Co integrating Relation between Macroeconomic Variables and Stock Return: Evidence from Dhaka Stock Exchange (DSE)

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Abstract:

The objective of this study is to investigate the long run equilibrium, short run dynamics adjustment as well as causal relationship between Dhaka stock Exchange (DSE) all share price index and macroeconomic variables of consumer price index (CPI), GDP, foreign remittances and import payment. This study uses cointegration test and vector error correction model (VECM) to identify long run equilibrium relationship and short run dynamics adjustment among these variables. The test result provides that variables are cointegrated and VECM provides that the system corrects its previous period's level of disequilibrium by 5.98 percent per month. Granger causality test has also been performed to estimate causal relationship and the result shows unidirectional causality from CPI and foreign remittance to stock price and bi-directional causality between import payment and stock price but no causal relation between GDP and stock price. The results of this study have implications to investors, policy makers and academicians.

Key words: Cointegration, VECM, Granger Causality, Macroeconomic Variables

1. Introduction:

The literature on financial economics contains a considerable number of empirical analyses that investigate the interactions and dynamic linkage between stock returns and macroeconomic variables. Among various macroeconomic variables gross domestic product (GDP), investment, money supply, and consumer price index (CPI) etc. has perhaps receive the most attention. Theoretically the influence of macroeconomic variables such as GDP, CPI or exchange rate may be motivated by using such model as the standard stock valuation models or standard macroeconomic text book models. According to stock valuation model, stock prices reflect discounted expected future cash flows earned by owner of the stocks. This means that any change in the economic variables that have a bearing on the future cash flows or the discount factors affect the stock prices. The standard aggregate demand and aggregate supply (AD/AS) framework also allows for the roles of equity markets in the transmission mechanism of monetary policy include not only the normal interest rate channel (traditional liquidity effect) but also other channels, one of which h involve equity prices via Tobin's q theory, wealth effects and household liquidity effects.

These theoretical foundations, unfortunately, do not provide unambiguous testable implications on the directional influences of macroeconomic variables on stock prices. The argument from the monetary transmission mechanisms highlights both positive and negative effects of macroeconomic variables on stock prices. Arguing through the stock valuation model, Mukherjee and Naka (1995) note that the effects of an increase in money supply on real economic activity, and thus expected future cash flows, suggest a positive relation between them. Conversely if the money supply generates inflation uncertainty and, consequently raises discount factor, then monetary expansion may exert a negative influence on equity markets. Ahmed. M. F (2000) found causal relation from change in stock price to consumption expenditure. The findings also reveal a causal relation from stock price to investment expenditure and very weak or no causal relation between stock price and industrial production index.

The present paper has a main focus on investigating the dynamic linkage between stock price and set of important macroeconomic variables i.e. consumer price index (CPI), gross domestic product at current market price, foreign remittance and import payment. The rapid growth of emerging stock markets including Dhaka Stock Exchange (DSE) has attracted increasing attention from both investors and financial economists. However, empirical studies on especially the interrelationship between macroeconomic variables such as consumer price index, gross domestic product, foreign exchange rate and interest rate are still not enough. This paper aims at investigating the dynamic relation between Dhaka Stock Exchange (DSE) all share price index and four different macroeconomic variables mentioned above.

Rational of the Study:

A 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 the country as well as an index of the confidence of domestic and global investors. A significance correlation does exist between the development of stock markets and economic growth which has also been documented in a number of studies. A well meaning of equity market is characterized by its informational efficiency in the sense that prices if securities traded in the market act as though they fully reflected all available information and react instantaneously and in an unbiased fashion [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. The absence of informational efficiency, participants of the stock market would be able to develop profitable trading rule and can earn above average market return. This paper examines whether there exist any dynamic and long run linkage between stock markets and few selected macroeconomic variables. A successful innovation of the relationship between Dhaka Stock Exchange (DSE) all share price index and our selected macroeconomic variables will assist the entire interested group to decide operational, managerial, sustainable growth decision efficiently. Investors can ensure maximum return from their investment in stock market. Regulators can formulate different policies and decisions for ensuring and creating smooth trading and investment atmosphere in the stock market based on their experience and knowledge on predictable stock market price behavior. Finally, the efficient trading activity in the stock exchange also contributes to the national interest of Bangladesh.

