THE BANGLADESHI EQUITY PREMIUM AND CONDITIONAL HETEROKEDASTICITY

ABSTRACT

This study investigates the equity premia of three Bangladeshi equity indices traded in the Chittagong Stock Exchange, CSE-30, CSCX, and CASPI, over the period 2004:02 to 2014:05. These premia are among the highest premia in its neighboring Asian countries and much higher than the corresponding figures in the advanced economies. The estimation of the Threshold Autoregressive model further reveals asymmetric adjustments of the premium of the CSE-30 index and symmetric adjustments of the equity premia of the CSCX and CASPI indices about their thresholds to negative and positive shocks in the long run. When the short-run dynamic components are introduced to the model, the estimation results suggest that the CSE-30, CSCX and CASPI indices respond to monetary, fiscal policy and economic shocks altering the deposit rates. This finding indicates that Bangladeshi economic policies matter for the stocks traded on the Bangladeshi Chittagong Stock Exchange in the short run. Additionally, for the CSE-30 index, the empirical results seem to indicate (i) a faster convergence for positive disequilibrium than for negative disequilibrium; (ii) a slower convergence for the CSCX and CASPI indices for positive disequilibrium than for negative disequilibrium. Finally, the empirical results indicate the presence of the GARCH (1, 2) effect on the Bangladeshi monthly equity premia and their variances.

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INTRODUCTION

The equity premium, the difference between the return on the market portfolio and the risk-free interest rate has been a topic of considerable debate. From the theoretical perspective, the equity premium is the difference between the expected real return on the market portfolio of common stocks and the real risk free interest rate. As initially recognized by Mehra and Prescott (1985), the historic U.S. equity premium, which is in the world's largest economy, appears to be much greater than what can be rationalized in the context of the standard neoclassical paradigm of financial economics. Mehra (2003) articulated that for the 1889-2000 period, the average annual real return on the US equity market has been about 7.9%, as compared to the real return on a relatively riskless security of 1.00%. This irrationally high average, dubbed "the equity premium puzzle" is not unique to the U.S. capital market. Internationally too, as reported by Dimson et al., (2006) over the 1900-2005 period, the equity premium measure relative to T-bills was 7.08% in Australia, 6.67% in Japan, 6.20% in South Africa, 3.83% in Germany, 5.73% in Sweden, 5.51% in the US, 4.43% in the UK, 6.55% in Italy, 4.54% in Canada, 6.79% in France, 4.55% in Netherlands, 4.09% in Ireland, 2.80% in Belgium, 3.07% in Norway, 3.40% in Spain, 2.87% in Denmark and 3.63% in Switzerland. The average equity premium for these 17 countries over this period of 106 years was 4.81%.

In the late 2011, Dimson et al., (2011) updated the global evidence on the long-term realized equity risk premium, relative to both bills and bonds, in nineteen different countries. Their sample was from 1900 to the start of 2011. They found that while there was considerable variation across countries, the realized equity risk premium was substantial universally. They reported that for a sample of the 19-country World index, over the entire 111 years, the geometric mean real returns were an annualized 5.5%; the equity premium relative to Treasury bills was an annualized 4.5%; and the equity premium relative to long-term government bonds was an annualized 3.8%. The expected equity premium is lower, around 3% to 3½% on an annualized basis.

Since its introduction to the literature in 1985, the equity premium puzzle has spawned many efforts by a number of researchers to explain this anomaly . With the exception of the following investigations, the majority of the studies concentrated on theoretically and empirically explaining the implausible equity premium puzzle.

Buranavityawut and Freeman (2006) examined consumption risk and the equity premium. Blanchard (1993) studied the variation of the equity premium over a 50 year period. Fama and French (2002) compared the estimated unconditional equity premium to the realized market gains. Siegel (1999) investigated the variations of the size of the equity premium. Welch (2000) surveyed financial economists on their expectations on the future equity premium.

While the theoretical and empirical debates are still unsettled, equity is the major instrument to channel the financial resources from the capital surplus economic units (the savers) to the financial deficit units (the borrowers) in the direct financing mode of the market economies. In the capital market, the realized equity premium is the premium that corporations have to pay to obtain their financial resources, when they issue new equities or to acquire their treasury stocks, just like the difference between the loan rate and the risk free interest rate that financial institutions charge for loans to corporations. Hence, the time path on which the equity premium adjusts towards its "normal" or equilibrium level following a shock has a major consequence on the cost of capital to corporations. Thus, policymakers should have accurate knowledge of the adjustment process of the equity premium when being disturbed by economic shocks or countercyclical monetary policy action in the equity market.

The remainder of the study is organized as follows: Section 2 briefly describes the nature of the equity premium; Section 3 summarizes the Vietnamese equity market; Section 4 describes the data set and its descriptive statistics; Section 5 discusses the methodology and model's specification; Section 6 reports and discusses the empirical results; and Section 7 provides some concluding remarks and recommendations.

NATURE OF EQUITY PREMIUM

Brealey and Myers (2003) articulated that an integral part of the economic and financial literature on equity premium is the assumption that "there is a normal, stable, risk premium on the market portfolio." Therefore, to estimate the ex-ante equity premium, the most popular method is to extrapolate the historically realized equity premium into the future (Welch, 2000). For example, Brealey and Myers (2000), described how to estimate a return for a diversified stock market portfolio. They do this by taking the current interest rate on U.S. Treasury bills plus the average equity premium over some historical time period. In other words, they simply extrapolated past returns forward. Brealey and Myers (2000) noted that their result is consistent with security analysts' forecasts of earnings growth. This assumption requires that the equity premium time series be mean-reverting. In addition, the capital asset pricing model (CAPM) conceptually postulates that investors set their required real earning yields as some markup relative to real risk free interest rates. In the equity market, this mark-up is the equity premium. If this equity premium becomes excessively high or low, the marketplace will put pressure on the investors to adjust it back to some "normal" or equilibrium equity premium. Specifically, the above assumption implies that the equity premium returns back to its long run equilibrium position following any shock.

Perhaps the state of the equity premium puzzle today still can be described best by one of the two researchers who originally recognized the anomaly: "After detailing the research efforts to enhance the model's ability to replicate the empirical data, I argue that the proposed resolutions fail along crucial dimensions." Mehra (2003). Also, Damodaran (2014) articulated that Equity risk premiums are a central component of every risk and return model in finance and are a key input into estimating costs of equity and capital in both corporate finance and valuation. Given their importance, it is surprising how haphazard the estimation of equity risk premiums remains in practice.

