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# Macroeconomic Factors and Bangladesh Stock Market: Impact Analysis through Co integration Approach

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*The paper investigates whether current economic activities in Bangladesh can explain stock market returns in long-run horizon by using co integration test and in short-run dynamic adjustment from a vector error correction model. In addition, this paper tests causality of economic variables on stock returns and vice-versa. This paper finds that the Bangladesh stock market does not reflect macroeconomic effect on stock price indices. The co integration test and the vector error correction model illustrate that stock price indices are not co integrated with a set of macroeconomic variables like industrial production index, broad money supply and GDP growth. Findings of no co-integration between the growth of stock market return and fundamental macroeconomic factors may be the outcome of a small and shallow emerging stock market of Bangladesh. But interest rate change or T-bill growth rate may have some influence on the market return. It is argued by the authors with the explanation that the stock market should react with these changes otherwise investor is likely to switch from stock market to money market or other places where opportunity cost for them is likely to be higher. However, the findings that change of interest rate Granger causes stock market returns unidirectionally implies that stock market index is not a leading indicator for the economic variable of the change in interest rate, which shows the evidence of informationally inefficient market.*

*Keywords: Cointegration, Macroeconomic variables, Stock market returns, Granger causality*

Field of Research: Securities Market and Market Efficiency

## 1. Introduction

The paper aims at investigating the relationship between stock market and different macroeconomic variables in a developing country like Bangladesh. The paper attempts to determine whether there exists any long run equilibrium relationship and a short-run dynamics between stock markets and real economic activity empirically in Bangladesh and to explain the direction of causality between changes in stock prices and that of the economic activity.

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Stock market plays an important role in any economy. A mature and sizeable stock market is perceived across the globe as an indicator of the economic health and prospect of a country as well as an index of the confidence of domestic and global investors. A significant correlation does exist between the development of stock markets and economic growth, which has also been documented in a number of recent studies. A well meaning equity market is characterized by its informational efficiency in the sense that the prices of securities traded in the market act as though they fully reflected all available information and react instantaneously and in an unbiased fashion to new information [Fama (1970), Strong & Walker (1987)]. Therefore, current price of the stock portrays all information available at time t. Accordingly, if macroeconomic activity affects stock prices then an efficient stock market instantaneously incorporates all available information about economic variables. In the absence of informational efficiency, participants in the stock market would be able to develop profitable trading rule and can earn above average market return.

According to Chen, Roll and Ross (1986), macroeconomic movements affect country's stock index. A number of studies find an economically meaningful positive relationship between macroeconomic variables and stock market returns for developed economies. However, these studies have not considered the emerging market of South Asian countries, generally. This paper extends this presumed relation to the emerging markets by considering Bangladesh case.

The main purpose of the paper is to test whether major macro-economic variables in Bangladesh can explain stock returns by using a co-integration test and vector error correction model. In addition, this paper proposes to test causality of economic variables on stock returns and vice-versa. The paper is organized as follows. Section two deals with the review of literature and section three presents methodology with model specification. Section four analyzes the empirical results followed by the discussion of findings and conclusion in section five and six respectively.

## 2. Review of Literature

The relationship between stock market returns and fundamental economic activities in the developed countries are well documented [Fama (1970, 1990, 1991)]. In recent years, numerous studies [Fama (1981), Huang and Kracaw (1984), Chen, Roll, and Ross (1986), Pearce and Roley (1988), Fung and Lie (1990), Chen (1991), and Wei and Wong (1992)] modeled the relation between asset prices and real economic activities in terms of production rates, productivity, growth rate of GDP, unemployment, yield spread, interest rates, inflation, dividend yields, etc. However, the economic role of the stock markets in relatively less developed Asian countries (e.g. Korea, Taiwan, Singapore, Hong Kong, Malaysia, China, etc.) is less clear.

In an informationally efficient market, stock prices immediately reflect changes in monetary policy and correctly anticipate future monetary growth. Cornelius (1994) examined the relationship between money supply changes and stock prices in six of the most active emerging markets – India, Korea, Malaysia, Mexico, Taiwan and Thailand. However, findings are not uniform across countries. Results from Granger-

causality tests suggest that at least four of these markets – India, Korea, Malaysia, and Mexico appear informationally inefficient.
Naka A., Mukherjee T. and Tufte D. (1998) explained the relationships among selected macroeconomic variables and the Indian stock market. By employing a vector error correction model, they find that three long-term equilibrium relationships exist among these variables. Results suggest that domestic inflation is the most severe deterrent to Indian stock market performance, and domestic output growth is its predominant driving force. After accounting for macroeconomic factors, the Indian market still appears to be drawn downward by a residual negative trend.

