Policy Analysis Unit (PAU)

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Effects of Monetary Policy on Price Formation of Financial Assets: A Test for Bangladesh

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Effects of Monetary Policy on Price Formation of Financial Assets: A Test for Bangladesh

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Abstract

The purpose of this paper is to estimate the effect of contractionary monetary policy shock on the stock price index using structural VAR approach. The estimated coefficients of money supply and money demand equations from the structural VAR model are theoretically consistent, suggesting that the short run identification restrictions are valid. Impulse responses of different variables of interest to contractionary monetary policy shocks, measured by exogenous increases in the short-run policy interest rates, establish the theoretical underpinnings of asset price channel to monetary policy shocks. The estimate confirms that a contractionary monetary policy shock, measured by increase in the short-term policy interest rate has small negative effect on the stock price index and the effect is short lived.

Keywords: Structural VAR, Asset Price Channel, Contractionary Monetary Policy Shock, Stock Price Shock., Adverse Supply Shock, Liquidity Puzzle.

JEL Classification: E41, E43, E44, E51, E52, G12

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1. Introduction

Several empirical studies indicate that monetary policy stance adopted by the Central Bank of a country has implications for stock price movement. Ehrmann and Fratzscher (2004) found that monetary policy shocks had immediate significant effect on stock price in the US economy. A tightening of monetary policy by 50 basis points reduced US stock returns by about 3 percent on the announcement day. Any significant downturn in the stock market limits firm's ability to raise capital for further expansion, thus retards output growth, lowers consumer demand and may cause financial instability. For example, the decline in asset price due to stock market crash in US in 1929 and the same in Japan in the late 1980s and early 1990s was followed by a slowdown in economic activity as well as increased financial and banking sectors instability. Romer (1990) argued that the negative effect of stock market variability is stronger enough to account for the entire decline in real consumer spending on durables that occurred in late 1929 and 1930. IMF (2003) found that recurrent equity price reductions are associated with heavy GDP losses. Understanding causality between monetary policy stance and the stock price behaviour has an important bearing for designing appropriate monetary policy stance. It can be noted that though a large number of studies have been conducted in the context of developed countries, a few have been attempted in the developing country context, particularly in South Asia. In fact, there is no such studies exist, to our knowledge, in the context of Bangladesh. This study therefore serves as an initial attempt to understand the behaviour of monetary policy over stock prices in economies with a comparable level of financial development.

Like many other developing countries, many firms in Bangladesh are constrained to get access to funds. Though banks provide short-term funds, they are sometimes reluctant to offer long-term finance the firms due to their low level of net worth and also the inability to meet collateral requirements. Therefore, real sector of the economy has been suffering from investment stagnation (Choudhuri et al, 1994). Appreciating the need for long-term fund for industrialization, government established some specialized financial institutions such as Bangladesh Shilpa (Industrial) Bank (BSB) and Bangladesh Shilpa Rin Sangstha (an industrial loan institute) in the 1970s but their performance remained far from the expected level. They are overburdened with high classified loans (47.25 percent and 55.23 percent respectively in December 2005) and emerge as a growing concern for financial system risk. It is argued that an efficient and stable stock

market provides a unique opportunity to provide capital for future business expansion and thus plays an important driving force for economic growth. Government indeed took initiative to revive the stock market in the late 1970s and undertook a series of measures through changes in the legal code and development of infrastructure, notably the establishment of Securities and Exchange Commission (SEC), Central Depository System and automation of securities transactions. Nonetheless, the market experienced a serious debacle in late 1996 due to lack of institutional presence in the share market, monopolistic dominance of member brokers, inefficiency of the SEC to cope with the developments and existence of kerb market (Alam and Jahan, 1996).The overall capital market in Bangladesh is yet to recover completely from the tailspin following the stock market bubble and its collapse in the mid-nineties (BB Annual Report, FY05).