BANGLADESHI EQUITY MARKET

As described by Mollik et al. (2009), the stock market history of Bangladesh dates back to 28 April, 1954 when the East Pakistan Stock Exchange Association Ltd. was established. Formal trading began on the bourse in 1956. The trading was suspended during the liberation war of Bangladesh in 1971. Operation resumed again in the 1976 with the change in government policy. During 1976, there were only 9 listed companies with total paid up capital of Bangladeshi Taka (Tkd) 0 .138 billion and market capitalization of Tkd 0 .147 billion which was 0.138 percent of GDP. Since then the stock exchange continued its journey of growth. The second stock exchange of the country, the Chittagong Stock Exchange (CSE) was established in December 1995. In order to control operation of the stock exchanges and trading of stocks of listed companies, the government of Bangladesh established the Securities and Exchange Commission (SEC) of Bangladesh on 8th June, 1993 under the Securities and Exchange Commission Act, 1993. The mission of the SEC is to protect the interests of securities investors, develop and maintain fair, transparent and efficient securities markets, ensure proper issuance of securities and compliance with securities laws.

From the inception, the stock market of the country was growing at a slow pace. However there was a large surge in the stock market in the Summer and Fall of 1996 evidenced by a 506.63 percent, 210.2 percent and 615.15 percent increase in the market capitalization, total annual turnover and daily average turnover in CSE respectively.

Later, investors' confidence was significantly damaged because of excessive speculation, allegedly aggravated by widespread irregular activities. The government of Bangladesh undertook the Capital Market Development Program (CMDP1) supported by the Asian Development Bank (ADB) on 20 November 1997. The CMDP1 aimed at (i) strengthening market regulation and supervision, (ii) developing the stock market infrastructure, (iii) modernizing stock market support facilities, (iv) increasing the limited supply of securities in the market, (v) developing institutional sources of demand for securities in the market, and (vi) improving policy coordination. The Central Depository Bangladesh Limited (CDBL) was incorporated as a public limited company on 20th August 2000 to operate and maintain the Central Depository System (CDS) of Electronic Book Entry, recording and maintaining securities accounts and registering transfer of securities; changing the ownership without any physical movement of securities and to ensuring risk-free and cost-effective settlements. The CDBL also focused on other investor services including providing a platform for the secondary market trading of Treasury Bills and Government Bonds issued by the Bangladesh Bank. CDBL went live with the Electronic Treasury Bills registry of Bangladesh Bank on 20th October, 2003 and thereafter started equity market operations on 24th January, 2004. Before establishment of CDBL, the delivery, settlement and transfer procedures were handled manually and were plagued by lengthy delays, risks of damage, loss, forgeries, duplication and considerable investment in time and capital. Besides, both the Chittagong Stock Exchange and the Dhaka Stock Exchanges have automatic trading services since July and August 1998, respectively.

Again, the Bangladeshi equity market experienced another bull run during most of 2010. The 2010 crisis was a case of deja vu and brought back memories of 1996 which led to a large sell-off and brought the economy to the brink of a financial meltdown. The 2010 market correction wiped out $27 billion in market capitalization and with it bankruptcies, savings, loss of jobs, triggering a wave of social discontent. The ensuing liquidity crunch led to heightened solvency risks. Indeed, given the interconnectedness between banks and equity markets, there was a grave concern that a perfect storm could result in a negative feedback loop from the financial sector to the real economy and potentially bringing the economy to a grinding halt.

Table 1- MARKET CAPITALIZATION OF LISTED COMPANIES AS PERCENTAGE OF GDP

Advanced Markets	2009	2010	2011	2012	***Asian Emerging Markets***	2009	2010	2011	2012
Canada	125.7	137.0	107.2	110.7	People's Republic of China	100.3	80.1	46.3	44.2
France	75.3	75.6	56.4	69.8	India	86.4	94.4	54.2	68.6
Germany	39.3	43.5	32.9	43.7	Malaysia	126.6	166.3	137.2	156.9
Japan	67.1	74.6	60.0	61.8	***Pakistan***	***20.5***	***21.6***	***15.5***	***18.9***
Rep. of Korea	100.3	107.3	89.2	104.5	Philippines	47.6	78.8	73.8	105.6
New Zealand	57.6	51.4	45.1	47.7	Sri Lanka	19.3	40.2	32.8	28.7
Singapore	160.1	170.4	125.8	150.8	Thailand	52.4	87.1	77.7	104.7
United States	108.5	118.9	104.3	119.0	Vietnam	21.8	19.2	14.8	23.2

Average	*91.7*	*97.3*	*77.6*	*77.1*	*Average*	*59.4*	*73.5*	*56.6*	*68.9*

Source: *World Bank, World Development Indicators. Market capitalization is the share price times the number of shares outstanding. Listed domestic companies are domestically incorporated companies listed on the country's stock exchange at the end of the year (2012). Listed companies do not include investment companies, mutual funds, or collective investment vehicles.*

In response to the crisis, the Bangladeshi government embarked on a series of reforms and partnered by the Asian Development Bank (ADB) under the Second Capital Markets Development Programme (CMDP2) in November 2012. The programme is based on a two-track approach that seeks to put fire walls in place to support market stabilization and plant the seeds for key reforms that would lead to sustainable market development.

CMDP2 is based on three important pillars. First, the Bangladesh Securities and Exchange Commission (BSEC) had to be given a stronger mandate, together with resources. The amendment of the Securities and Exchange Commission (SEC) Act in November 2012 paved the way for the BSEC to have unhindered access to the BSEC Fund. The amendment also removed government approval of the BSEC budget or expenditures from the BSEC Fund as well as provided benefits to BSEC staff comparable to those at Bangladesh Bank (BB).

The operationalization of a real-time market surveillance system under CMDP2 helps BSEC to detect trading irregularities and market abuse as they occur. The installation of such a state-of-the-art surveillance system also increases transparency of market transactions and contributes significantly to enhanced investor confidence.