Karamustafa O and Kucukkale Y (2003) investigated whether current economic activities in Turkey have explanatory power over stock returns, or not. They considered monthly data of stock price indexes of Istanbul Stock Exchange and a set of macroeconomic variables, including money supply, exchange rate of US Dollar, trade balance, and the industrial production index. Engel-Granger and Johansen-Juselius cointegration tests and Granger Causality test were used in the study to explain the long-run relations among variables questioned. Obtained results illustrate that stock return is co-integrated with a set of macroeconomic variables by providing a direct long-run equilibrium relation. However, the macroeconomic variables are not the leading indicators for the stock returns, because any causal relation from macroeconomic variables to the stock returns cannot be determined in sample period. In contrast, stock return is the leading indicator for the macroeconomic performance for the Turkish case.

Hardouvelis (1987), Keim (1985), Litzenberger and Ramaswamy (1982) empirically investigated whether the main economic indicators (e.g., inflation, interest rates, treasury bond's returns, trade balance, dividend returns, exchange rates, money supply, and crude oil prices) are effective to explain the share returns. If there were a co-integration relation between macroeconomic indicators and share returns, there would be a causal relation between these variables, too. Otherwise, share returns cannot be explained by main macroeconomic variables.

Using cointegration techniques, Chowdhury A.R. (1995) explains the lack of efficiency in the emerging stock markets by investigating the issue of informational efficiency in the Dhaka Stock Exchange in Bangladesh. He argued that in an efficient market the prices of the securities fully reflect all available information i.e. stock market participants incorporate the information contained in money supply changes into stock prices. Initially he tested the bivariate relationship between stock prices and money supply changes. Results from bivariate models suggest independence between the stock price and monetary aggregates. In other words Dhaka stock market is informationally inefficient. However, it is well known that bivariate models fail to address the obvious possibility that the relationship may be driven by another variable acting on both stock price and money supply. Hence multivariate models were estimated which shows the presence of a unidirectional causality from the money (both narrow and broad) to stock price. But the findings are insensitive to the functional form of the variables employed. Thus the stock prices do not immediately reflect changes in monetary policy and the market in inefficient. One important limitation of this study is that the cointegrating test was conducted only for bivariate model. No such test was conducted for multivariate model.

It is an empirical question whether principal economic indicators such as industrial production, interest rates, yield of T-bill, GDP and money supply are significant explanatory factors of Bangladesh stock market. The conclusion that macroeconomic performance affects share prices exposed the necessity of investigating relationship between stock market return and a number of macroeconomic variables taking into consideration of the Bangladesh stock market, which is an emerging one.

## 3. Methodology

### 3.1 Research Methods

In this paper the relationship between stock market and selected macroeconomic variables has been examined. We use share price index to represent the stock market and several macroeconomic variables namely broad money supply, treasury bill rate, interest rate, GDP, industrial production index etc. A series of tests such as unit roots, cointegration, vector error correction models (VECM) have been carried out. Granger causality test was also conducted to test the causality. These tests examine both long-run and short-run relationships between the stock market index and the economic variables. The VECM analyses provide some support for the argument that the lagged values of macroeconomic variables have a significant influence on the stock market.

#### 3.1.1 Unit Root Test

Many studies have shown that most macroeconomic time series are not stationary, rather non-stationary with a deterministic trend. This creates a problem since in the conditions of non-stationary data the normal properties of Durbin-Watson (DW) and t statistics and measure such as $R^2$ break down. Running regression with such data produces questionable, invalid and spurious results. To eliminate this problem, stationarity test must be performed for each of the variables. There have been a variety of proposed methods for implementing stationarity tests (for example, Dickey and Fuller, 1979; Sargan and Bhargava, 1983; Phillips and Perron, 1988 among the others) and each has been widely used in the applied economics literature. In this study, Augmented Dickey-Fuller (ADF) test procedure was employed for implementing stationarity tests.

