0.064	173.685	0.206	0.000	-1.565
M. Hossain Garments..	124.060	0.00	-2.368	0.000	124.060	0.174	0.000	-2.374
Renwick Jeanswear	321.780	-0.02	0.874	0.009	321.771	0.280	0.000	0.846
Rose Heaven Ball pens ltd.	1031.050	-0.03	-1.339	0.043	1031.006	0.502	0.000	-1.339
Tulip Dairy Product	156.462	-0.03	-1.836	0.046	156.416	0.195	0.000	-1.899
Padma oil co. ltd.	85.866	-0.03	2.478	0.047	85.819	0.145	0.001	2.415
MAQ Enterprises ltd	220.355	-0.04	-1.164	0.077	220.278	0.232	0.000	-1.244
Quasem silk mills	237.801	-0.07	-1.511	0.194	237.608	0.241	0.001	-1.638
Perfume chemical ind.	190.952	-0.19	-0.266	1.628	189.324	0.215	0.009	-0.636
Shyam Sugar Mills Ltd.	443.619	-0.30	0.875	0.614	20.448	0.327	0.009	0.289

*Significant at 1% level; **Significant at 5% level; *** Significant at 10% level.