2.0 Review of Literature:

The relationship between stock market returns and fundamental economic activities in the developed countries are well documented [Fama (1970, 19901 1.991)]. In recent years, numerous studies [Fama (1981), Huang and Kracaw (1984)' Chen' Roll, and Ross (1986), Pearce and Rotey (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 bf 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 lstanbul Stock Exchange and a set of macroeconomic variables, including money supply, exchange rate of us Do1ar, trade balance, and the industrial production index. Engle-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 models 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 cointegration test conducted only for bivariate model.

Ahmed M.F. (2000) examines the causal relation between DSE stock index and a couple of macroeconomic variables like consumption expenditure, investment expenditures, real economic activity measured by GDP and industrial production index. The author employed Granger (1988) causality test and found a causal relation from stock price to consumption expenditures. He also found a unidirectional causality from investment to stock prices; weak relationship between stock price and GDP and no causal relation between stock price and industrial production index. Finally he concluded in that study that stock market is not informationally efficient in Bangladesh.

Ahmed. M. N. and Imam M. Osman, (2007) examines the long run equilibrium and short tern dynamics between DSE stock index and a set of macroeconomic variables. In the macroeconomic variables they use money supply, 91 day T-bill rate, interest rate GDP and Industrial production index. They applied Johansen and Juselius (1990) maximum likelihood Cointegration test, Vector Error Correction Model (VECM) and also employed Granger Causality test. In the cointegration test, they found two cointegrating vectors but between them one is statistically significant. In the VECM test, they found that the lagged stock index was adjusted to long run equilibrium by percent by 43.82 percent by the combined lagged influence of all the selected macroeconomic variables. Granger causality test provides a unidirectional causality from interest rate change to stock market return.

Therefore available literature gives us enough evident that equilibrium relationship between stock prices and different macroeconomic variables was tested by a handsome amount in developed countries which is very insignificant in case of less developed economy like Bangladesh. Although Dhaka Stock Exchange (DSE) is considered to be an important emerging stock market, a good number of studies in this field are simply absent. There are few papers available on this relevant field but they also involves with weak methodology, insufficient number of observations that results poor, faulty and unsatisfactory test output. This paper expected to have a significant contribution towards measuring long run equilibrium relationship and short run dynamics adjustment between DSE all share price index and the selected macroeconomic variables.

3.0 Methodology:

3.1 Research Methods:

This study basically examines both long run equilibrium and short term dynamics adjustment between Dhaka Stock Exchange (DSE) all share price index (DSI) and some selected macroeconomic variables i.e. consumer price index (CPI), gross domestic product at current market price (GDPMP), foreign remittances (REMIT) and import payment (IMPMT) and also the causal relation among them. Long run equilibrium relation among the variables is examined by following the methodology explained by Johansen and Juselius (1990) and Vector Error Correction Model (VECM) will be applied to test short run dynamics adjustment towards equilibrium. Finally Granger Causality (1988) test is performed to identify the causal relationship among the variables. Therefore, the study starts with identifying the order of integration of all the variables by applying Augmented Dickey-Fuller (ADF) Test and Phillips-Parron (P-P) Test. When they are found to have the same order of integration then cointegration test is used to identify the number of cointegrating vectors and cointegrating equation among the variables. But if any variable doesn't have the same order of integration, it will not be incorporated in this investigation. Cointegrating equation actually implies the long run equilibrium relationship among the variables. When these variables are found cointegrated then the speed of adjustment of short run dynamics which converge towards long run equilibrium will be tested by applying Vector Error Correction Model (VECM). Finally, causal relation among the variables has been estimated based on Granger Causality (1988).