#### 3.1.2 Johansen Cointegration Method

The Johansen method applies the maximum likelihood procedure to determine the presence of cointegrating vectors in non-stationary time series as a vector autoregressive (VAR). Consider a VAR of order p

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots\cdots\cdots + A_p Y_{t-p} + BX_t + \varepsilon_t$$

where $Y_t$ is a k-vector of non-stationary I(1) variables, $X_t$ is a d vector of deterministic variables, and $\varepsilon_t$ is a vector of innovations. We can rewrite the VAR as:

$$\Delta Y_t = \Pi Z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + BX_t + \varepsilon_t$$

where $$\Pi = \sum_{i=1}^{p} A_i - I \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j$$

Here $Y_t$ is a vector of nonstationary variables. The information on the coefficient matrix between the levels of the series $\Pi$ is decomposed as $\Pi = \alpha\beta'$ where the relevant elements of the $\alpha$ matrix are adjustment coefficients and the $\beta$ matrix contains the cointegrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of cointegrating vectors. The first likelihood ratio statistics for the null of exactly r cointegrating vectors against the alternative of r+1 vectors is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vectors against the alternative is the trace statistic. Critical values for both test statistics are tabulated in Johansen and Juselius (1990). The number of lags applied in the cointegration tests is based on the information provided by the multivariate generalization of the AIC.

### 3.1.3 Vector Error Correction (VEC) Model

A vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be cointegrated. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. If the two endogenous variables $Y_{1t}$ and $Y_{2t}$ have no trend and the cointegrating equations have an intercept, the VEC has the form

$$\Delta Y_{1t} = \gamma_1 (Y_{2,t-1} - \mu - \beta Y_{1,t-1}) + \varepsilon_{1,t}$$
$$\Delta Y_{2t} = \gamma_2 (Y_{2,t-1} - \mu - \beta Y_{1,t-1}) + \varepsilon_{2,t}$$

### 3.1.4 Granger Causality Test

The causality relationships among the variables in this study are determined by using the methodology based on Granger (1988). The Granger tests involve the estimation of the following equations.

$$X_t = \alpha_0 + \sum_{s=1}^{k} \alpha_{1s} X_{t-s} + \sum_{i=1}^{m} \alpha_{2i} Y_{t-m} + \varepsilon_{1t}$$
$$Y_t = \beta_0 + \sum_{j=1}^{n} \beta_{1j} Y_{t-j} + \sum_{h=1}^{p} \beta_{2h} X_{t-h} + \varepsilon_{2t}$$

where $\varepsilon_{1t}$ and $\varepsilon_{2t}$ are assumed to be uncorrelated and $E(\varepsilon_{1t}\,\varepsilon_{1s}) = 0 = E(\varepsilon_{2t}\,\varepsilon_{2s})$ for all $s \neq t$.

These equations can be used to show the unidirectional causality from stock price index and macroeconomic variable. If the estimated coefficients $\alpha_{2i}$ are statistically significant i.e. $\alpha_{2i} \neq 0$, then Y Granger-causes X. Similarly, X is the “Cause Variable” for Y if $\beta_{2h}$ is statistically significant i.e. $\beta_{2h} \neq 0$. If both $\alpha_{2i}$ and $\beta_{2h}$ are significant, it would provide evidence of a mutual dependency between these two variables.

Finally, if both $\alpha_{2i}$ and $\beta_{2h}$ are statistically not different from zero, then X and Y will be independent.
According to this approach, a stock market is said to be informationally inefficient if Y Granger-causes X (considering X represents stock market variable and Y represents macroeconomic variable). Mathematically, $\alpha_{2i} \neq 0$ and $\beta_{2h} = 0$. The stock market will be informationally efficient if the direction of causality runs from lagged X value to current Y value i.e. $\alpha_{2i} = 0$ and $\beta_{2h} \neq 0$. This means relationship between lagged stock prices and current value of macroeconomic variable imply a stock market with a forward-looking propensity where changes in the macroeconomic variables are correctly anticipated.

### 3.2 Data and Data Sources

The data used for the analysis in this study include selected macroeconomic variables and stock price index. Monthly data series for the period of July 1997 to June 2005 (96 monthly observations) was considered. The data has been compiled from Economic Trend published by Bangladesh Bank and International Financial Statistics. For stock price the data used are the monthly general share price index of Dhaka Stock Exchange (DSE). It is the closing index prices of the last trading day in each month. The macroeconomic variables used are monthly data for the same time period as the stock market data (July 1997 to June 2005). This study selects macroeconomic variables namely Money Supply (M2), Treasury Bill Rate (91-day weighted average rate), Interest Rate, Gross Domestic Product, Industrial Production Index.