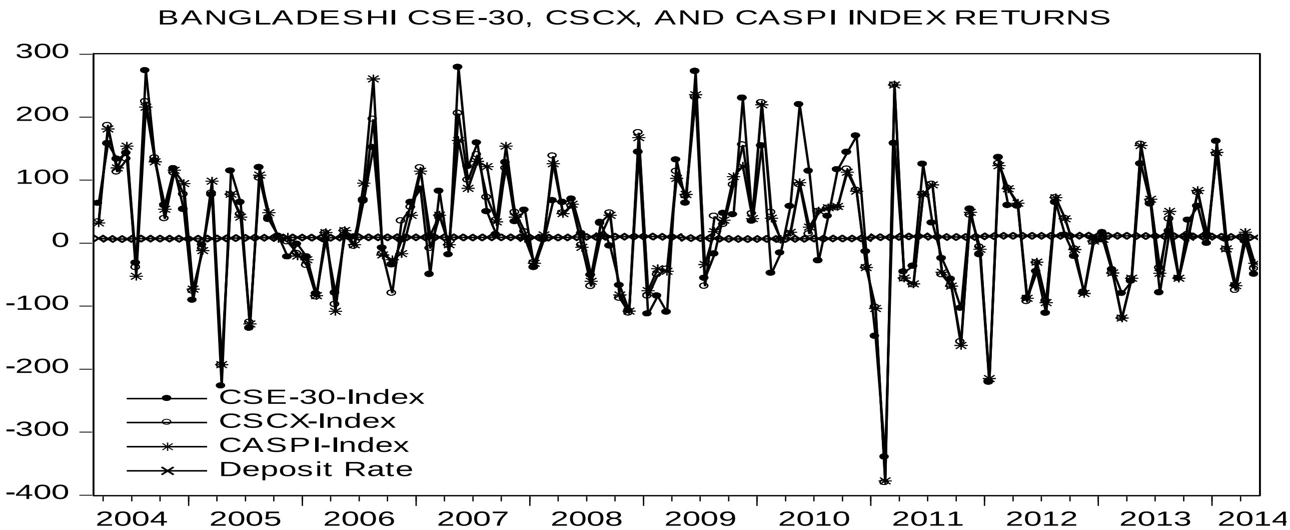
Secondly, stock exchanges were identified as critical drivers of change. The agreed approach was to correct the governance structure through demutualization of the Dhaka and Chittagong stock exchanges.

This would serve to align the broader incentives of market development with those of the "club members," mainly the brokers and dealers. Numerous steps have been taken to effectively implement the demutualization process, such as enactment of the Demutualization Act in April 2013, followed by submission of the demutualization schemes by both stock exchanges and the approval of these schemes by BSEC in September 2013.

The CMDP2 is nearing its mid-point. Reforms have been rolled out and the market is gaining greater confidence in line with increasing traction of the new policy and regulatory incentives. Results to date are promising as foremost the market has stabilized as evidenced by the 21% increase in market capitalization to $32.98 billion (as of November 06, 2013) from $27.1 billion a year earlier. The Bangladeshi total market capitalization to gross domestic product ratios from 2009 to 2013 were 7.64 percent, 11.08 percent, 17.24 percent, 23.45 percent and 25.39 percent, respectively. However, as compared to data reported in Table 1, the Bangladeshi equity market is still relatively small as a percentage of its GDP at the end of 2012.

DATA

This study utilizes three monthly stock price indices of the Bangladeshi Chittagong Stock Exchange (CSE-30, CSCX, and CASPI) in Bangladesh and the deposit rate as the proxy measure for risk-free rate. The data set, used in this investigation, covers the period from February 2004 to May 2014 where the data is available. The time-series data is obtained from the Chittagong Stock Exchange. In this analysis, let $ER_{s,t}$ and RF_t denote the annualized monthly return on each of the three aforementioned Bangladeshi equity indices and the risk free rate, respectively. The monthly returns on the indices are annualized to be comparable to the risk-free rate which is stated on an annual basis. The difference between $ER_{s,t}$ and RF_t is defined as the equity premium of the index s and is denoted by $EP_{s,t}$, where s = CSE-30, CSCX, and CASPI. Figure 1 illustrates the behavior of $ER_{s,t}$, RF_t and $EP_{s,t}$ over the sample period.



Sources: Bangladeshi Equity Market

Figure 1

Following are the descriptive statistics of the four time series (CSE-30, CSCX, CASPI and the Deposit Rate) of the Bangladeshi equity annualized monthly returns. The mean of CSE-30 is 14.96 percent, ranging from -349.09 percent to 269.65 percent with standard error being 100.45 percent. The corresponding figures for the CSCX are 14.31 percent, -389.46, 241.38 percent, and 96.77 percent, respectively. As to the CASPI index, its mean is 15.89 percent, ranging from -386.80 percent to 251.32 percent with standard error being 96.68 percent. Finally, the corresponding statistics for the proxy measure of the risk-free rate are 9.20 percent, 6.43 percent, 11.85 percent, and 1.59 percent, respectively. In addition, as compared to the figures reported by Pablo et al. (2014) from their 2014 survey of market premium used in 2014 in 88 countries, in Table 2, the average premia for the Bangladeshi indices are the among the highest premia in its neighboring Asian countries and much higher than the corresponding figures in the advanced economies.

Table 2- MARKET RISK PREMIUM USED IN 2014 IN SELECTED ADVANCED AND ASIAN EMERGING MAKETS

Advanced Markets	Mean	St. Div.	Min.	Max.	***Asian Emerging Markets***	Mean	St. Div.	Min.	Max.
Canada	5.3	1.2	3.0	10.0	People's Republic of China	8.1	3.5	3.9	20.0
France	5.8	1.5	2.0	11.4	India	8.0	2.4	2.3	16.0
Germany	5.4	1.7	1.0	12.4	Malaysia	6.4	6.8	3.4	8.8
Japan	5.3	2.4	2.0	16.7	Pakistan	11.1	5.3	2.5	19.0
Rep. of Korea	6.3	1.8	2.0	11.1	Philippines	8.1	1.4	6.4	11.0
New Zealand	5.6	1.4	2.0	18.0	Sri Lanka	11.3	2.0	9.0	14.0
Singapore	5.7	1.3	3.9	9.6	Thailand	8.0	1.8	6.0	15.1
United States	5.4	1.4	1.5	13.0	Vietnam	10.3	3.3	3.9	16.0
Average	5.6	1.6	2.2	12.8	*Average*	8.9	3.3	4.7	15.0

Source: *Market Risk Premium used in 88 countries in 2014: a survey with 8,228 answers, by Pablo Fernandez, Pablo Linares, and Isabel Fernandez Acín. IESE Business School. Downloadable in:* *http://ssrn.com/abstract=2450452***.**