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 propertied of Durbin-Watson (DW) and t statistics and measure such as R2 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 and Phillips and Perron (PP) 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

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

where Yt is a k-vector of non-stationary l(1) variables, Xt is a d vector of deterministic variables, and e1 is a vector of innovations. We can rewrite the VAR as:

$$\Delta Y_t = \prod Z_{t-1} + \sum_{i=1}^{p-1} \Gamma \Delta Y_{t-1} + BX_t + \varepsilon$$

Where

$$\Pi = \sum_{i=1}^{p} A_i - 1 \qquad \text{and} \qquad \Pi_i = \sum_{j=i+1}^{p} A_j$$

Here Yt is a vector of nonstationary variables. The information on the coefficient matrix between the levels of the series Π is decomposed as $\Pi = \alpha\beta'$ where the relevant elements of the α matrix are adjustment coefficients and the β 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 eigen value 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' lf the two endogenous variables Y1t and Y2t have no trend and the cointegrating equations have an intercept, the VEC has the form

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

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.

$$X_t = \alpha_0 + \sum_{j=1}^{k} \alpha_{1s} X_{t-s} + \sum_{i=1}^{m} \alpha_{2i} Y_{t-m} + \varepsilon_{1t}$$

$$Y_t = \beta_0 + \sum_{j=1}^{n} \beta_{1j} Y_{t-j} + \sum_{h=1}^{p} \beta_{2h} X_{t-h} + \varepsilon_{2t}$$

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

These equations can be used to show the unidirectional causality from stock price index and macroeconomic variable. lf the estimated coefficients α_{2i} statistically significant i.e. $\alpha_{2i} \neq 0$, then Y Granger-causes X. Similarly, X is the "Cause Variable" for y if β_{2h} is statistically significant i.e. β_{2h}

$\neq 0$. lf both α_{2i} and β_{2h} are significant, it would provide evidence of a mutual Dependency between these two variables.

Finally, if both α_{2i} and β_{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 $\beta_{2h} \neq 0$. The stock market will be informationally efficient if the direction of causality 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 this investigation include four important macroeconomic variables and DSE all share price index. Monthly data series for the period from January 1987 to December 2010 (270 monthly observations) is considered. The data has been compiled from "*Monthly Economic Trend*" Published by Bangladesh Bank. The monthly DSE all share price index was collected from "*Monthly Review"* published by Dhaka Sock Exchange (DSE). The Stock index used here is the closing index of the last trading day in each month. For macroeconomic variables monthly data has been used for the same period. The selected macroeconomic variables are broad money supply (M2), consumer price index (CPI), gross domestic product measured at current market price (GDPMP), foreign remittance (REMIT) and import payment (IMPMT). It is important to note that due to unexpected abnormal behavior was found in stock prices at Dhaka Stock Exchange (DSE) during the period from January 1996 up to June 1997 (total 18 months), these monthly observations within this period was not considered in this analysis.

3.3 Model Specification

Long run equilibrium and short run dynamics adjustment between DSE all share price index and selected macroeconomic variables will be tested by cointegration test and VECM. Granger causality among the variables will also be tested. As these tests don't require data series of the variables to be stationary, that's why the level data for all these variables are used to formulate the model. The model has been estimated in such a way that measure the influence of broad money supply (M2) consumer price index (CPI), gross domestic product at current market price (GDPMP), foreign remittances (REMIT) and import payment (IMPMT) on DSE all share price index and also the causal relation among them. Therefore the model can be represented in the following way:

$$DSI = \alpha + \beta_1 CPI + \beta_2 GDPMP + \beta_3 REMIT + \beta_4 IMPMT + \varepsilon$$

4.0 Empirical Result:

4.1 Summery of Descriptive Statistics:

Table: 1 present the summery of descriptive statistics for the selected variables under study. We have examined 270 monthly observations of all the variables to estimate the following statistics. As mean describes the average value in the series and Std. Dev. measures the dispersion or spread of the series, then all the variables are highly volatile data series. The maximum and minimum statistics measure upper and lower bounds of the variables under study during our sample time frame. The skewness measures whether the distribution of the data is symmetrical or asymmetrical. Positive skewness value of the all variables indicates that distribution of all the data series has a long right tail. On the other hand kurtosis measures the peakedness and flatness of the distribution of the series. Kurtosis estimates in this table indicate that none of the distribution of the variable data is normal and we have found leptokurtic distribution in DSI, M2, CPI, REMIT and IMPMT and the remaining variable i.e. GDPMP have platykurtic distribution. Jarque-Bera test statistics is used for testing whether the data series is normally distributed. The small probability value estimated below failed to accept null hypothesis that the data series is normally distributed.