### 3.3 Model Specification

This study examines both long run and short-run relationship among the stock price index and the macroeconomic variables. Here three different models have been considered to test the relationships taking multicollinearity problems into account. In the model, stock price index (SPINDEX) is considered as dependent variable and Industrial production index (IIP), Money supply (M2), Gross Domestic Product (GDP), Interest rate (Intr), 91-day T-bill rate (TB91R) as independent variable. All variables except interest rate are transformed into natural logs. We expect that there will be long-run cointegrating relationships between the variables consistent with macroeconomic fundamentals. Further, there should be short run relationships between these variables. The forms of these variables in the model are in the order of co-integration one – I(1), which is explained in table-2 and 3. So the models are as follows

$$\ln \mathrm{DSpindexch}_t = \alpha_1 + \beta_{11} \ln \mathrm{DIIP}_t + \beta_{12} \ln \mathrm{M2}_t + \beta_{13} \ln \mathrm{GDPch}_t + e_{1t} \quad (1)$$

$$\ln \mathrm{DSpindexch}_t = \alpha_2 + \beta_{21} \ln \mathrm{DIIP}_t + \beta_{22} \ln \mathrm{M2}_t + \beta_{23} \ln \mathrm{GDPch}_t + \beta_{24} \mathrm{DIntrch}_t + e_{2t} \quad (2)$$

$$\ln \mathrm{DSpindexch}_t = \alpha_3 + \beta_{31} \ln \mathrm{DIIP}_t + \beta_{32} \ln \mathrm{M2}_t + \beta_{33} \ln \mathrm{GDPch}_t + \beta_{34} \ln \mathrm{Tb91rch}_t + e_{3t} \quad (3)$$

# 4. Empirical Results

## 4.1 Summary Statistics

Table-1 represents the summary statistics of the variables under study. The average monthly index is 841 during the study period (July 1997-June 2005) with a high standard deviation implying a volatile stock market. The average index of industrial production is 234 with a maximum of 310 and minimum of 178. The trend is increasing which indicates slow but steady growth over time. Velocity of money and real activity increases as the money supply significantly increased within the study period. Gross Domestic Product (GDP) doubled recently over the 8 years period of time having a nominal growth of 8.8 percent per annum on an average. The average interest rate is 8.05 percent during the period with 1.4 percent deviation. But trend is declining as government has undertaken the necessary steps to reduce the interest rate in order to encourage the investor for investing in the stock market. Interest rate shows the investors expectation of return if they wish to invest in money market and ensure the fund to be secured. Hence the variable represents opportunity costs of investors fund when to invest in capital market. Also 91-day weighted average T-bill rate per month is 6.98 percent, which is the average risk free rate during the period. This is the rate at which banks used to employ their excess liquidity for very short period of time in order to tap the opportunity cost of the idle fund.

**Table-1: Summary Statistics**

| Name of the Variables | Observations | Mean | Std. Dev. | Maximum | Minimum |
|---|---|---|---|---|---|
| Stock Price Index | 96 | 841.44 | 371.39 | 1971.31 | 478.4 |
| Industrial Production Index | 96 | 234.55 | 33.17 | 310 | 178 |
| Money Supply (M2) (Tk. in Crore) | 96 | 89084.6 | 29812.98 | 151561.8 | 17470.7 |
| GDP (Tk. in Crore) | 96 | 262280.8 | 51857.41 | 368476 | 182249 |
| Interest Rate (%) | 96 | 8.05 | 1.40 | 9.98 | 5.09 |
| 91-day T-bill Rate (%) | 96 | 6.98 | 1.53 | 9.12 | 4.85 |

## 4.2 Test for Stationarity

Table-2 summarizes the ADF test results. The third column summarizes the ADF test statistics of the variables under study considering for both with and without trend (with constant). All the variables are non-stationary in levels. Some of them are non-stationary in first difference. The fourth column represents the p-value of the trend. Based on the existence of the trend, the data are de-trended in some cases and ADF test for these de-trended variables are considered. Then variables are transformed into natural logs except interest rates. The fifth column describes the order of cointegration of the concerned variables.

