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Effects of Monetary Policy on Capital Market in Bangladesh

Khan Md. Saidjada
Md. Sakhawat Hossain
Md. Habibour Rahman

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Chief Economist's Unit (CEU)
Bangladesh Bank
Head Office, Dhaka, Bangladesh

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Khan Md. Saidjada*
Md. Sakhawat Hossain
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Abstract

The purpose of this paper is to estimate the responses of stock prices to monetary policy changes, exchange rate movements and domestic inflation in Bangladesh for the period July 1999-June 2012. To measure the monetary policy changes we use three alternative variables namely broad money, reserve money and 91-day treasury bill rate. In this study we adopt the widely used Johansen approach to cointegration along with Vector Error Correction model to assess long-run and short-run relationship among the above mentioned variables. Working over the period July 1999-June 2012, the results of this paper remain inconclusive particularly with respect to the relationship between monetary policy and stock prices. No cointegration and hence no long-run relationship among the variables is found when we use broad money or reserve money as a monetary policy variable. However, a long-run relationship is found if we use 91-day treasury bill rate as a monetary policy variable instead of broad money or reserve money. The relationship between stock prices and the exchange rate is also not significant.

Keywords: Stock prices, monetary policy, unit root, Cointegration, Vector Error Correction.
JEL Classification: E43, E44, E52, F31

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I. Introduction

Capital market plays an important role in mobilizing financial resources from surplus units and transferring those to deficit and productive units of an economy. It provides an alternative source of funds for the firms for long-term investment purpose. In addition, a developed capital market also provides access to the foreign capital for domestic industries by creating a platform for foreign companies or investors to invest in domestic securities. Though the capital market of Bangladesh is one of the smallest in the world, it is the third largest in the South Asian region after India and Pakistan in terms of market capitalization[1]. During the last few years, stock market of Bangladesh has shown noteworthy growth in terms of almost all the indicators such as market capitalization, turnover and the price index. At the same time the market has experienced a notable volatility. Since stock prices are sensitive to economic conditions, it is crucially important for policymakers as well as investors to know the relationship between macroeconomic variables and stock price in Bangladesh.

Like many other countries, maintaining low and stable inflation and fostering higher inclusive growth are two main objectives of monetary policy in Bangladesh. However, instruments of monetary policy do not influence these objectives directly and immediately. Bernanke & Kuttner (2005) argue that the most direct and immediate effects of monetary policy actions are on financial markets; by affecting asset prices and returns, policymakers try to modify economic behavior in ways that will help to achieve their ultimate objectives. Against this backdrop, this paper explores how monetary policy and asset prices, particularly stock prices, are related in Bangladesh.

Bangladesh Bank (the Central Bank of Bangladesh) pursues its monetary policy within a framework of monetary targeting with reserve money as the operating target, and broad money (M2) as an intermediate target[2]. Until early 1990s, the financial sector of Bangladesh was mostly government controlled. In the early 1990s, like many other developing countries, Bangladesh underwent financial sector reforms. The salient features of the Financial Sector Reform Program (FSRP) were interest rate liberalizations (i.e., lending and deposit rates have been gradually freed from restrictions except for certain categories of agricultural and export credit.), development of money market instruments (i.e., introduction of repo in July 2002 and reverse repo in June 2003), introduction of Open Market Operation (OMO) by various government treasury bills (T-bills) auction (e.g., 28-day, 91-day, 182-day, 364-day, 2-year, and 5-year) etc. These reforms allow Bangladesh Bank to conduct monetary policy relying on market based instruments along with direct instruments. Among the market based instruments,

[1] *Monthly Review*, December 2012, Vol. 27, No.12, Dhaka Stock Exchange
[2] *Monetary Policy Review*, October 2005, Vol. 1, No. 1, Bangladesh Bank

yield rate on 91-day T-bill auctions, as a measure of short term interest rate, can be used as one proxy for monetary policy stance in Bangladesh[3]. This paper also considers broad money (M2) and reserve money as a monetary policy variable.

Theoretically, stock prices show a positive relationship with money supply and an inverse relationship with interest rate. The discounted cash flow model (Fisher, 1930 & Williams, 1938) states that the value of a stock is equal to the present value of its future cash flows. In accordance with New-Keynesian theory, the central bank exerts some control of the real interest rate due to prices being sticky in the short-run (Bjørnland & Leitemo, 2008). Hence, by altering interest rate, which serves as a discount rate, monetary policy can affect stock prices.

As the openness of Bangladesh economy is increasing over time, there is a possibility to have a relationship between exchange rate and stock prices. There are two models - Flow Oriented Model (Dornbusch & Fischer, 1980) and Stock Oriented Models (Branson, 1983 & Frankel, 1983) - those explain the relationship between stock prices and exchange rate. According to the Flow Oriented Model (Dornbusch & Fischer, 1980), which works through current account or trade balance, depreciation of a currency raises competitiveness of its domestic firms which lead to an increase in foreign demand for its exportables. As a result, revenue of the firm and its value increases which increases stock price in turn. On the other hand, Stock Oriented Models (Branson, 1983 & Frankel, 1983) predict that an increase in domestic stock prices will lead to an appreciation of the domestic currency.

In addition, this paper has an interest in looking into the relationship between stock prices and inflation, as one of the main objectives of monetary policy is price stability. The relationship between inflation and stock price is not direct and straightforward. Empirical evidence is also inconclusive. For these reasons, apart from monetary policy variables, this paper also includes exchange rate and domestic inflation.

Despite a number of papers on this issue in Bangladesh, none of these papers considers these variables simultaneously. This gap induces us to estimate the dynamic responses of stock prices to monetary policy changes, nominal exchange rate movements and domestic inflation in Bangladesh using recent data.

The rest of the paper is organized as follows: In the next two sections we discuss the recent development of Bangladesh's capital market and literature review respectively. Section four

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[3] Ahmed, Akhtaruzzaman & Barua (2006) provides a convincing argument in favor of using treasury bill as a monetary policy variable for Bangladesh, though they used 28-day treasury bill rate. Instead of 28-day treasury bill rate, we use 91-day treasury bill rate in this paper, because auction of 28-day treasury bills have not taken place after 29 June, 2008.

discuses empirical methodology and data, while section five present empirical results. Section six provides concluding remarks.