Though some studies have attempted to explain the causes and effects of stock market collapse on national economy, they have not analyzed it from monetary policy perspective. In order to play a proactive role in capital market development, as a Central Bank, Bangladesh Bank needs to analyze the reactive function of stock market over changes in monetary policy. The relationship between monetary policy and stock prices is complex, because stocks are influenced by monetary policy through several channels. However, this paper has examined a limited aspect, namely the effects of monetary policy on stock prices by using structural VAR. Estimated results show that contractionary monetary policy shocks have, on average, small and negative transitory effects on stock market indices.

The remainder of the paper is structured as follows. The next section describes conceptual issues which are important for empirical analysis. Section 3 reviews the past empirical findings. Section 4 specifies the model and explains the reasoning behind choosing particular variables. Section 5 discusses the empirical results. Section 6 concludes the findings.

2. Conceptual issues

The monetary policy stance is transmitted into the real economy by various channels such as *Asset Price Channel, Interest Rate Channel, Exchange Rate Channel*[1] *and Credit Channel.* All of these channels indeed affect stock prices directly or indirectly. Tobin (1969, quoted in Mishkin, 2004)

[1]However, in the empirical model of structural VAR the endogeneity of the Exchange Rate Channel in influencing the relationship between monetary policy and the stock price is not captured.

hypothesized that monetary policy can affect the real economy through asset price channel. Expansionary monetary policy increases household's spending capacity which, in part, is spent in stock market, increases the demand for stocks and raises the stock prices. Tobin argued that if the market value of a firm's capital exceeds the cost of acquiring it, the firm increases its capital stock. On the other hand, contractionary monetary policy lowers the present value of future earning flows and hence depresses stock markets.

The traditional Keynesian view of transmission channel is that monetary expansion leads to a fall in real interest rate, lowers firm's cost of capital and encourages higher investment spending through borrowing. In fact, when interest rates are very low, fixed interest securities provide very little competition for shares. A rational investor therefore, other things being equal, would like to pay a higher price for a share. It is argued that extremely low returns from regular savings accounts, which yielded less than 1 percent, contributed to increasing Japanese stock prices to more than 60 times earnings, almost 5 times book value and more than 200 times dividends in December 1989 (Malkiel, 2003). A tightening of monetary policy reduces liquidity in the banking system, increases deposit and T-bill rates. This lowers the present value of future cash flows from stocks through discount factor and investors tend to readjust their investment portfolio. Capital market instruments such as equities experience far wider price fluctuations than money market instruments and are considered to be risky investments (Mishkin, 2004). It is therefore argued that if interest rates on bank deposit are relatively high, they can offer a stable, profitable alternative to the stock return. Rational investors would sell some stocks and invest in fixed income securities causing stock prices to fall sharply. This happened in the US in the early 1980s and 1987, just before the stock-market crash of October 1987. Similarly, interest rates in Japan rose sharply in 1990 and the stock market collapsed (Malkiel, 2003).

Credit view argues that monetary policy influences the financing cost of a firm as well as the availability of loans. If a credit channel is at work for firms that are quoted on stock markets, one would expect that expansionary monetary policy will enable them to take bank loan at easier terms and gain on bank lending rate. This interest differential gain will improve their balance sheets, make them more competitive and induce them to expand business activities. The burgeoning effect of these activities will be reflected through the stock price. Conversely, contractionary monetary policy will affect the firms' share price in the opposite direction.

Besides monetary policy, stock prices may be influenced by other factors. The firm-foundation theory argues that the market price of a share depends mostly on the growth rate of a firm's economic fundamentals such as dividends, earnings, interest rates and risk variables. In a top-down approach, economy's outlook, future sales and earnings of the industry are taken into account to estimate firm-specific return on stocks. Expectation of enrichment of economic fundamentals of a firm is reflected through higher price of stock.

The relationship between *inflation* and stock price is not direct and straightforward. Empirical evidence is also inconclusive. Inflation may affect other economic input variables in varying degrees. Following the dividend discount model, it may have both negative and positive effects on stock prices. If firms, in an inflationary environment, are able to increase prices in line with increased cost and the negative effect of an increase in the required rate of return is offset by the increase in the growth rate of earnings and dividends, stock price may be stable or positive. However, if firms are unable to raise prices in line with higher costs, stock prices are expected to fall. Chami, Cosimano and Fullerkamp (1999) attempted to establish how inflation, monetary policy and stock price are interlinked. They argued that inflation, due to expansionary monetary policy, decreases the real value of firm's asset and causes a decrease in real stock returns.