**Table-2: Unit Root Test**

| Variables | Test for unit root in | ADF Test Statistic | | Trend (p-value) | Order of cointeg-ration |
|---|---|---|---|---|---|
| | | Without trend | With trend | | |
| M2 | Level (1) [12] | 2.3612 | -1.2993 | 0.1124 | |
| lnM2 | Level (1) [12] | -0.0362 | -2.6208 | - | I(1) |
| | 1st Difference (1) [12] | **-4.0434*** | **-4.0253*** | - | |
| IIP | Level (3) [12] | 1.7855 | -1.6103 | 0.0513 | |
| lnDIIP | Level (12) [12] | -2.2409 | -2.3786 | - | I(1) |
| | 1st Difference (11) [12] | **-3.2924*** | **-3.6569*** | - | |
| GDP | Level (1) [12] | 1.9497 | -0.6588 | 0.2911 | |
| lnGDP | Level (1) [12] | 1.7535 | -1.7002 | - | I(2) |
| | 1st Difference (12) [12] | -2.0355 | -2.4229 | - | |
| | 2nd Difference (9) [12] | **-3.1011*** | **-3.5776*** | - | |
| Intr | Level (9) [12] | -0.3232 | -2.4043 | 0.0132 | |
| DIntr | Level (9) [12] | -2.0250 | -2.1693 | | I(2) |
| | 1st Difference (11) [12] | -2.1341 | -1.9448 | - | |
| | 2nd Difference (1) [12] | **-2.8998*** | **-3.9303*** | - | |
| Tb91r | Level (2) [12] | -2.0525 | -2.4293 | 0.1416 | |
| lnTb91r | Level (3) [12] | -1.9951 | -2.5672 | - | I(2) |
| | 1st Difference (6) [12] | -2.8947 | -2.9007 | - | |
| | 2nd Difference (1) [12] | **-3.1970*** | **-3.2264*** | - | |
| Spindex | Level (3) [12] | -0.1118 | -1.5445 | 0.0122 | |
| lnDSpindex | Level (5) [12] | -0.5745 | -2.6498 | - | I(2) |
| | 1st Difference (12) [12] | -2.3379 | -2.7238 | - | |
| | 2nd Difference (3) [12] | **-3.4574*** | **-3.4913*** | - | |

Note: * indicates significant at 5% level. Figures within the first bracket of the 2nd column represent the significant lag length and that of within the third bracket represents the total lag lengths that are considered in this analysis.

Table-3 represents the order of co-integration of the selected variables. Some of them are co-integrated of order one and some are of order two. So changed data series are considered for those series that are integrated of order two to make them order one. Because if the series are integrated of order one and are non-stationary, then the series may be said to be co-integrated and there can be a long-run equilibrium relationship among the series.

**Table-3: Selected Variables for Cointegration Test**

| Variable | Order of Cointegration | Selected Variable | Order of Cointegration |
|---|---|---|---|
| lnM2 | I (1) | lnM2 | I (1) |
| lnDIIP | I (1) | lnDIIP | I (1) |
| lnGDP | I (2) | lnGDPch | I (1) |
| Intr | I (2) | DIntrch | I (1) |
| lnTb91r | I (2) | lnTb91rch | I (1) |
| lnDSpindex | I (2) | lnDSpindexch | I (1) |

### 4.3 Cointegration Results and Long-run Equilibrium Relationship

The cointegration procedure developed in Johansen (1991) and Johansen & Juselius (1990) is employed to test the long run equilibrium relationship between the stock price index and macroeconomic variables. Johansen method uses likelihood ratio test to determine the number of cointegrating relationships, which may exist between the variables. If the hypothesis of no cointegration is rejected, then a stable long run relationship between stock index and related variable does exist.

While performing cointegration and the subsequent estimation, two tests (1) Intercept & No trend in CE and (2) Intercept & Trend in CE are conducted throughout the analysis. However, only the results of first one will be discussed here. As the findings of the second test, i.e., Intercept & Trend in CE are almost similar with that of the first one so the result for that is not reported.