II. Recent Development of Capital Market in Bangladesh

Capital market, an integral part of a financial system, plays a significant role in economic development in any mature economy. In the presence of a bank-dominated financial system where the dependence on bank loan is substantial, capital market of Bangladesh is still at the evolving phase and has a heterogeneous composition compared with developed and well functioning capital markets. As a result, capital market in Bangladesh is yet to play a sufficient role in investment financing. In recent years, the development of capital market has got heightened attention from policy makers. In FY12, the amount of industrial term loans disbursed by banks and non-bank financial institutions (NBFIs) was Tk. 352.78 billion (of which the amount disbursed by NBFIs was Tk. 38.0 billion) compared with only Tk. 42.0 billion raised from new capital issues through private placements, public offerings, and right

Table 1: Indicators of Capital Market Development

	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12
Securities Market (DSE)										
Number of listed securities[4]	260	267	259	277	281	294	308	279[5]	278	290
Issued equity and debt (billion Tk)	36.1	46.8	52.8	64.7	83.7	109.0	147.2	213.1	305.7	384.25
Market capitalization (billion Tk)	69.2	142.4	213.0	205.3	412.2	789.4	1,001.9	2,277.0	2,317.4	1,933.02
Turnover (billion Tk)	30.6	24.8	74.1	46.0	164.7	543.2	892.8	2,714.3	3,258.8	1,171.45
General price index	830	1,319	1,713	1,340	2,149	3,001	3,010.3	6,253.7	6,117.2	4,572.88
Market cap to GDP ratio	2.30	4.28	5.75	4.93	10.18	17.18	20.19	43.92	41.1	31.64
Market cap to M2 ratio	6.07	10.97	14.06	11.36	19.49	18.32	33.76	62.72	52.61	37.38

Source: *Monthly Review,* various issues, Dhaka Stock Exchange.

offerings in the capital market[6]. This indicates the overwhelming preference of bank finance in industrial investment financing. Such high dominance of term loans in bank financing implies low equity stake and high risk exposure on lending banks and financial institutions, including liquidity risk arising from funding of long term loans with relatively short term deposits. This shows that Bangladesh has a financial system which is highly dominated by the banks. Despite the limited role of the capital market, the capital market has shown notable progress, with

[4] Including debentures but excluding government bonds.
[5] Total 64 companies were delisted from Dhaka Stock Exchange Main market and transferred to OTC market.
[6] See, *Bangladesh Bank Quarterly,* various issues, Bangladesh Bank and *Monthly Review,* Dhaka Stock Exchange.

upward trends in all share price indexes, turnover values, and market capitalization compared with ten years ago.

Figure 1: Share Price Index and Market capitalization to GDP and M2 Ratio

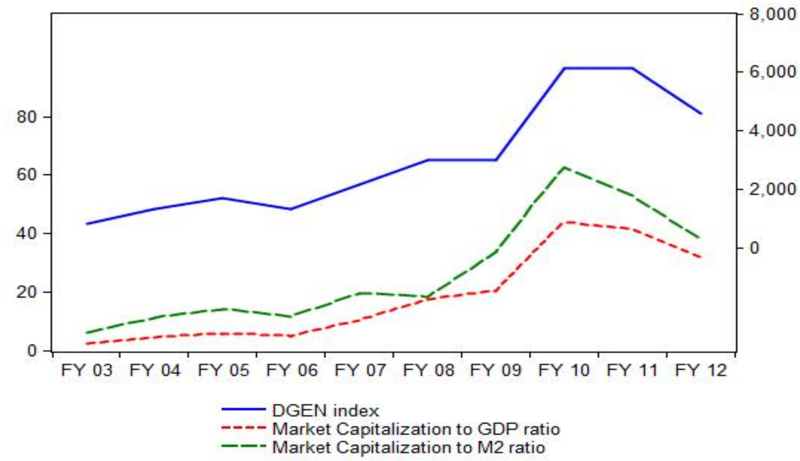

Figure-1 shows that market capitalization to GDP ratio started to rise from 2.3 percent in FY03 and continued to the historical highest of 43.92 percent in FY10. After FY10 market capitalization to GDP ratio started to decline and reached 31.65 percent in FY12. Similarly market capitalization to M2 ratio started to rise from 6.07percent in FY03 and continued to the historical highest of 62.72 percent in FY10. After FY10 market capitalization to M2 ratio started to decline and reached at 37.38 percent in FY12.

III. Literature Review

During the last few decades the area of the relationship between stock market returns and macroeconomic variables literature has been enriched by a large number of empirical research. Different authors have selected different macroeconomic variables for different countries and a variety of econometric techniques have been used to explore the relationship between stock prices and those selected variables. However, a few such empirical studies are found in Bangladesh context and their results are also inconclusive. In this section we review the studies related to foreign countries first and then papers in the context of Bangladesh.

Sprinkel (1971), Keran (1971), Homa and Jaffee (1971) found a significant relationship between money supply changes and stock prices in the United States for the period of 1918-1963, 1956-1970 and 1954-1969 respectively. Using monthly data Cooper (1974) found a positive relationship between the S&P 500 Index and money supply in the United States for the period of 1947-1970. Using monthly data for the period of 1947-1972 in the United States, Rozeff (1974) found that the lag effect of monetary policy on stock market was essentially zero. Stock returns did not lag behind growth rates of money supply. However, current stock returns bore a significant relationship to current monetary growth rates. All relationships of stock returns to monetary variables were significantly improved when current stock returns were related to future monetary data. Hafer (1985) studied the above relationship for the period of 1977-1984 using monthly data. He examined how stock returns changes due to changes in anticipated and unanticipated money supply growth. Based on evidence from several different stock price indexes, unanticipated changes in money have a statistically significant effect on stock prices. Expected changes in money do not display a statistically significant effect.