3. Existing Empirical Literature

Sprinkel (1971), Keran (1971), Homa and Jaffee (1971) found a *significant* relationship between money supply changes and stock prices. Subsequent studies conducted by Cooper (1974) and Rozeff (1974) found a similar relationship between these two variables, though the timing of the relationship differed from the earlier findings. They found that stock prices responded to changes in the growth rate of money supply with one to three months' lag. Hafer (1985) studied the above relationship in a slightly different way. They examined how stock returns changes due to changes in anticipated and unanticipated money supply growth. They found that money supply and stock prices are positively associated. They also found that stock prices quickly eliminate any unexpected change in money supply growth.

Jensen et. al. (1996, 1997, 1998, and 2000) conducted a number of significant studies on this issue. They found that stock returns can be significantly influenced by the prevailing monetary environment. They showed that the business conditions proxies (i.e. the term spread, dividend

yield, and default spread) suggested by Fama and French (1989) have different effects on stock returns depending on the prevailing monetary policy, where monetary policy is indicated by discount rate changes. Their studies also show that the relationship between stock price returns and both size and the price-to-book value ratio only holds during periods of easy monetary policy. A subsequent study by Thorbecke (1997) indicates that expansionary monetary policy increases ex-post stock returns which are consistent with theoretical arguments. Following lower interest rate, economic activity of a firm increases leading to larger cash flows and subsequently higher returns. Patelis (1977) examined whether shifts in monetary policy affect the predictability of excess stock returns and found that monetary policy variables were significant in predicting future stock returns, although they were not the only relevant factors (i.e., dividend yield was also relevant).

Lastrapes (1998) analyzed the response of asset prices to monetary policy shocks in eight industrialized countries. The identification of monetary policy shocks is achieved by means of long-run restrictions under the assumption that money supply shocks do not permanently affect interest rates, real output, real stock prices and real money. The author found that real stock prices responded positively and significantly to unexpected changes in nominal money supply shock for most of the countries. However, there was a wide variation in the magnitude of effects across different countries.

Since firms' sizes, in terms of equity capital, differ, Cooley and Quadrini (1999) developed a value-weighted index and employed a general equilibrium model to examine the response of stock market index to monetary policy shocks. Their study shows that one per cent monetary shock is accompanied by about 0.2 percent decline in stock market index. Rapach (2001) examined the effects of money supply shock including a set of other macro shocks on real stock prices using US data. The author identified these shocks by providing a long-run restriction and found that expansionary monetary policy shocks had a positive effect on real stock prices which could be explained by the standard dividend discount model. Detken and Smets's (2003) study on a large sample of industrial countries (38 boom periods since the 1970s for 18 OECD countries) indicated that the boom phase typically featured rising money, output and credit gaps, and low interest rates relative to a Taylor rule types benchmark.

Empirical studies conducted by Rigobon and Sack (2003 and 2004) show that monetary policy affects equity markets in a strongly asymmetric fashion. The effect of monetary policy on equity markets was stronger when changes in the Federal Reserve's fund target rate occurred and came as a surprise to market participants. Bernanke and Kuttner (2005) also found similar results. They found that an unexpected change in US monetary policy was negatively associated with US stock returns. Neri (2004) evaluated the effects of monetary policy shocks on stock market indices in the G-7 countries and Spain using the methodology of structural VARs. The author found that contractionary shock negatively affect stock market index. However, this effect was small and transitory and varied across countries in terms of persistence, magnitudes and timing of these effects. Ehrmann and Fratzscher (2004) examine the reaction of equity markets to US monetary policy in the period 1994 to till 2003. Three factors such as high degree of market volatility, changes in direction of monetary policy, and unanticipated changes in fed fund rate cause stronger effect on stock price. The effect was stronger in industries that were cyclical and capital-intensive than non-cyclical industries.