4.2 Test of Stationarity:

Table: 2 presents the summery of unit root test for all the variables under study using Augmented Dickey-Fuller (ADF) Test and Phillips-Parron Test (PP) Test. These tests of stationarity has been conducted with constant and linear trend and assumed the same null hypothesis of no unit root in the data series. Here we found that all the variables under examination are found to be integrated one under PP test. ADF test also provide the identical result that all the variables are first order integrated except M2. The variable M2 involves second order integrated data. As one of the basic objectives in this study is to examine the variables having the same order of integration, so our selected variables successfully satisfy this condition except M2. In this connection it will be worth noting an important guideline given by Walter Enders in his famous book, *Applied Econometric Time Series (2004, 2nd ed)*, that *"although forms of the Johansen tests can detect differing order of integration, it is wise not to mix variables with different orders of integration".* According to this guideline we have decided to incorporate those variables having **I(1)** and leave those variables having more than one order of integration. Finally, the variables i.e. DSI, CPI, GDPMP REMIT AND IMPMT were selected and used for establishing long run equilibrium relationship among themselves.

4.3 Cointegration Results and Long-run Equilibrium Relationship

Cointegration methodology explained by Johansen and Juselius (1990) examines different types test to identify the number of cointegrating vectors as well as the cointegrating equations among different nonstationary variables. The test of cointegration has been performed assuming a linear deterministic trend and an optimum lag length of 4. At first, the unrestricted cointegration rank among the variables under study is examined through the use of trace statistics and eigenvalue statistics. Trace statistics test the null hypothesis of $r = 0$ or $r \leq 1$ against alternative hypothesis of $r \geq 1$ or $r = 2$. on the other hand maximum eigen value statistics test the null hypothesis of $r = 0$ or $r = 1$ against alterhative hypothesis of $r = 1$ or $r = 2$. Table -3 reveals that trace statistics reject the null hypothesis of no cointegrating relationship

among the variables. An examination of trace statistics with that of critical value at 5 percent indicates that there is one cointegrating equation among the variables.

Another important test to identify the number of cointegrating vectors is examination of maximum eigen value. This test (see Table : 4) also reveals the same result that there is one cointegrating equation among the variables. Based on the above two test, when we came to know that there is one cointegrating equation among those variables then we estimate the normalized cointegrating coefficients of all the variables which is presented in Table -5. From this estimates it can be concluded that change in stock price is influenced positively by consumer price index (CPI), foreign remittances (REMIT). On the other hand, gross domestic product measured at current market price (GDPMP) and import payment (IMPMT) affects the change in stock prices negatively.

4.4 Short-run Dynamic Adjustment using VECM

The Vector Error Correction (VECM) allows us to make inferences on the long run impacts of the variables in levels to those in lagged values. The variables' responses tot themselves are significant and positive, indicating positive autocorrelation. As our selected variables have one cointegrating equation, then there must have an error correction model. We have estimated the error correction model which is presented in Table 6. The error correction term has a positive sign and is significant at 5 percent. This implies that DSE all share price index adjust to long run equilibrium. The estimated value of the error correction term shows that the system corrects its previous period's level of disequilibrium by 5.98 percent per month. Based on the VECM estimates, the system equation can be presented in the following way:

D(DSI) = 0.0598088147473 * (DSI(-1) + 14.5035594126 * CPI(-1) + 0.000562302155973 * GDPMP(-1) + 0.269465053731 * REMIT(-1) - 4.46019211303 * IMPMT(-1) - 1738.55781507) + 0.146836090567 * D(DSI(-1)) - 0.0638311474861 * D(DSI(-2)) - 2.50103833018 * D(CPI(-1)) - 2.81601140467 * D(CPI(-2)) + 0.000437354668289 * D(GDPMP(-1)) + 0.000241863334116 * D(GDPMP(-2)) - 0.116587577733 * D(REMIT(-1)) - 0.0611709967267 * D(REMIT(-2)) + 0.336590416523 * D(IMPMT(-1)) + 0.279062840224 * D(IMPMT(-2)) + 27.7104620872

4.5 Granger Causality Test:

Granger causality enables us to identify leading, lagging and coincident macroeconomic factors for the stock market performance. The test Granger causality (see Table: 7) provides evidence of unidirectional causality from consumer price index (CPI) and foreign remittances (REMIT) to DSE all share price index (DSI) and a bi-directional causality between import payment and DSI with 5 percent significance level. On the other hand, based on this estimates DSI and GDPMP does not have any causal relation which is consistent with the test performed by Ahmed & Imam (2007). has no evident that DSE all share price index (DSI) does not Granger Cause consumer price index (CPI), gross domestic product at current market price which is consistent with the test performed by Ahmed. M. F. (2000) and Ahmed. M. N. and Imam M. Osman, (2007).

5.0 Discussion and Findings:

This paper analyses long tern equilibrium relationship as well as short-run dynamic adjustment of such relationship between a groups of macroeconomic variables i.e. consumer price index (CPI), gross domestic product at current market price (GDPMP), foreign remittance (REMIT) and import payment (IMPMT). A single multivariate model is designed to identify the relationship among the endogenous variables after considering the necessary tests (i.e. the test of stationarity) to incorporate variables into the model. The test of cointegration provides a single cointegrating vectors and DSE all share price index is influenced positively by CPI and foreign remittances and negatively by GDP and Import payment. The estimates of Vector Error Correction Model (VECM) shows that short run dynamics adjustment rate is 5.98 percent per month which in indicator of weak-form of efficiency in Dhaka Stock Exchange. Finally, unidirectional causal relationship is also found from CPI and remittance to DSE all share price index and bi-directional causality is also found between Import payment and stock index.

6.0 Conclusion:

One of the functions of stock market in the economy is not only to raise capital but also to channel funds to the most profitable opportunities and to ensure that those funds were well used. We need to think in such a way that development of the stock market can be measured in terms of its efficiency and macroeconomic variables can play a crucial role for measuring this efficiency. This paper use monthly data to examines how DSE all share price index move simultaneously with other macroeconomic variables and how they establish a long run equilibrium relation among themselves. This study also examines about how and at what rate short run disequilibrium converges towards long run equilibrium through using VECM. This study ends with identifying the causal relationship between DSE all share price index and selected macroeconomic variables. These test result provides a single cointegrating equation and also estimates of short run dynamic adjustment in the model. The test of Granger causality found both the unidirectional and bi-directional causality among the variables except GDP. Finally, based on all the test result, it is proved once again that the stock price at DSE is not informationally efficient.

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Appendix:

Table-1: Summery of Descriptive Statistics

Statistics	DSI	M2	CPI	GDPMP	REMIT	IMPMT
Mean	1126.734	103992.1	241.1928	43106.06	1665.047	752.9998
Median	710.8773	65004.55	237.3700	34644.00	740.9200	597.2377
Maximum	7135.160	399279.0	434.8400	96880.40	7259.230	2689.900
Minimum	286.0400	14353.00	114.9600	11284.33	177.9200	197.0193
Std. Dev.	1164.735	96278.35	90.44846	25822.93	1933.019	545.9273
Skewness	2.796704	1.285307	0.547961	0.599874	1.426223	1.161956
Kurtosis	11.68284	3.743751	2.313701	2.161678	3.758314	3.542085
Jarque-Bera	1200.128	80.56371	18.81059	24.09954	98.00423	64.06222
Observations	270	270	270	270	270	270