Mukherjee and Naka (1995) studied the relationship between Tokyo stock prices and several Japanese macroeconomic variables which include exchange rate, money supply, index of industrial production, inflation and interest rates. They used data ranging from January 1971 to December 1990 using a Vector Error Correction Model. They observed that stock price index had a positive relationship with all other variables except for inflation and interest rates.

Nasseh and Strauss (2000) investigated the relationship between stock prices and domestic and international macroeconomic activity in six countries in European continent; France, Germany, Italy, Netherlands, Switzerland, and the U.K. by using a cointegration approach. Their paper used quarterly data during the period of Q1:1962 to Q4:1995. They found that Industrial Production Indies (IP) and Business Surveys of Manufacturing Order (BSM) can explain movement of stock prices in long-run. They also find the negative influence of interest rates on stock prices. In addition, this study also argue that German industrial production and stock prices also positively influence on the return of other European stock markets like Netherlands, France, Italy, Switzerland and the UK.

Tsoukalas (2003) studied the relationship between stock prices and macroeconomic factors in Cyprus using the Vector Autoregressive model. The variables examined include exchange rate, industrial production, money supply, and consumer prices. The result of the study indicates a strong relationship between stock prices and all the macroeconomic factors.

Ibrahim and Aziz (2003) analyzed the dynamic linkages between stock prices and four macroeconomic variables for the case of Malaysia using the methods of cointegration and vector autoregression. Empirical results suggest the presence of a long-run relationship between these variables and the stock prices and substantial short-run interactions among them. In particular, documents positive short-run and long-run relationships between the stock prices and two macroeconomic variables. The exchange rate, however, is negatively associated with the stock prices. For the money supply, documents immediate positive liquidity effects and negative long-run effects of money supply expansion on the stock prices. Also notes the predictive role of the stock prices for the macroeconomic variables.

Neri (2004) analyzed the relationship between monetary policy and stock market indices in the G-7 countries and Spain using the methodology of structural VARs. This paper found that contractionary monetary policy shocks, measured by exogenous increases in the short-term interest rate have, on average, small, negative and transitory effects on stock market indices. The persistence, the magnitudes and the timing of these effects differ significantly across countries.

Rapach (2001) provides another analysis, based on US data, of the effects of money supply shocks and other shocks on real stock prices. These shocks are identified by means of long-run restrictions. The main result is that each identified shock affects real stock prices. Expansionary monetary policy shocks have a positive effect on real stock prices, the response of which can be rationalized according to the standard present-value evaluation principle. The positive effect on output increases expected real dividends while the decrease in the interest rate reduces the discount factor at which future dividend payments are evaluated. Another interesting result is that aggregate supply and monetary policy shocks contributed significantly to the surge in stock prices in the second half of the 1990s.

Wu (2001) employed a monetary approach to analyze the asymmetric asset-price movements (exchange rates and stock prices) in Singapore, a small open economy with managed exchange rate targeting. The Singapore dollar exchange rates vis-a-vis the developed countries' currencies are negatively related to stock prices whereas the relationship between the Singapore dollar-Malaysian ringgit exchange rate and stock prices is positive instead. The pattern of asymmetry is explained by the relative exchange-rate elasticity of real money demand and real money supply and evidenced by the distributed-lag regression and VAR analysis. Furthermore, the distributed-lag regression of monthly data suggests that fiscal revenues as well as fiscal expenditures exert positive influences on stock prices.

Ratanapakorn and Sharma (2007) use Granger causality approach in order to investigate the long-term and short-term relationships between the US Stock Price Index (S&P 500) and six macroeconomic variables over the period 1975 until 1999. In the long-run relationship, they find that the stock prices negatively related to the long-term interest rate, and positive relationship between stock prices and the money supply, industrial production, inflation, the exchange rate and the short-term interest rate. They conclude that in the Granger causality sense, every macroeconomic variable causes the stock prices in the long-run but not in the short-run.

Stoica and Diaconașu (2012) found that monetary policy impact - via interest rate has both long and short term relationship between stock prices and interest rates in EU during 2000-2012. They also found that on the long-run the co-movement between interest rates and stock prices are stronger during the financial crisis period compared entire sample. Ioannidis and Kontonikas

(2008) found that monetary policy shifts significantly affect stock returns, thereby supporting the notion of monetary policy transmission via the stock market.

Arshad and Javed (2009) examined the relationship between stock returns of Karachi stock exchange and monetary variables in Pakistan such as money supply, treasury bill rates, foreign exchange rates, and the consumer price index for the period of June 1998 to June 2008. They concluded that monetary variables have a long-run as well as short-run relationship with equity returns. Using standard time series techniques they found a positive relationship with money supply and negative relationship with interest rate, inflation and exchange rate.

Agrwal, Srivastav and Srivastav (2010) analyzed the relationship between stock returns and Indian rupee-US Dollar exchange rates using daily data for the period of October 11, 2007 to March 9, 2009. They found a negative correlation between stock returns and exchange rates and unidirectional causality running from stock returns to exchange rate.

Ahmed, Akhtaruzzaman and Barua (2006) analyzed the relationship between monetary policy and stock price in Bangladesh using the methodology of structural VAR. This study employed monthly data on consumer price index, industrial production index, 28-day treasury bill rate, money supply (M1) and All Share Price Index of Dhaka Stock Exchange for the period spanning from April 1997 to March 2006. This study found that a contractionary monetary policy shock, measured by increase in the short-term policy interest rate (28-day treasury bill rate) has small negative effect on the stock price index and the effect is short lived in Bangladesh.

Banerjee and Adhikary (2009) investigated the dynamic effects of interest rate (weighted average interest rate on bank deposit) and exchange rate (USD against BDT) changes on All Share Price Index (ASPI) of Dhaka Stock Exchange. They applied the Johansen-Juselius procedure and the Vector Error Correction Model (VECM) respectively to test the co-integrating relationship and the existence of long–run equilibrium relationship among the variables for the period of January 1983 to December 2006. They found that the interest rate and exchange rate changes affect for the stock market in the long-run and there is no significant influence in the short-run.