**Table-4: Johansen Cointegration Test**

| Variables | | Eigenvalue | Likelihood Ratio | 5% critical value | Null | Alternative |
|---|---|---|---|---|---|---|
| Model-1 | LNDSPINDEXCH, LNDIIP, LNM2, LNGDPCH | 0.2066 | 43.1996 | 47.2100 | k = 0 | k = 1 |
| | | 0.1361 | 22.8339 | 29.6800 | k <= 1 | k = 2 |
| | | 0.1013 | 9.9608 | 15.4100 | k <= 2 | k = 3 |
| | | 0.0064 | 0.5610 | 3.7600 | k <= 3 | k = 4 |
| Model-2 | LNDSPINDEXCH, LNDIIP, LNM2, LNGDPCH, DINTRCH | 0.3171 | **74.6747*** | 68.52 | k = 0 | k = 1 |
| | | 0.1642 | 41.1075 | 47.21 | k <= 1 | k = 2 |
| | | 0.1588 | 25.3131 | 29.68 | k <= 2 | k = 3 |
| | | 0.1013 | 10.0943 | 15.41 | k <= 3 | k = 4 |
| | | 0.0078 | 0.6892 | 3.76 | k <= 4 | k = 5 |
| Model-3 | LNDSPINDEXCH, LNDIIP, LNM2, LNGDPCH, LNTB91RCH | 0.3013 | **71.9218*** | 68.52 | k = 0 | k = 1 |
| | | 0.1999 | 40.3730 | 47.21 | k <= 1 | k = 2 |
| | | 0.1166 | 20.7485 | 29.68 | k <= 2 | k = 3 |
| | | 0.0978 | 9.8428 | 15.41 | k <= 3 | k = 4 |
| | | 0.0089 | 0.7850 | 3.76 | k <= 4 | k = 5 |

Note: *(**) denotes rejection of the hypothesis at 5% (1%) significance level. Likelihood ratio rejects any cointegration for model-1, one cointegrating equation(s) at 5% significance level for model-2, model-3, model-4 and one cointegrating equation(s) at 1% significance level for model-5.

Table-4 provides the test statistics for cointegration vectors and critical values at 5 percent significance level. The result shown in the table is obtained by considering six lags and without any trend term. The test result indicates that there is no relationship between lnDSpindexch, lnDIIP, lnM2 and lnGDPch. However existence of such relationship does emerge, when additional variables are added with the model-1 such as DIntrch, lnTb91rch.

As the objective of the study is to find the long run relationship between the stock index and macroeconomic variables, table-5 provides the estimates of these relationships. From the analysis it can be concluded that for model-2, change of stock price index is influenced positively by industrial production index, change of GDP and change of interest rate. But the result is insignificant for industrial production index. On the other hand money supply (M2) affects the stock index positively and significantly. In model-3 when T-bill rate is considered instead of interest rate, the result obtained is almost same as observed in the previous model except one exception. The change of T-bill rate also positively affects the stock price index.

**Table-5: Normalized Cointegrating Coefficients**

| | | LNDSPIN DEXCH | LNDIIP | LNM2 | LNGDPCH | DINTRCH | C |
|---|---|---|---|---|---|---|---|
| **Model-2** | Coefficients | 1.00 | 0.4149 | -0.0661 | 12.0233 | 3.3903 | 0.6716 |
| | S.E. | - | 0.3486 | 0.0241 | 5.6957 | 1.0688 | - |
| | t-statistics | - | 1.1901 | -2.7350*** | 2.1109** | 3.1720*** | - |
| | Log Likelihood | 1145.49 | | | | | |
| | | **LNDSPIN DEXCH** | **LNDIIP** | **LNM2** | **LNGDPCH** | **LNTB91RCH** | **C** |
| **Model-3** | Coefficients | 1.00 | 0.5575 | -0.1561 | 12.4603 | -0.7135 | 1.6893 |
| | S.E. | - | 0.3944 | 0.0313 | 6.0520 | 0.3511 | - |
| | t-statistics | - | 1.4136 | -4.9945*** | 2.0588** | -2.0321** | - |
| | Log Likelihood | 1068.88 | | | | | |

Note: (**)(***) significant at 5% and 1% significant level respectively

### 4.4 Short-run Dynamic Adjustment using VECM

The Vector Error Correction Model (VECM) allows us to make inferences on the long-run impacts of the variables in levels to those in differences. The variables' responses to themselves are significant and negative, indicating positive autocorrelation. If the variables of the model-2 are cointegrated, then there exists an error correction model that may take the following form

$$\Delta \ln \mathrm{DSpindex}_{1t} = \gamma_{10} + \sum_{i=1}^{p} \gamma_{11j} \Delta \ln \mathrm{DSpindex}_{t-i} + \sum_{k=1}^{r} \phi_{12i} \Delta \ln \mathrm{M2}_{t-k} + \sum_{l=1}^{s} \phi_{13i} \ln \mathrm{GDPch}_{t-l}$$
$$\sum_{m=1}^{t} \phi_{14i} \mathrm{DIntrch}_{t-m} + \sum_{j=1}^{p} \phi_{15i} \ln \mathrm{DIIP}_{t-j} + \rho_1 \mu_{1,t-1} + e_{1t}$$

where $\Delta$ denotes first difference operator, $\mu_{1,\ t-1}$ is the correction term, $e_{1t}$ is the random disturbance terms. The error correction term $\mu_{1,\ t-1}$ which is the residual series of the cointegrating vectors normalized for the $\ln DSpindexch_t$, $\ln DIIP_t$, $\ln M2_t$, $\ln GDPch_t$ and $Dintrch_t$ measure the deviations of the series from the long run equilibrium relations. Similarly, error correction model for equation 3 can be formed. Table-6 contains the significant part of the estimated error correction for the model-2 and model-3.