METHODOLOGICAL ISSUES AND THE ANALYTICAL FRAMEWORK

Structural Break

Historically, every economy would experience many business cycles caused by internal and external shocks; therefore, countercyclical monetary policy actions would be used to bring the economy back to its long-run path. Bangladesh is no exception! Consequently, the spread between return on any of the aforementioned market equity index and the risk free rate, the equity premium, is most likely to suffer some structural breaks. To search endogenously for the possibility of any structural break in the basis, this investigation utilized Perron's (1997) endogenous unit root test function with the intercept, slope, and the trend dummy, as specified by equation (1), to test the hypothesis that the spread between each stock price index and the deposit rate has a unit root.

$$EP_{s,t} = \mu_s + \theta_s DU_s + \varsigma_s t_s + \xi_s DT_s + \delta_s D_s(T_b) + \zeta_s EP_{s,t-1} + \sum_{i=1}^{k} \psi_{s,i} \Delta EP_{s,t-i} + \upsilon_{s,t} \qquad (1)$$

where s = CSE-30, CSCX, and CASPI; $DU_s = 1(t > T_b)$ is a post-break constant dummy variable; t_s is a linear time trend; $DT_s = 1(t > T_b)$ is a post-break slope dummy variable; $D_s(T_b) = 1(t = T_b + 1)$ is the break dummy variable; and $\varepsilon_{s,t}$ are white-noise error terms. The null hypothesis of a unit root is stated as $\zeta_s = 1$. The break date, T_b, is selected based on the minimum t-statistic for testing $\zeta_s = 1$ (see Perron, 1997).

Threshold Autoregressive (TAR) model

To further investigate the nature of the Granger causality between each of the above equity premia and the risk-free rate, this study uses the threshold autoregressive (TAR) model, developed by Enders-Siklos (2001) that allows the degree of autoregressive decay to depend on the state of the equity premium, i.e. the "deepness" of cycles. The estimated TAR model would empirically reveal if an excess of the above premia tend to revert back to the long-run position faster when the premium is above or below the threshold. Therefore, the TAR model indicates whether troughs or peaks persist more when shocks or countercyclical monetary policy actions occur, causing changes in the deposit rate, pushing the given equity premium out of its long-run equilibrium path. In this model's specification, the null hypothesis that the basis contains a unit root can be expressed as $\rho_{s,1} = \rho_{s,2} = 0$, while the hypothesis that the basis is stationary with symmetric adjustments can be stated as $\rho_{s,1} = \rho_{s,2}$.

The first step in the Enders-Siklos' (2001) procedure is to regress the equity premium, $EP_{s,t}$, on a constant, a time trend, and an intercept dummy (with values of zero prior to the structural break date and values of one for the structural break date and thereafter), as specified by equation (2).

$$EP_{s,t} = \pi_{s,0} + \pi_{s,1} Trend_{s,t} + \pi_{s,2} Dummy_{s,t} + \varepsilon_{s,t} \qquad (2)$$

The retentions of these estimated coefficients of equation (2) are determined by the calculated t-statistics at the 5 percent level of significance. The saved residuals, $\varepsilon_{s,t}$ from the estimation of equation (2), denoted by $\hat{\varepsilon}_{s,t}$, are then used to estimate the following TAR model:

$$\Delta\hat{\varepsilon}_{s,t} = I_t \rho_{s,1} \hat{\varepsilon}_{s,t-1} + (1 - I_t)\rho_{s,2}\hat{\varepsilon}_{s,t-1} + \sum_{i=1}^{p} \alpha_i \Delta\hat{\varepsilon}_{s,t-p} + \hat{u}_{s,t} \qquad (3)$$

where $\hat{u}_{s,t} \sim i.i.d.(0, \sigma_s^2)$, and the lagged values of $\Delta\hat{\varepsilon}_{s,t}$ are meant to yield uncorrelated residuals. As defined by Enders and Granger (1998), the Heaviside indicator function for the TAR specification is given as:

$$I_{s,t} = \begin{cases} 1 & if\ \hat{\varepsilon}_{s,t-1} \geq \tau_s \\ 0 & if\ \hat{\varepsilon}_{s,t-1} < \tau_s \end{cases} \tag{4}$$

The threshold value, τ_s, is endogenously determined using the Chan (1993) procedure which obtains τ by minimizing the sum of squared residuals after sorting the estimated residuals in an ascending order, and eliminating 15 percent of the largest and smallest values. The elimination of the largest and the smallest values assures that the $\hat{\varepsilon}_{s,t}$ series crosses through the threshold in the sample period. Throughout this study, the included lags are selected by the statistical significance of their estimated coefficients as determined by the *t-statistics*.

The Asymmetric Error-Correction Models

If the results of the above asymmetric co-integration tests are positive, a Threshold Autoregressive Vector Error-Correction (TAR-VEC) model is specified and estimated to continue an investigation into any asymmetric short-run dynamic behaviour that occur between each of the three Bangladeshi monthly changes in equity indices and the deposit rates. Results of this model can be used to study the Granger causality between the monthly changes in each of the equity indices and the deposit rates. The Granger causality will help to evaluate empirically (through statistics) how changes in each of the three Bangladeshi equity indices and the deposit rates respond to the widening and the narrowing of the spread between the monthly changes in a given index and the deposit rates due to external economic shocks or countercyclical policy actions, altering the deposit rates. Again, conventional error-correction models do not suffice for this purpose, because they do not allow the asymmetric adjustments toward the long-run equilibrium that the TAR-VEC model does.

$$\Delta ER_{s,t} = \alpha_{s,0} + \rho_{s,1} I_t \hat{\varepsilon}_{s,t-1} + \rho_{s,2}(1 - I_t)\hat{\varepsilon}_{s,t-1} + A_{s,11}(L)\Delta ER_{s,t-i} + A_{s,12}(L)\Delta RF_{t-i} + u_{s,1t} \tag{5}$$

$$\Delta RF_t = \tilde{\alpha}_{s,0} + \tilde{\rho}_{s,1} I_t \hat{\varepsilon}_{s,t-1} + \tilde{\rho}_{s,2}(1 - I_t)\hat{\varepsilon}_{s,t-1} + A_{s,21}(L)\Delta ER_{s,t-i} + A_{s,22}(L)\Delta RF_{t-i} + u_{s,2t} \tag{6}$$

where $u_{s,1t} \sim i.i.d.(0, \sigma_s^2)$, $u_{s,2t} \sim i.i.d.(0, \sigma_s^2)$, s = SE-30, CSCX, and CASPI, and the Heaviside indicator function is set in accordance with (4). This assumes that the monthly changes in each of the Bangladeshi equity indices may respond differently depending on whether the spread is widening or narrowing as a result of expansionary monetary policy, contractionary monetary policy, or external shocks that cause the deposit rate to change.