Quadir (2012) studied the effects of macroeconomic variables of treasury bill interest rate and industrial production on stock returns on Dhaka Stock Exchange for the period between January 2000 and February 2007 on the basis of monthly time series data using Autoregressive Integrated Moving Average (ARIMA) model. This paper found a positive relationship between Treasury bill interest rate and industrial production with market stock returns but the coefficients have turned out to be statistically insignificant.

Rahman and Uddin (2009) investigated the interactions between stock prices and exchange rates in three emerging countries of South Asia named as Bangladesh, India and Pakistan. They used average monthly nominal exchange rates of US dollar in terms of Bangladeshi Taka, Indian Rupee and Pakistani Rupee and monthly values of Dhaka Stock Exchange General Index, Bombay Stock Exchange Index and Karachi Stock Exchange All Share Price Index for period of January 2003 to June 2008 to conduct the study. Using Johansen cointegration and Granger causality test this study found neither cointegrating relationship nor any causal relationship between stock prices and exchange rates in the countries.

IV. Data and Methodology

To estimate the effect of monetary policy shocks on stock prices, we have identified several variables that could capture the impact of the various transmission channels. Monthly data on Dhaka Stock Exchange General Index (DGENI), Reserve Money (RM), Broad Money (M2), Treasury bill rate (TRB), Consumer Price Index (CPI) and Nominal Exchange Rate of BDT against USD (ER) for the period July 1999 through June 2012 have been used in this study. The Dhaka Stock Exchange General Index (DGENI) is used as a proxy for stock prices in Bangladesh. This paper considers M2, RM and TRB alternatively as a monetary policy variable. To capture the relationship between stock prices and exchange rate, nominal exchange rate of Bangladeshi Taka *vis-à-vis* the United States dollar (BDT/USD) has been included in this study. Moreover, to estimate the impact of inflation, we have chosen the Consumer Price Index to include in the study. All the variables, with only exception of TRB, are expressed in natural logarithms. The data used in this study are collected from Bangladesh Bank, Bangladesh Bureau of Statistics and Dhaka Stock Exchange Ltd.

Most of the macroeconomic variables are characterized by unit-root processes i.e., non stationary. As we see in Panel A of Figure A1 in Appendix, variables included in this study are most likely to have unit roots. Regression of non stationary variables may leads to a spurious result. The Augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1979, 1981) is widely used to test unit roots in the variables. However, Monte Carlo simulations show that the power of the various DF tests can be very low (Enders, 2010). This means that DF test has an inherent bias in favor of accepting the null hypothesis of unit root. Phillips and Perron (1988) introduced an alternative of the Dickey-Fuller (DF) test that considered autocorrelation and heteroskedasticity. Choi and Chung (1995) argue that Phillips-Perron (PP) test appears to be more powerful than the ADF test in case of low frequency data. For these reasons, both the PP and ADF methodologies have been used in this study to test unit roots in the variables.

If the variables are integrated in same order, they are ready for testing cointegration. If the variables are found to be I (1), the existence of cointegrating relationship among the variables will be checked using the Johansen approach, due to Johansen (1988), and Johansen and Juselius (1990). If the series are really cointegrated, the number of the cointegrating relation must be less than the number of variables in the model. If both the trace and maximum eigenvalue tests suggest the presence of one cointegrating relationship, there exists a long-run relationship among the variables. Then using the cointegrating relationship a Vector Error Correction (VEC) model will be developed, which explains the short-run dynamics of the variables. For the stability of the equilibrium relationship, at least one of the error correction terms requires to be significant, because they represent the coefficients for the speed of adjustment once the system is shocked.

After the VEC estimation, we will proceed to unveil innovation accounting that includes impulse responses and variance decompositions. Impulse response functions and variance decompositions are used to summarize the dynamic relations between variables in the system. The forecast error variance decomposition shows to what variability in one element can be explained by the innovations from the other element in the system.

V. Estimation Results: Cointegration, Vector Error Correction and Innovation Accounting

As per the methodology, Table 2 presents the results of the ADF and PP unit root tests[7] for the variables included in the study. We conduct each type of unit root test for different specifications i.e., without trend and with trend. The outcomes of both tests are robust and consistent in that all the series are I(1) in level, and I(0) in first difference irrespective of their specifications. Since all the variables are I(1) in level, this property qualify the variables to be examined in the Johansen cointegration test. However, the results of the Johansen cointegration test are lag length sensitive. To determine the optimal lag length, the most common procedure is to use the Akaike information criterion (AIC) or Schwartz Bayesian criterion (SBC). Though the SBC selects a more parsimonious model, we consider both of the criteria in this experiment[8]. Based on the data, as shown in Figure A1 in appendix, in the Johansen cointegration test specification either of option *"intercept (no trend) in cointegrating equation and in VAR"* or option *"intercept and trend in cointegrating equation and no intercept in VAR"* will be appropriate. However, to make the test more general, we check for the both options.

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[7] All the estimations and tests in this study have been conducted using Eviews7 econometric package.

[8] In practice, the SBC will select a more parsimonious model than will either the AIC or *t*-tests. Nevertheless, whichever method is used, the researcher must ensure that residuals act as white-noise processes (Enders, 2010:217).