The error correction term has a correct negative sign and is significant at 10 percent only for model-2. This implies that stock price index adjusts to long run equilibrium. The estimated value of the coefficients of the error correction term shows that the system corrects its previous period's level of disequilibrium by 100$\rho$ percent per month. So from the analysis of model-2 results, it can be concluded that the stock price index is adjusting towards equilibrium at a rate of 43.82 percent per month implying that it requires around two and a half months to reach equilibrium from disequilibrium state. However, the result for coefficient of error correction term of model-3 is not significant.

**Table-6: Vector Error Correction Estimate**

| Error Correction | Model-2 | Model-3 |
|---|---|---|
| | **∆lnDSpindexch** | **∆lnDSpindexch** |
| CointEq1 | -0.4382* (-1.7842) | -0.1137 (-0.4088) |
| $\Delta lnDSpindexch_{t-1}$ | -0.5502** (-2.1876) | -1.0123*** (-3.0757) |
| $\Delta lnDSpindexch_{t-2}$ | -0.5655** (-2.1748) | -0.9297** (-2.4569) |
| $\Delta lnDSpindexch_{t-3}$ | -0.3332 (-1.2150) | -0.7761** (-1.9806) |
| $\Delta lnDSpindexch_{t-4}$ | -0.1057 (-0.4103) | -0.5177 (-1.4273) |
| $\Delta lnDSpindexch_{t-5}$ | 0.0371 (0.1797) | -0.1547 (-0.5488) |
| $\Delta lnDSpindexch_{t-6}$ | 0.2007 (1.4544) | 0.0083 (0.0497) |
| $\Delta lnGDPch_{t-1}$ | -51.9631 (-1.4127) | 10.0768 (0.2512) |
| $\Delta lnGDPch_{t-2}$ | 23.5816 (0.6863) | 4.6175 (0.1212) |
| $\Delta lnGDPch_{t-3}$ | -26.0032 (-0.8145) | -22.1425 (-0.5830) |
| $\Delta lnGDPch_{t-4}$ | 62.2149* (1.9309) | 48.3656 (1.2300) |
| $\Delta lnGDPch_{t-5}$ | -45.9235 (-1.4437) | -31.2059 (-0.8043) |
| $\Delta lnGDPch_{t-6}$ | 5.8467 (0.1851) | -8.3725 (-0.2189) |
| $\Delta DIntrch_{t-1}$ | 1.9376*** (2.5823) | |
| $\Delta DIntrch_{t-2}$ | 1.1471* (1.7018) | |
| $\Delta DIntrch_{t-3}$ | 1.9401*** (3.1018) | |
| $\Delta DIntrch_{t-4}$ | 1.7801*** (3.1293) | |
| $\Delta DIntrch_{t-5}$ | 1.1195** (2.082) | |
| $\Delta DIntrch_{t-6}$ | 0.4210 (1.0948) | |
| C | 0.0057 (0.6334) | 0.0093 (0.8827) |
| **Diagnostics Test Result** | | |
| R-squared | 0.7448 | 0.6531 |
| Adj. R-squared | 0.6036 | 0.4610 |
| S.E. equation | 0.0764 | 0.0892 |
| F-statistic | 5.2739 | 3.4004 |
| Log likelihood | 121.2582 | 107.7348 |
| Akaike AIC | -2.0286 | -1.7212 |
| Schwarz SC | -1.1277 | -0.8204 |

Note: (*)(**)(***) represents level of significance at 10%, 5% and 1%.
Values in parenthesis denote t-values.

### 4.5 Outcome of Granger Causality

Granger causality enables us to identify leading, lagging and coincident macroeconomic factors for the stock market performance. In analyzing Granger-causality the profound affect of lag values of macroeconomic variables upon the growth of the stock market return has been investigated while controlling for lag values of the growth of the stock market return.