GARCH(s, r)-M MODEL

Regarding the equity premium in relation to market volatility and economic conditions, Graham and Harvey (2009) analyzed the history of the equity premium from surveys of U.S. Chief Financial Officers conducted every quarter from June 2000 to March 2009. They defined the equity premium as the expected 10-year S&P 500 return relative to a 10-year U.S. Treasury bond yield. They noted that these surveys were conducted during the darkest parts of a global financial crisis. They further indicated that the equity premium sharply increased during the crisis. The authors also found that the level of the equity premium closely tracks the market volatility as measured by the VIX. Additionally, from June 2000 to March 2012 surveys, Graham and Harvey (2012) found that while the equity premium sharply increased during the financial crisis peaking in February 2009, and then steadily fell until the second quarter 2010. These aforementioned results indicated that the equity premium is affected by market volatility and economic conditions of the economy.

The Bangladeshi economy has become steadily more internationalized and the international economic landscape over the sample period has been dotted with international political and social turmoil. These developments may exacerbate the variance of equity premium and cause the variance to be different from some sub-periods to others over the sample period. Additionally, the graph of the Bangladeshi equity premia in Figure 1 strongly supports the different variances in the Bangladeshi equity return from one sub-period to another. Therefore, another important question for investors, policy makers, and corporate executives is whether the fluctuations in the equity premia of the market portfolio and hence their variances from the one month affect the premia and the variances in the following month. To this end, this investigation specifies and estimates the following GARCH(s, r)-in-Mean (GARCH-M) model to discern this possibility. The GARCH-M models have been very popular and effective for modeling the volatility dynamics in many asset markets.

$$EP_{s,t} = c_s + \lambda_s Ln(\omega_{s,t}^2) + \varepsilon_{s,t} \tag{7}$$

$$\omega_{s,t}^2 = \alpha_s + \sum_{l=1}^{r} \beta_{s,l}\varepsilon_{s,t-l}^2 + \sum_{m=1}^{s} \eta_{s,m}\omega_{s,t-m}^2 \tag{8}$$

where $EP_{s,t}$ is the equity premium, *Ln* is the natural Logarithm, and $\omega_{s,t}^2$ is the variance of the Bangladeshi equity indices at time *t*; $\varepsilon_{s,t}$ is a disturbance; c is a constant; λ_s, α_s, $\beta_{s,l}$, and $\eta_{s,m}$ are the parameters of the model to be estimated. The retentions of these estimated coefficients are determined by the calculated z-statistics at the 5 percent level of significance. The *r* and *s* indices are the highest subscripts *l* and *m* of retained β_l and η_m.

EMPIRICAL RESULTS

Results of the Test for Structural Break

The estimation results of Perron's endogenous unit root tests are summarized in Exhibits 1-a, 1-b, and 1-c. With regard to the CSE-30 index reported in Exhibit 1-a, an analysis of the empirical results reveals that the post-break intercept dummy variable, *DU*, and the post-break slope dummy variable, *DT*, are negative and insignificant at any conventional level. The time trend is positive and is also insignificant at a 10 percent level. The break dummy variable, $D_s(T_b) = 1(t = T_b + 1)$ is negative and significant at any conventional level of significance. The empirical results of these tests suggest that the Bangladeshi CSE-30 equity premium followed a stationary process with a break date of January 2001.

A close look that the estimation results for the Bangladeshi CSCX index, summarized in Exhibit 1-b reveal the following: The post-break intercept dummy variable, *DU*, is negative and insignificant at a 10 percent level. The post-break slope dummy variable, *DT*, is positive and insignificant at any conventional level. The time trend is negative and is significant at a 1 percent level. The break dummy variable, $D_s(T_b) = 1(t = T_b + 1)$ is negative and significant at any conventional level. The empirical results of these tests suggest that the Bangladeshi CSE-30 equity premium followed a stationary trend process with a break date of May 2006.

Finally, an analysis of the estimation results for the Bangladeshi CASPI index, summarized in Exhibit 1-c suggest that he post-break intercept dummy variable, *DU*, is negative and insignificant at a 10 percent level. The post-break slope dummy variable, *DT*, is positive and significant at any conventional level. The time trend is negative and is significant at a 1 percent level. The break dummy variable, $D_s(T_b) = 1(t = T_b + 1)$ is positive and significant at any conventional level. The empirical results of these tests suggest that the Bangladeshi CSE-30 equity premium followed a stationary trend process with a break date of July 2006.

Exhibit 1-a- Perron's Endogenous Unit Root Test—Bangladeshi CSE-30, Data, 2004:02-- 2014:05

$$EP_t = 32.2943 - 43.9559DU + 0.0145t - 0.0329DT - 338.6281D(T_b) - 0.0174EP_{t-1} + \upsilon_t$$

(-1.4919) (-0.3058) (0.0145) (-0.328) (-3.3820*) (-0.6469)

No. of augmented lags: $k = 0$ Break Date: January 2011 $t(\alpha = 1) = -11.2765*$

Exhibit 1-b- Perron's Endogenous Unit Root Test—Bangladeshi CSCX, Data, 2004:02-- 2014:05

$$EP_t = 131.4597 - 49.6816DU - 7.5599t + 6.6588DT - 70.6960D(T_b) - 0.0787EP_{t-1} + \upsilon_t$$

(3.1723*) (-1.0121) (-2.9894*) (2.6285*) (-0.7404) (-0.8519)

No. of augmented lags: $k = 0$ Break Date: May 2006 $t(\alpha = 1) = -11.6800*$

Exhibit 1-c- Perron's Endogenous Unit Root Test-- Bangladeshi CASPI Data, 2004:02-- 2014:05

$$EP_t = 117.0101 - 46.1375DU - 5.9087t + 5.1432DT + 209.8753D(T_b) - 0.0751EP_{t-1} + \upsilon_t$$

(2.9896*) (-0.9665) (-2.6541*) (2.2987) (2.2254*) (-0.8224)

No. of augmented lags: $k = 0$ Break Date: July 2006 $t(\alpha = 1) = -11.7673*$

Notes: *Critical values for t-statistics in parentheses: Critical values based n = 100 sample for the break-date (Perron, 1997). "*", "**", and "***" indicate significances at 1 percent, 5 percent, and 10 percent levels, respectively.*

Results of the Cointegration Test with Asymmetric Adjustment

To examine whether the aforementioned Bangladeshi three equity premia , $EP_{s,t}$, and the risk-free rate, $RF_{s,t}$, are co-integrated when allowing for possible asymmetric adjustments, each of the three equity premia is regressed on a constant and an intercept dummy with values of zero prior to its break date and values of one for the break date and thereafter. As previously articulated, the retentions of these estimated coefficients of equation (2) are determined by the calculated t-statistics at the 5 percent level of significance. The estimation results are reported in Exhibits 2-a, 2-b, 2-c.