Table 2: Unit root tests for variables

Variables	Augmented Dickey-Fuller Test				Phillips-Perron Test				Remark
	In level		In first difference		In level		In first difference		
	Intercept	Int. and trend	Intercept	Int. and trend	Intercept	Int. and trend	Intercept	Int. and trend	
DGENI	-0.83 (0.81)	-2.22 (0.47)	-12.24 (0.00)	-12.21 (0.00)	-0.84 (0.80)	-2.57 (0.29)	-12.24 (0.00)	-12.21 (0.00)	I(1)
TRB	-2.58 (0.10)	-2.48 (0.34)	-4.89 (0.0001)	-4.97 (0.0004)	-1.93 (0.32)	-1.70 (0.75)	-7.69 (0.00)	-7.83 (0.00)	I(1)
M2	2.86 (1.00)	-0.24 (0.99)	-18.68 (0.00)	-19.34 (0.00)	2.34 (1.00)	-0.44 (0.99)	-17.45 (0.00)	-18.45 (0.00)	I(1)
RM	-0.05 (0.95)	-2.55 (0.30)	-20.68 (0.00)	-20.62 (0.00)	0.23 (0.97)	-2.53 (0.32)	-21.87 (0.00)	-21.80 (0.00)	I(1)
CPI	3.64 (1.00)	-2.13 (0.53)	-9.92 (0.00)	-10.75 (0.00)	3.42 (1.00)	-2.11 (0.54)	-10.03 (0.00)	-10.70 (0.00)	I(1)
ER	-0.58 (0.87)	-1.98 (0.60)	-10.96 (0.00)	-10.93 (0.00)	-0.59 (0.87)	-2.11 (0.54)	-10.87 (0.00)	-10.84 (0.00)	I(1)

Note: The null hypothesis states that the variable has a unit root. P-values are shown in the parentheses following each adjusted t-statistic. DGENI, TRB, M2, RM, CPI and ER indicate Dhaka Stock Exchange General Index, 91-Day Treasury Bill Rate, Broad Money, Reserve Money, Consumer Price Index and Nominal Exchange Rate of BDT against USD respectively. All the variables, with only exception of 91-Day Treasury Bill Rate, are expressed in natural logarithms.

As mentioned earlier, this paper considers M2, RM and TRB rate alternatively as a monetary policy variable. If we consider M2 as a monetary policy variable instead of RM and TRB, SBC suggests one lag for four variables (DGENI, M2, CPI and ER) Vector Autoregression (VAR), while AIC suggests two lags. If we use one lag in VAR, we get conflicting results: the maximum eigenvalue test indicates no cointegration, whereas the trace test indicates the presence of one cointegrating relation among the variables[9] (Panel A of Table A1 in appendix). Johansen and Juselius (1990) suggest that the maximum eigenvalue test gives better results. Enders (2010:392) argues that when the results conflict, the maximum eigenvalue test is usually preferred for its ability to pin down the number of cointegrating vectors. Against this backdrop, we reject the possibility of the existence of any cointegrating relationship under this option[10].

[9] In Eviews, we use option *"intercept (no trend) in cointegrating equation and in VAR"* in the Johansen cointegration test specification.

[10] We also use option *"intercept and trend in cointegrating equation and no intercept in VAR"* in the cointegration test specification. In this case both the trace test and the maximum eigenvalue test indicate no cointegration (Panel B of Table A1 in appendix).

Similarly, under two-lag assumption, both options indicate no cointegrating relation among the variables (Panel C & D of Table A1 in appendix).

If we replace M2 with RM, then for the four variables case (DGENI, RM, CPI and ER), SBC and AIC suggest 1 and 2 lag in VAR respectively. In this case, both options under either lag specification indicate no cointegrating relation among the four variables (Table A2 in appendix).

If we drop RM from the model and include 91-day treasury bill rate as a monetary policy variable, then for the four variables case (DGENI, TRB, CPI and ER), SBC and AIC suggest 1 and 3 lag in VAR respectively. In this case, under one-lag in VAR assumption, both options indicate no cointegrating relation among the variables. However, under three-lag in VAR specification and first option, both the trace and maximum eigenvalue suggest one cointegrating relation among the four variables, indicating the existence of the long-run relationship in the system (Table 3). Then a Vector Error Correction (VEC) model requires estimating to understand the short-run dynamics in the system.

Table 3: Johansen cointegration tests

			λ Stat	**Critical Values**	**Probability**	**No. of CE**
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	60.06	47.86	0.00	1
	H_0: r≤1	H_A: r > 1	28.31	29.80	0.07	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	31.75	27.58	0.01	1
	H_0: r=1	H_A: r = 2	18.77	21.13	0.10	0

Note: The λ_{trace} and λ_{max} are calculated as per Johansen (1988) and Johansen and Juselius (1990). P-values are calculated as per MacKinnon et al. (1999). Critical values reported here are for the 5 percent significance level. CE stands for cointegrating equation. r stands for the rank of the matrix, which denotes the number of the CE between the variables. H_0 and H_A denote the null and alternative hypotheses, respectively.

Table 4 presents VEC (3) estimates for stock price index, T-bill rate, consumer price index and exchange rate in Bangladesh (for detail VEC results see Table 3A in Appendix). The cointegrating equation, as placed at the top of the table, shows a long-run significant negative relationship between stock prices and T-bill rate; and positive relationship of consumer price index and exchange rate with stock prices. However, the coefficient of exchange rate is not significant at the 5 percent level. The coefficient of error correction term on the regression with first difference Stock Price Index is significant, suggesting the adjustment nature of stock prices if the long-run equilibrium relationship is shocked. Pesaran and Pesaran (2009) assert that the sign of the error correction term must be opposite to that of the coefficient on the same variable in the cointegrating equation. The long-run equilibrium equation in this study has been normalized on stock prices, and hence possesses a positive sign. The corresponding error correction term on first differenced Stock Price Index has a negative sign as expected.

Table 4: Cointegrating Equation and Vector Error Correction estimates

CE for VECM(3): ECT= DGENI(-1) + **0.1188** TBR(-1) **-2.32** CPI(-1) -1.0527 ER(-1) + 8.10
[6.49] [-6.52] [-1.42]

Error Correction:	D(DGENI)	D(TBR)	D(CPI)	D(ER)
ECT(-1)	**-0.1758**	-0.1193	**0.0068**	0.0080
	[-4.79]	[-0.62]	[2.64]	[1.37]
R-squared	**0.26**	**0.31**	**0.13**	**0.07**