Table-2 : Test of Stationarity						**Order of Cointegration**	
Variables	**Test of Unit Root in**	**Augmented Dickey-Fuller Test**		**Phillips-Parron Test**		**ADF**	**PP**
		ADF t- stat	**p-value**	**PP t-stat**	**p-value**		
DSI	Level Data	4.718397	1.0000	4.200915	1.0000	**I(1)**	**I(1)**
	1st Deterrence Data	-12.45976	0.0000	-12.69417	0.0000		
M2	Level Data	3.907506	1.0000	17.67196	1.0000	**I(2)**	**I(1)**
	1st Deterrence Data	0.917188	0.9999	0.937188	0.9999		
CPI	Level Data	0.451360	0.9999	-1.216535	0.9045	**I(1)**	**I(1)**
	1st Deterrence Data	-3.979140	0.0336	-2692351	0.0000		
GDPMP	Level Data	-1.564011	0.8046	-1.585761	0.7963	**I(1)**	**I(1)**
	1st Deterrence Data	-1629962	0.0000	-16.29962	0.0000		
REMIT	Level Data	0.15364	0.9976	-0.735630	0.9688	**I(1)**	**I(1)**
	1st Deterrence Data	-18.81074	0.0000	-45.28955	0.0001		
IMPMT	Level Data	0.892090	0.9999	-3.367377	0.0580	**I(1)**	**I(1)**
	1st Deterrence Data	-6.015762	0.0000	-3529807	0.0000		

Table -3 :Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of CE(s)	**Trace Statistic**	**Critical Value(0.05)**	**Prob.**
None	116.8306	88.80380	0.0001
At most 1	57.29331	63.87610	0.1580
At most 2	32.46190	42.91525	0.3639
At most 3	16.64456	25.87211	0.4419
At most 4	5.679727	12.51798	0.5020

Table – 4: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
Hypothesized No. of CE(s)	**Max-Eigen Statistic**	**Critical Value (0.05)**	**Prob.**
None	59.53728	38.33101	0.0001
At most 1	24.83141	32.11832	0.2963
At most 2	15.81734	25.82321	0.5610
At most 3	10.96483	19.38704	0.5170
At most 4	5.679727	12.51798	0.5020

Table -5 : Test of Cointegration					
1 Cointegrating Equation(s):		Log likelihood -8403.487			
DSI	**CPI**	**GDPMP**	**REMIT**	**IMPMT**	**@TREND(87M02)**
1.000000	30.31551	-0.004864	1.107110	-8.476463	-7.015582
Standard Error	(14.7797)	(0.00533)	(0.32780)	(1.22028)	(11.4228)

Table – 6 :Vector Error Correction Estimates	
Error Correction:	D(DSI)
CointEq1	0.059809
DSI(-1)	1.000000
D(DSI(-1))	0.146836
D(DSI(-2))	-0.063831
D(CPI(-1))	-2.501038
CPI(-1)	14.50356
D(CPI(-2))	-2.816011
GDPMP(-1)	0.000562
D(GDPMP(-1))	0.000437
REMIT(-1)	0.269465
D(GDPMP(-2))	0.000242
IMPMT(-1)	-4.460192
D(REMIT(-1))	-0.116588
D(REMIT(-2))	-0.061171
D(IMPMT(-1))	0.336590
D(IMPMT(-2))	0.279063
C	-1738.558
C	27.71046

Table – 7: Test of Granger Causality between DSE All Share Price Index and Selected Macroeconomic Variables					
Direction of Causality			**Observations**	**F- Statistics**	**Prob.**
CPI	→	DSI	264	2.20381	**0.0432**
DSI	~	CPI		1.37696	0.2243
GDPMP	~	DSI	264	0.36539	0.9004
DSI	~	GDPMP		0.14684	0.9896
REMIT	→	DSI	264	8.68740	**1.E-08**
DSI	~	REMIT		1.53313	0.1677
IMPMT	→	DSI	264	2.38191	**0.0295**
DSI	→	IMPMT		7.30300	**3.E-07**