Exhibit 2-a- Estimation Results for Equation (2), Bangladeshi CSE-30 Data, 2004:02-- 2014:05

$$EP_t = 32.5796 - 54.1956Dummy_t + \varepsilon_t$$

(-1.6491) (-4.0917*)

ln L = -736.9210 $R^2 = 0.0567$ DW statistic[(a)] = 1.9234 $F_{(1,121)} = 8.3292^{*}$

Exhibit 2-b- Estimation Results for Equation (2), Bangladeshi CSCX-30 Data, 2004:02-- 2014:05

$$EP_t = 45.8179 - 0.0582Trend_t + \varepsilon_t$$

(-1.6491) (-4.0917*)

ln L = -734.2251 $R^2 = 0.0271$ DW statistic[(a)] = 1.9998 $F_{(1,121)} = 4.3951^{**}$

Exhibit 2-c- Estimation Results for Equation (2), Bangladeshi CASPI Data, 2004:02-- 2014:05

$$EP_t = 48.8533 - 0.5317Trend_t + \varepsilon_t$$

(2.8284*) (-2.1993**)

ln L = -733.9037 $R^2 = 0.0305$ DW statistic[(a)] = 2.0027 $F_{(1,121)} = 4.8368^{*}$

Notes: *"*" indicates significance at 1 percent level.*

(a) *As articulated by Enders and Siklos (2001, p. 166), in this type of model specification, ε_t may be contemporaneously correlated.*

Each of the residual series from the above estimations is used to estimate the TAR model specified by equations (4) and (5). The estimation results for the TAR model are reported in Exhibit 3-a, 3-b, and 3-c. Numerically, the estimation results reveal $|\rho_{s,2}| > |\rho_{s,1}|$ *for s's, which seems to indicate* a *slower* convergence for positive disequilibrium than for negative disequilibrium, i.e., an asymmetric adjustment process. However, based on the calculated partial *F*-statistics (3.4586, 2.5184, and 2.4169), the null hypothesis that $\rho_{s,1} = \rho_{s,2}$, can be rejected at a 10 percent level of significance for the CSE-30 index; while this null hypothesis cannot be rejected at any significant level for s = CSCX and CASPI. These statistical test results suggest an asymmetric adjustment of the equity premium of the CSE-30 index about its threshold and symmetric adjustments of the equity premia of the CSCX and CASPI indices about their thresholds to negative and positive shocks in the long run.

Additionally, The calculated statistics $\Phi_{s,\mu}$ *(s=CSE-30, CSCX, and CASPI)* indicate that the null hypothesis of no co-integration, $\rho_{s,1} = \rho_{s,2} = 0$, should also be rejected at the 1 percent significance level for all indices, confirming that all three equity premia are stationary. With regard to the stationarity of the premia, Ewing et al. (2007) pointed out that this simple finding of stationarity of a given premium is consistent with the two underlying series comprising that premium (the monthly return on the Bangladeshi CSE-30, CSCX, and CASPI indices and the risk-free rate) being co-integrated in the *conventional, linear combination sense*.

Exhibit 3-a- Unit Root and Test of Asymmetry, Bangladeshi CSE-30 Data, 2004:02-- 2014:05

ρ_1	ρ_2	τ	$H_0:\rho_1=\rho_2=0$	$H_0:\rho_1=\rho_2$	aic	sic
-0.8594*	-1.5857*	-87.3395	Φ_μ = 21.3169*	*F* = 3.4586***	9.2001	9.3156
	$Q_{(12)}$=6.4230[0.8933]		*ln L = -723.2971*	*$F_{(4,116)}$=29.0125**	DW = 2.0076	

Exhibit 3-b- Unit Root and Test of Asymmetry, Bangladeshi CSCX Data, 2004:02-- 2014:05

ρ_1	ρ_2	τ	$H_0:\rho_1=\rho_2=0$	$H_0:\rho_1=\rho_2$	aic	sic
-1.0566*	-1.4987*	-0.3407	Φ_μ = 33.2406*	*F* = 2.5184	9.0882	9.2037
	$Q_{(12)}$=7.6520[0.8116]		*ln L = -716.5272*	*$F_{(4,1116)}$=35.1335**	DW = 1.9845	

Exhibit 3-c- Unit Root and Test of Asymmetry, Bangladeshi CASPI Data, 2004:02-- 2014:05

ρ_1	ρ_2	τ	$H_0:\rho_1=\rho_2=0$	$H_0:\rho_1=\rho_2$	aic	sic
-1.1917*	-1.6163*	-4.3392	Φ_μ = 38.9692*	*F* = 2.4169	9.0376	9.1531
	$Q_{(12)}$=8.9180[0.7099]		*ln L = -713.4650*	*$F_{(4,116)}$=38.2422**	DW = 1.9968	

Notes: *The null hypothesis of a unit root, $H_0:\rho_{s,1} = \rho_{s,2} = 0$, uses the critical values from Enders and Siklos, 2001, p. 170, Table 1 for four lagged changes and n = 500.. "*" and "**"indicate 1 percent and 5 percent levels of significance, respectively. The null hypothesis of symmetry, $H_0:\rho_{s,1} = \rho_{s,2}$, uses the standard F* *distribution.* τ *is the threshold value determined via the Chan (1993) method.* $Q_{(12)}$ *denotes the Ljung-Box Q-statistic with 12 lags.*

Results of the Asymmetric Error-Correction Models

Exhibits 4-a, 4-b, and 4-c summarize the estimation results for the TAR-VEC model specified by equations (4), (5) and (6) using the monthly returns on the CSE-30, CSCX, and CASOI indices and the deposit, i.e., risk-free rate. In the summary of the estimation results, "*", "**", and "***" indicate the 1 percent, 5 percent and 10 percent significant levels of the *t-statistic*. $Q_{LB\,(12)}$ is the Ljung-Box statistic and its significance is in square brackets, testing for the first twelve of the residual autocorrelations to be jointly equal to zero. *lnL* is the log likelihood. The overall *F-statistics* with the p-value in square brackets test the overall fitness of the models. $A_{ij}(L)$ is the first-order polynomial in the lag operator L. F_{ij} is the calculated F-statistic (with the p-value in brackets), which tests the null hypothesis that all coefficients of A_{ij} are equal to zero.