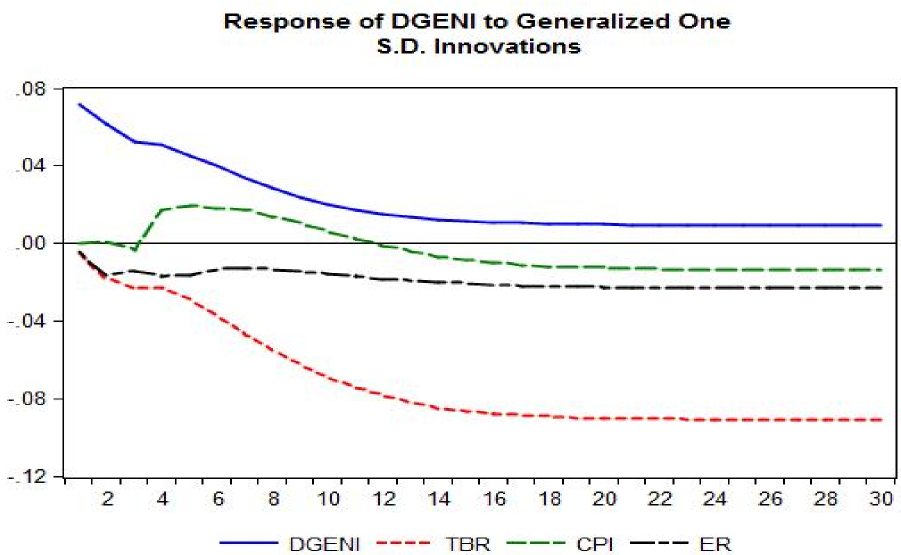
Note: All values in the parentheses against each coefficient are t-statistic. ECT denotes error correction term. CE stands for cointegrating equation.

In the same fashion, the coefficient of is statistically significant both in the long-run cointegrating equation and short-run error correction dynamics and the corresponding error correction term on first differenced Consumer Price Index (though it is very weak) has appropriate sign. The coefficient of T-bill rate appears with a significant negative sign in the cointegrating equation. The sign of corresponding error correction term is negative as expected, but is insignificant; suggesting T-bill rate is weakly exogenous in the T-bill rate–stock price relationship. Exchange Rate is insignificant both in the long-run cointegrating equation and short-run error correction dynamics. Although there is a long term relationship among stock prices, T-bill rate and consumer price index, it is only stock prices and Consumer Price Index that adjust any disequilibrium once the system is shocked; T-bill rate and Exchange Rate do not adjust any disequilibrium. The coefficient of error correction term on first-differenced stock price index is -0.1758. This implies that only 17.58 percent of the last month's disequilibrium is corrected this month, requiring almost 6 months to bring the system into the steady state once it is disturbed. In the growth equations of four variables, there exist short-run interactions between stock prices and any other variables in the model, but are not significant at 5 percent level of significance. Hence, looking into short-run dynamics through innovation accounting becomes imperative.

In case of impulse response, this paper employs generalized approach. Pesaran and Shin (1998) argue that unlike the traditional impulse response analysis, generalized impulse response analysis does not require orthogonalization of shocks and is invariant to the ordering of variables in the VAR. This approach is also used in the construction of order-invariant forecast error variance decompositions.

Based on the VECM (3), generalized impulse responses and forecast error variance decompositions of stock prices in Bangladesh are presented in Figure 2 and Table 5 respectively. The response of stock prices (DGENI) due to one standard deviation innovation in T-bill rate appears to be negative and very strong. However, the response of stock prices to one standard deviation innovation in Consumer Price Index becomes positive after three months, reaches to its peak in five months and declines thereafter. On the other hand, the response of stock prices to the innovation in exchange rate (BDT against USD) seems to be negative, but very weak.

Figure 2: Generalized impulse Response of Stock Price (DGENI)



While impulse responses are useful in assessing the signs and magnitudes of responses to specific shocks, the variance decomposition analysis provides an important insight into the relative importance of each variable in the system. Table 5 shows the share of the forecast error variance of stock prices (DGENI) for different forecast horizon that can be attributed to different variables included in this system.

The share of the forecast error variance of stock prices (DGENI) due to its own shock declines gradually as forecast horizon increases, while the share of interest rate (T-bill rate) and consumer price shock increases as forecast horizon increases. At six month forecast horizon 80 percent of the forecast error variance of stock prices (DGENI) is account for its own shock, but at one year forecast horizon it decreases to 41 percent. At this horizon, interest rate shock is the most important source of the variability of stock prices (53 percent). The share of consumer price shock to the forecast error variance of stock prices (DGENI) increases up to 5 percent at eight month forecast horizon, while the contribution of exchange rate remains very small at any forecast horizon. These results further strengthen the previous results of VEC.

Table 5: Generalized Forecast Error Variance Decomposition of (DGENI)

Variance Decomposition of LDGENI:					
Period	S.E.	LDGENI	TBR	LCPI	LER
1	0.071	100.00	0.00	0.00	0.00
2	0.097	96.53	2.00	0.01	1.47
3	0.112	93.47	4.63	0.11	1.79
4	0.127	89.38	5.98	2.03	2.62
5	0.139	84.80	8.53	3.67	3.00
6	0.150	79.61	12.80	4.65	2.94
7	0.161	73.25	18.73	5.24	2.78
8	0.173	66.38	25.70	5.29	2.63
9	0.186	59.39	33.16	4.97	2.48
10	0.199	52.72	40.49	4.46	2.33
11	0.214	46.65	47.22	3.91	2.21
12	0.228	41.34	53.13	3.43	2.11