**Table-7: Tests for Granger causality between Stock Price Index and Macroeconomic Variable**

| Direction of Causality | | | F-Statistic | Probability |
|---|---|---|---|---|
| LNDIIP | ~ | LNDSPINDEXCH | 0.5088 | 0.7998 |
| LNDSPINDEXCH | ~ | LNDIIP | 1.2512 | 0.2901 |
| LNM2 | ~ | LNDSPINDEXCH | 0.7185 | 0.6358 |
| LNDSPINDEXCH | ~ | LNM2 | 0.6951 | 0.6542 |
| LNGDPCH | ~ | LNDSPINDEXCH | 0.7214 | 0.6336 |
| LNDSPINDEXCH | ~ | LNGDPCH | 0.5033 | 0.8039 |
| **DINTRCH** | **→** | **LNDSPINDEXCH** | **2.0573** | **0.0681*** |
| LNDSPINDEXCH | ~ | DINTRCH | 1.2429 | 0.2941 |
| LNTB91RCH | ~ | LNDSPINDEXCH | 0.4859 | 0.8169 |
| LNDSPINDEXCH | ~ | LNTB91RCH | 0.6691 | 0.6748 |

Note: * significant at 10% level. (~) implies lack of any causal relationship. (→) shows the direction causal relationship

The causal relationship between the stock price index and the macroeconomic variables are reported in table-7. As seen from the Granger causality test it is suggested that there exists no Granger causality between change of stock index and industrial production, money supply, Change of GDP, change of T-bill rate. But unidirectional causality is observed in case of change of interest rate and stock market index is not a leading indicator for the economic variable of the change in interest rate, which shows the evidence of informationally inefficient market.

## 5. Discussion of Findings

This paper analyzes long-term equilibrium relationships as well as short-run dynamic adjustment of such relationships between a group of macroeconomic variables and the stock price index. The macroeconomic variables are represented by the industrial production index, broad money supply, interest rate, T-bill rate and GDP.

Three different multivariate models were used to identify the relationship among the endogenous variables taking multicollinearity into account. Among them no cointegration was found in the first model, which considers the relationship between growth of stock market return with industrial production index, money supply and GDP growth. So there exists no long run relationship between stock market and these fundamental macroeconomic factors. When one additional variable – change of interest rate is added with the previous model, existence of significant long run relationship was observed with money supply, GDP growth and interest rate change. So inclusion of one variable makes significant result for three variables. Though the result provides the evidence of long run relationship between stock market and macroeconomic factors but this may be partly attributable to the effect of interest rate upon the three fundamental macroeconomic variables, especially money supply change, which makes them significant on the growth of stock market return. Instead of interest rate when T-bill rate is considered, the model provides the same result as discussed earlier.

From the Vector Error Correction model, which estimates the short run adjustment for the long run relationship between stock market and macroeconomic factors, there exists no strong argument in favor of the adjustments. That means no such type of adjustments, which makes the stock market return converged to the long run equilibrium, is absent. This observation corroborates the findings of a study by Imam and Amin (2004) that volatility of DSE return series increases over time.

Granger causality test was used to analyze the causal relationship between stock market and macroeconomic variables. Results from the test show the presence of a unidirectional causality from interest rate change to the stock market return. Thus stock prices do not immediately reflect changes of the macroeconomic factors and also fail to anticipate future changes.

## 6. Conclusion and Policy Implications

The purpose of this study was to investigate whether real economic activities in Bangladesh can explain stock market returns in long run horizon by using a cointegration test and a Granger causality test and in short run dynamics from a vector error correction model. Generally there exists no long run relationship between stock market index and macroeconomic variables. But interest rate change or T-bill growth rate may have some influence on the market return. The explanation is straightforward. The stock market should react with these changes otherwise investor is likely to switch from stock market to money market or other places where opportunity cost for them is likely to be higher. Findings of no cointegration between the growth of stock market return and fundamental macroeconomic factors may be the outcome of a small and shallow emerging stock market because Dhaka Stock Market is characterized by a thin market having small market capitalization, low level of liquidity and depth [Imam (2000)].

One of the important characteristics of a well functioning equity market is its informational efficiency in the sense that the prices of the securities traded in the market fully reflect all available information. In an efficient market, macroeconomic factors cannot have a systematically lagged effect on the stock market. The result of Granger causality test provides the notion of informational inefficiency for the Dhaka Stock Exchange (DSE), which cannot ensure the fair price, established for the stocks being traded in DSE and deters the role of DSE in allocating resources efficiently. The implication of the finding suggests that a rational investor can earn above average abnormal return constantly in Dhaka Stock Market.

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