An analysis of the overall empirical results (CSE-30, CSCX, and CASPI) that all the estimated equations (5) and (6) using different indices are absent of serial correlation and have good predicting power as evident by the Ljung-Box statistics and the overall *F-statistics*, respectively.

Table 4-a: Return on Bangladeshi CSE-30 and Deposit Rates Data, 2004:04 - 2014:05

$$\Delta ER_t = 0.4374 - 0.8815 I_t \hat{\varepsilon}_{t-1} - 0.8248(1-I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta ER_{t-i} + A_{12}(L)\Delta RF_{t-i} + u_{1t}$$

(0.9630) (-7.2269*) (5.0497*) F_{11}= 5.9474[0.0010] F_{12}=8.5439[0.0000]

$Q_{(12)}$ = 8.7710[0.7224] *ln L* = -570.0879 $F_{(9,89)}$*-statistic* =19.0235*

$$\Delta RF_t = -0.0100 + 0.0004 I_t \hat{\varepsilon}_{t-1} - 0.0002(1-I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta ER_{t-i} + A_{22}(L)\Delta RF_{t-i} + u_{2t}$$

(-0.2173) (0.6002) (-0.210) F_{21}=3.1956[0.0272] F_{22}=4.2043[0.0036]

$Q_{(12)}$ =5.7310 [0.8703] *ln L* = -44.7344 $F_{(9,90)}$*-statistic* =2.4612**

Table 4-b: Return on Bangladeshi CSCX and Deposit Rates Data, 2004:04 - 2014:05

$$\Delta ER_t = -2.5948 - 0.9540 I_t \hat{\varepsilon}_{t-1} - 1.1741(1-I_t)\hat{\varepsilon}_{t-1} + A_{11}(L)\Delta ER_{t-i} + A_{12}(L)\Delta RF_{t-i} + u_{1t}$$

(-0.2108) (-5.9441*) (-7.5483*) F_{11}= 4.3723[0.0153] F_{12}=10.5916[0.0000]

$Q_{(12)}$ = 20.8440[0.0527] *ln L* = -586.1629 $F_{(8,93)}$*-statistic* =23.7142*

$$\Delta RF_t = -0.0735 + 0.0007 I_t \hat{\varepsilon}_{t-1} - 0.0014(1-I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta ER_{t-i} + A_{22}(L)\Delta RF_{t-i} + u_{2t}$$

(-1.1030) (0.8665) (-1.7429***) F_{21}=4.8666[0.0003] F_{22}=9.5928[0.0167]

$Q_{(12)}$ =7.463 [0.8255] *ln L* = -48.3026 $F_{(6,93)}$*-statistic* =2.4844**

Table 4-c: Return on Bangladeshi CASPI and Deposit Rates Data, 2004:04 - 2014:05

$$\Delta ER_t = -0.2886 - 1.0336 I_t \hat{\varepsilon}_{t-1} - 1.1378(1-I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta ER_{t-i} + A_{22}(L)\Delta RF_{t-i} + u_{1t}$$

(-0.0247) (-6.6994*) (-7.5490*) F_{21}=4.8666[0.0002] F_{22}=9.5828[0.0000]

$Q_{(12)}$ =13.9190[0.3059] *ln L* = -552.3706 $F_{(16,82)}$*-statistic* =16.7635*

$$\Delta FR_t = -0.0499 + 0.0008 I_t \hat{\varepsilon}_{t-1} - 0.0010(1-I_t)\hat{\varepsilon}_{t-1} + A_{21}(L)\Delta ER_{t-i} + A_{22}(L)\Delta RF_{t-i} + u_{2t}$$

(-0.0247) (-6.6994*) (-7.5490*) F_{21}=3.1382[0.0481] F_{22}=3.6454[0.0592]

$Q_{(12)}$ =11.2570[0.5070] *ln L* = -50.1436 $F_{(5,96)}$*-statistic* =2.2727***

Notes: *Partial F-statistics for lagged values of changes in the lending rate and Central Bank discount rate, respectively, are reported under the specified null hypotheses.* $Q_{(12)}$ *is the Ljung-Box Q-statistic to test for serial correlation up to 12 lags. "*" and "***"indicates 1 percent and 10 percent levels of significance of the t-statistic, respectively.*

With regard to the short-run dynamic Granger causality between the annualized monthly changes or the returns on each of the Bangladeshi indices under investigation and the risk-free rate, the partial *F-statistics* in equation (5) reveal a bi-directional Granger-causality between the risk-free rate to their monthly returns; i.e., the monthly returns of CSE-30, CSCX, and CASPI respond to both their own lagged changes and the lagged changes of risk-free rate as well. Similarly, the empirical results for equation (6), the partial *F-statistics* suggest that the risk-free rate responds not only to its own lagged changes but also to lagged changes of the monthly returns of CSE-30, CSCX, and CASPI in the short run. Over all, the TAR-VEC estimation results seem to suggest that the Bangladeshi CSE-30, CSCX and CASPI indices respond to monetary, fiscal policy and economic shocks which change the deposit rates. This finding indicates that the Bangladeshi economic policies matter for the stocks traded on the Bangladeshi Chittagong Stock Exchange in the short run.

As to the long-run adjustments when the short-run dynamics is introduced to the model as specified by equations (5) and (6), the estimation results are reported in exhibits 4-a, 4-b, and 4-c. An analysis of the results reveal that the calculated t-statistics indicate that all $\rho_{s,1}$ and $\rho_{s,2}$ are statistically significant at any conventional levels. Specifically, for the CSE-30 index, the empirical results reveal that $|\rho_1| > |\rho_2|$ *which seems to indicate* a *faster* convergence for positive disequilibrium than for negative disequilibrium. With regard to the CSCX and CASPI indices, the empirical results reveal that $|\rho_{s,2}| > |\rho_{s,1}|$, for s = CSCX and CASPI, indicating a *slower* convergence for positive disequilibrium than for negative disequilibrium.

GARCH(s, r)-M Model

As aforementioned, the retentions of the estimated coefficients of equations (7) and (8) are determined by the calculated z-statistics at the 5 percent level of significance. The *r* and *s* indices are the highest subscripts *l* and *m* of retained β_l and η_m which are *l* =1 and *m*=2, respectively. The values of *l* and *m*, in turn, suggest GARCH (1, 2) be the best model for this investigation**.** The estimation results of the GARCH (1, 2)-M model are reported in Exhibit 5.