VI. Conclusion

This paper is an attempt to estimate the responses of stock prices to monetary policy changes, exchange rate movements and domestic inflation in Bangladesh for the period July 1999-June 2012. To measure the monetary policy changes we use three alternative variables namely broad money, reserve money and 91-day treasury bill rate. In this study we adopt the widely used Johansen approach to cointegration along with VEC model to unveil both long-run and short-run relationship among the above mentioned variables. If we consider 91-day treasury bill rate as a monetary policy variable instead of broad money or reserve money, we find existence of a cointegrating relationship among the variables.The cointegrating equation shows a significant long-run relationship between stock prices, T-bill rate and Consumer Price Index which is theoretically consistent. However, the relationship between Exchange Rate and Stock Prices is not significant at the 5 percent level. This may be due to very limited foreign portfolio investment in the capital market of Bangladesh and that profits of exporting domestic firms are inelastic to exchange rate movement. The positive significant relationship between consumer price index and stock price index for the period of study indicates the presence of wealth effect of stock prices. Higher stock prices increase the wealth of households, prompting consumers to spend more which in turn influences inflation. Although there is a long term relationship among stock prices, T-bill and consumer price index, it is only stock prices and consumer price index that adjust any disequilibrium once the system is shocked; T-bill rate and exchange rate do not adjust any disequilibrium. When we use broad money (M2) or reserve money (RM) as a monetary policy variable, no cointegration and hence no long-run relationship among the variables is found. If there is a robust relationship between monetary policy and stock prices, the empirical results for the three alternative monetary policy variables are expected to be found in the same line. In this study we find that stock price has a negative relationship with treasury bill rate, but no long-run relationship with broad money or reserve money. Against this backdrop, the results of this paper, however, remain inconclusive particularly in respect of the relationship between monetary policy and stock prices at least for the 1999-2012 sample period.

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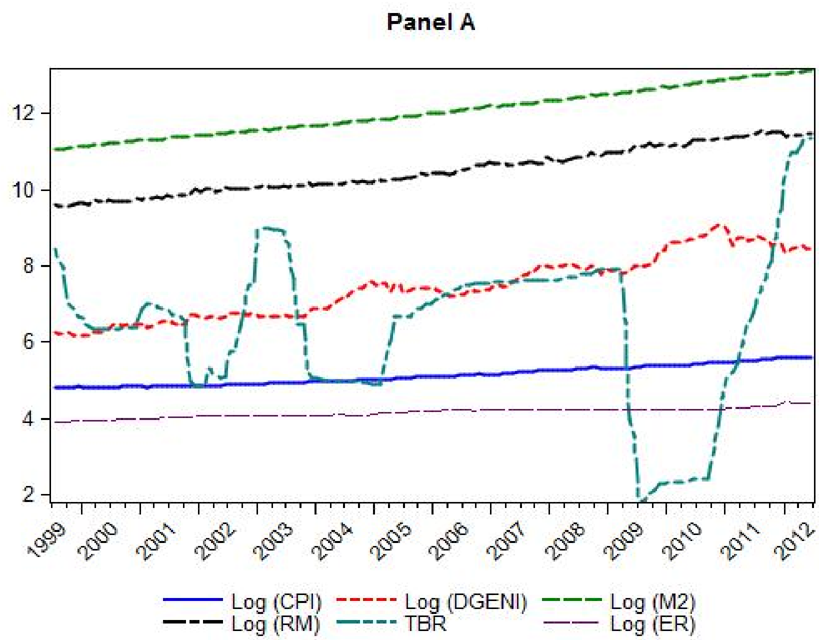
Appendix

Figure A1: Dhaka Stock Exchange General Index, T-bill rate, CPI and Exchange Rate in levels (Panel A) and in differences (Panel B)



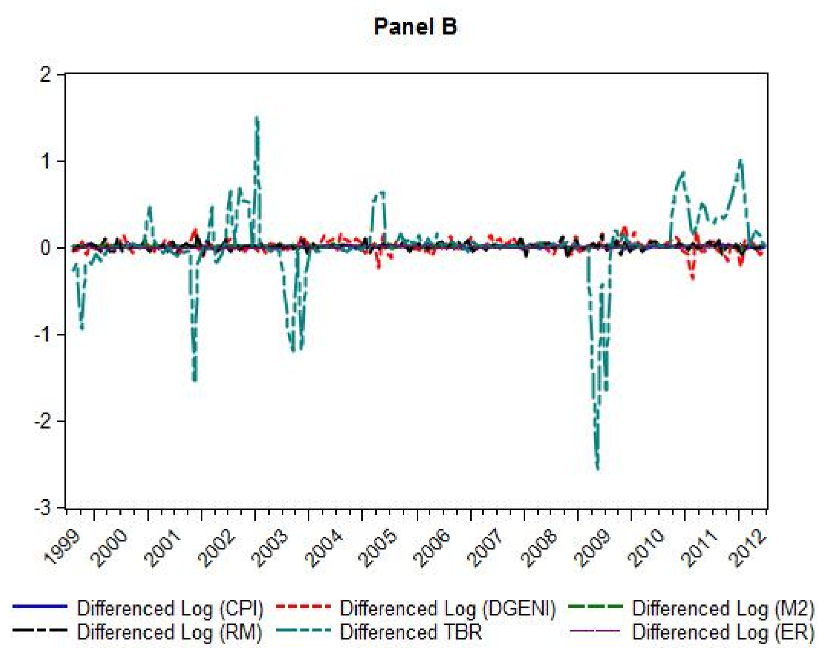


Table A1: Johansen cointegration tests for the variables-DGENI, M2, CPI & ER

Panel A: 1 lag in VAR and option "intercept (no trend) in cointegrating equation and in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	48.08	47.86	0.05	1
	H_0: r≤1	H_A: r > 1	23.59	29.80	0.22	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	24.50	27.58	0.12	0
	H_0: r=1	H_A: r = 2	13.49	21.13	0.41	0

Panel B: 1 lag in VAR and option "intercept and trend in cointegrating equation and no intercept in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	56.01	63.88	0.19	0
	H_0: r≤1	H_A: r > 1	29.54	42.92	0.53	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	26.46	32.12	0.21	0
	H_0: r=1	H_A: r = 2	13.50	25.82	0.76	0

Panel C: 2 lag in VAR and option "intercept (no trend) in cointegrating equation and in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	42.96	47.86	0.13	0
	H_0: r≤1	H_A: r > 1	23.07	29.80	0.24	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	19.89	27.58	0.35	0
	H_0: r=1	H_A: r = 2	14.44	21.13	0.33	0

Panel D: 2 lag in VAR and option"intercept and trend in cointegrating equation and no intercept in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	52.30	63.88	0.32	0
	H_0: r≤1	H_A: r > 1	30.29	42.92	0.49	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	22.01	32.12	0.49	0
	H_0: r=1	H_A: r = 2	14.44	25.82	0.68	0

Note: The λ_{trace} and λ_{max} are calculated as per Johansen (1988) and Johansen and Juselius (1990). P-values are calculated as per MacKinnon et al. (1999). Critical values reported here are for the 5 percent significance level. CE stands for cointegrating equation. r stands for the rank of the matrix, which denotes the number of the CE between the variables. H_0 and H_A denote the null and alternative hypotheses, respectively.

Table A2: Johansen cointegration tests for the variables-DGENI, RM, CPI & ER

Panel A: 1 lag in VAR and option "intercept (no trend) in cointegrating equation and in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	34.25	47.86	0.49	0
	H_0: r≤1	H_A: r > 1	15.41	29.80	0.75	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	18.84	27.58	0.43	0
	H_0: r=1	H_A: r = 2	9.46	21.13	0.79	0

Panel B: 1 lag in VAR and option"intercept and trend in cointegrating equation and no intercept in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	45.96	63.88	0.60	0
	H_0: r≤1	H_A: r > 1	27.10	42.92	0.68	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	18.86	32.12	0.74	0
	H_0: r=1	H_A: r = 2	12.34	25.82	0.85	0

Panel C: 2 lag in VAR and option "intercept (no trend) in cointegrating equation and in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	34.93	47.86	0.45	0
	H_0: r≤1	H_A: r > 1	14.98	29.80	0.78	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	19.95	27.58	0.34	0
	H_0: r=1	H_A: r = 2	9.57	21.13	0.78	0

Panel D: 2 lag in VAR and option"intercept and trend in cointegrating equation and no intercept in VAR"

			λ Stat	Critical Values	Probability	No. of CE
λ_{trace} tests:						
	H_0: r=0	H_A: r > 0	44.01	63.88	0.69	0
	H_0: r≤1	H_A: r > 1	23.94	42.92	0.84	0
λ_{max} tests:						
	H_0: r=0	H_A: r = 1	20.07	32.12	0.65	0
	H_0: r=1	H_A: r = 2	11.74	25.82	0.89	0

Note: The λ_{trace} and λ_{max} are calculated as per Johansen (1988) and Johansen and Juselius (1990). P-values are calculated as per MacKinnon et al. (1999). Critical values reported here are for the 5 percent significance level. CE stands for cointegrating equation. r stands for the rank of the matrix, which denotes the number of the CE between the variables. H_0 and H_A denote the null and alternative hypotheses, respectively.

TableA3: Vector Error Correction estimates

CE for VECM(3): ECT= DGENI(-1) + **0.118755** TBR(-1) **-2.322151** CPI(-1) -1.052695 ER(-1) + 8.099074

		TBR(-1)	CPI(-1)	ER(-1)
		[6.48821]	[-6.51566]	[-1.42356]

Error Correction:	D(DGENI)	D(TBR)	D(CPI)	D(ER)
ECT(-1)	**-0.175796**	-0.119340	**0.006825**	0.007983
	[-4.78605]	[-0.62025]	[2.64087]	[1.37129]
D(DGENI(-1))	0.014791	0.272354	0.009601	-0.003652
	[0.19017]	[0.66849]	[1.75456]	[-0.29626]
D(DGENI(-2))	0.019754	0.561028	0.002191	-0.012353
	[0.25166]	[1.36443]	[0.39671]	[-0.99295]
D(DGENI(-3))	0.119918	-0.038049	-0.003325	-0.011901
	[1.54853]	[-0.09380]	[-0.61028]	[-0.96967]
D(TBR(-1))	-0.012267	0.319344	0.000297	-0.000705
	[-0.74840]	[3.71919]	[0.25774]	[-0.27124]
D(TBR(-2))	0.008348	0.271905	-0.001473	0.000174
	[0.49341]	[3.06816]	[-1.23731]	[0.06482]
D(TBR(-3))	0.032214	0.039961	-0.001011	-0.001331
	[1.85962]	[0.44038]	[-0.82947]	[-0.48475]
D(CPI(-1))	-0.030169	6.108173	0.172934	-0.068584
	[-0.02522]	[0.97489]	[2.05497]	[-0.36179]
D(CPI(-2))	-1.212883	9.242380	0.043390	0.032031
	[-0.99649]	[1.44960]	[0.50669]	[0.16605]
D(CPI(-3))	4.368103	0.469284	0.020231	-0.105371
	[3.63591]	[0.07457]	[0.23935]	[-0.55342]
D(ER(-1))	-1.222822	4.428456	0.015911	0.132928
	[-2.26409]	[1.56528]	[0.41871]	[1.55294]
D(ER(-2))	0.126890	1.122093	0.014896	-0.166800
	[0.23257]	[0.39261]	[0.38804]	[-1.92899]
D(ER(-3))	-0.753755	1.900808	0.012922	0.028548
	[-1.37338]	[0.66116]	[0.33465]	[0.32821]
C	0.001085	-0.104848	0.003701	0.004521
	[0.09122]	[-1.68323]	[4.42355]	[2.39891]
R-squared	**0.26**	**0.31**	**0.13**	**0.07**

Note: All values in the parentheses against each coefficient are t-statistic. ECT denotes error correction term. CE stands for cointegrating equation.

Table A4: Portmanteau Tests for Autocorrelations

VEC Residual Portmanteau Tests for Autocorrelations
Null Hypothesis: no residual autocorrelations up to lag h

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	0.52	NA*	0.53	NA*	NA*
2	1.42	NA*	1.43	NA*	NA*
3	4.12	NA*	4.19	NA*	NA*
4	13.23	0.99	13.54	0.99	28
5	27.44	0.98	28.24	0.97	44
6	43.35	0.95	44.80	0.93	60
7	50.22	0.99	52.01	0.98	76
8	59.18	0.997	61.46	0.99	92
9	94.24	0.82	98.73	0.73	108
10	109.10	0.83	114.63	0.72	124
11	131.81	0.68	139.12	0.51	140
12	151.19	0.59	160.16	0.39	156