An analysis of the estimation results of the GARCH(r, s)-M model suggests the presence of GARCH (1, 2) effect on the Bangladeshi monthly changes in the CSE-30, CSCX, and CASPI indices and their variances. Financially, the empirical results indicate that the fluctuations in the equity premia on the market portfolio and their variances from the one month affect the premia and the variances in the following month.

Exhibit 5-a- GARCH (1,2)-M Model Results ,Bangladeshi CSE-30 Data, 2004:02-- 2014:05

$$EP_t = 28914.7700 - 3134.2080 Ln(\omega_t^2) + \varepsilon_t \quad (9)$$

(1.0048) (-1.6016)

$$\omega_t^2 = 8557.2710 + 3.4197\varepsilon_{t-1}^2 - 1.8405\omega_{t-1}^2 - 0.4643\omega_{t-2}^2 \quad (10)$$

(0.1243) (0.2691) (-0.7534) (-0.5576)

Notes: *Akaike info criterion=25.2571; Schwarz criterion =25.3943; Hannan-Quinn Criterion=25.3129; Log likelihood = -1547.3140; Durbin-Watson Statistic = 0.0044.*
"", "**", and "***" indicate the 1 percent level, 5 percent, and 10 percent level of significances, respectively.*

Exhibit 5-b- GARCH (1,2)-M Model Results ,Bangladeshi CSCX Data, 2004:02-- 2014:05

$$EP_t = -9295.2490 + 1026.9140 Ln(\omega_t^2) + \varepsilon_t \quad (9)$$

(-3.7092*) (3.6810*)

$$\omega_t^2 = 4801.3830 + 0.0071\varepsilon_{t-1}^2 - 0.1262\omega_{t-1}^2 + 0.5609\omega_{t-2}^2 \quad (10)$$

(1.5359) (1.7517***) (-0.6057) (2.2372**)

Notes: *Akaike info criterion=12.0013; Schwarz criterion =12.1385; Hannan-Quinn Criterion=12.0570; Log likelihood = -732.0800; Durbin-Watson Statistic = 1.9029.*
"", "**", and "***" indicate the 1 percent level, 5 percent, and 10 percent level of significances, respectively.*

Exhibit 5-c- GARCH (1,2)-M Model Results ,Bangladeshi CASPI Data, 2004:02-- 2014:05

$$EP_t = -8541.9280 + 938.8178.Ln(\omega_t^2) + \varepsilon_t \quad (9)$$

(-137.8878*) (151.4318*)

$$\omega_t^2 = 5193.7110 + 0.0078\varepsilon_{t-1}^2 - 0.1390\omega_{t-1}^2 + 0.5557\omega_{t-2}^2 \quad (10)$$

(2.3307*) (1.8289***) (-0.7046) (3.2747*)

Notes: *Akaike info criterion=12.0054; Schwarz criterion =12.1426; Hannan-Quinn Criterion=12.0611; Log likelihood = -732.3324; Durbin-Watson Statistic = 1.8969.*
"", "**", and "***" indicate the 1 percent level, 5 percent, and 10 percent level of significances, respectively.*

CONCLUDING REMARKS

While the theoretical debate on the anomalous equity premium is unsettled, equity has been an important instrument channeling the financial resources from the capital surplus economic units (the savers) to the financial deficit units (the borrowers) in the direct financing mode of the market economy. This study uses the well known TAR and the GARCH (r, s)-M models to analyze the behavior of the Bangladeshi equity premia for CSE-30, CSCX, and CASPI indices. This study utilizes annualized monthly changes in the three indices and the deposit rate as the proxy measure for the risk-free rate. The equity premium is defined as the difference between the monthly change in the Bangladeshi equity indices and the bank deposit rate. The data set used in this investigation covers the period from its inaugural month of February, 2004 to May 2014 where the data is available. The descriptive statistics reveal that the Bangladeshi equity premia calculated from these three indices over the sample period are among the highest premia in its neighboring Asian countries and much higher than the corresponding figures in the advanced economies.

Perron's endogenous unit root test revealed that these three equity premia have different structural beaks over the sample periods. The CSE-30 premium is trendless while the CSCX and CASPI premia oscillate around their time trend and they all are stationary. The estimation results of the TAR model further reveals an asymmetric adjustment of the equity premium of the CSE-30 index about its threshold and symmetric adjustments of the equity premia of the CSCX and CASPI indices about their thresholds to negative and positive shocks in the long term.

With regard to the short-run dynamic Granger causality between the annualized monthly changes or the returns on each of the Bangladeshi indices under investigation and the risk-free rate, the partial *F-statistics* in equation (5) reveal a bi-directional Granger-causality between the risk-free rate to their monthly returns; i.e., the monthly returns of CSE-30, CSCX, and CASPI respond to both their own lagged changes and the lagged changes of risk-free rate as well. Similarly, the empirical results for equation (6), the partial *F-statistics* suggest that the risk-free rate responds not only to its own lagged changes but also to lagged changes of the monthly returns of CSE-30, CSCX, and CASPI in the short run. Over all, the TAR-VEC estimation results seem to suggest that the Bangladeshi CSE-30, CSCX and CASPI indices respond to monetary, fiscal policy and economic shocks which change the deposit interest rates. This finding indicates that the Bangladeshi economic policies matter for the stocks traded on the Bangladeshi Chittagong Stock Exchange in the short run.

As to the long-run adjustments when the short-run dynamics are introduced to the model as specified by equations (5) and (6), the estimation results are reported in exhibits 4-a, 4-b, and 4-c. An analysis of the results reveal that the calculated t-statistics indicate that all $\rho_{s,1}$ and $\rho_{s,2}$ are statistically significant and any conventional levels of confidence. Specifically, for the CSE-30 index, the empirical results reveal that $|\rho_1| > |\rho_2|$ which seems to indicate a faster convergence for positive disequilibrium than for negative disequilibrium. With regard to the CSCX and CASPI indices, the empirical results reveal that $|\rho_{s,2}| > |\rho_{s,1}|$, for s = CSCX and CASPI, indicating a *slower* convergence for positive disequilibrium than for negative disequilibrium.

Finally, the empirical investigations suggest GARCH (1, 2)-M to be the best model for this investigation**.** The significance of the GARCH (1, 2)-M indicates the presence of GARCH (1, 2) effect on the Bangladeshi monthly equity returns and their variance.

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