Bjørnland (2005), using structural VAR, examined whether monetary policy and stock market affected each other. The author found that a shock on either sector had significant and direct impact on the other sectors. For example, a monetary policy shock that increased fed fund rate by ten basis points caused stock prices to decline by one-and-a-half percent. On the other hand, a stock price shock that increased stock prices by one percent caused interest rate to rise by five basis points. Bredin and Hyde (2005), in an event study, examined the impact of (un)expected changes in UK and German/euro area policy rates on UK and German aggregate and sectoral stock returns.Their result showed that UK monetary policy surprises had a significant negative influence on both aggregate and industry level stock returns in both the UK and Germany but the influence of German/Euro area monetary policy shocks appeared insignificant for both countries.

4. Model Specification

Identification of an appropriate monetary policy indicator for stock market reaction function is indeed a challenging task. It may be noted that with the initiation of the Financial Sector Reform Program (FSRP) in 1990, BB has operationalised monetary management through indirect manipulation of Reserve Money (RM) as an operating target to modulate liquidity consistent with overall monetary projection. The monetary policy instruments that are used in this case are *T-bill, Repo, Reverse Repo, CRR, SLR and Bank Rate*[2]. However, all of them may not be equally good as a monetary policy indicator, particularly to signal the financial market about BB's policy stance. BB mainly injects or withdraws reserves from the banking system through open market operations (OMO). This is pursued in two ways. The first type is the outright purchase or sale of approved securities[3] through weekly auctions in volumes consistent with the growth paths for RM and M2 targeted in the annual monetary program. BB injects reserves into the banking system by purchasing approved securities and withdraws reserves from the banking system by selling them. By adjusting the amount and the officially acceptable interest rate at auctions, BB influences the successful bidding rate, and the subsequent public announcement of this rate can convey its intention regarding short-term interest rates. For instance, if BB intends to raise short-term interest rates, it increases the scale of its auction in absorbing operations and raises its internally acceptable bidding rate so as to push up the successful bidding rate of the auction and thus mop up excess liquidity from the banking system, which influences short-term interest rates. Any significant changes in the interest rate may persuade the stockholders to recalculate their return through dividend discount window and may react accordingly.

The second type of OMO is repo (repurchase agreement) and reverse repo auctions. In order to facilitate liquidity management on a day-to-day basis, BB goes for second type of open market operation, either through repurchase agreement (repo) to temporarily add reserves or through reverse repurchase agreements (reverse repo) to temporarily withdraw reserves. Repurchase agreements are essentially short-term loans collateralized by underlying approved securities. BB

[2] Islamic banks in Bangladesh do not participate in inter-bank money market and in the repo, reverse repo arrangement and/or weekly auction procedures of BB given their non-interest bearing viewpoints. This makes the use of indirect monetary instruments of BB somewhat limited in influencing their excess liquidity position.

[3] These are either government securities or the securities that are guaranteed by government.

accepts the bids to the extent needed to maintain the intended level of market liquidity, in descending order of interest rates quoted for the repo operations. BB buys the underlying assets for a given price with an agreement by the selling institution to buy it back at a specified date and price. As the counterpart of repo auctions, BB accepts excess funds from the banks in ascending order of interest rates to the extent needed to maintain the intended level of liquidity. It can be mentioned that BB has introduced repo and reverse repo operations from July 2002 and April 2003 respectively. These variables have limited observations as per requirement of a good time series data. Besides, they work as fine tuning to supplement the weekly T-bills auctions. Furthermore they may not signal the market on any significant policy changes. Among the open market instruments, yield rate on T-bill auctions can be a better proxy for monetary policy stance. Since Bangladesh Bank has introduced T-bills of different maturities, it can be questioned which T-bill rate is an appropriate proxy for a good measure of monetary policy stance. Looking into the volume of transactions of BB's auction, it is found that 28-day treasury bills are heavily transacted compared to other T-bills. *Interest rate, i.e., yield rate on 28-day treasury bill can be a better representation of BB's monetary policy stance*.

Before 1990, banking sector of Bangladesh was characterized by administered credit control regime. Removal of absolute credit ceilings and selective credit controls allowed monetary instruments, particularly bank rate, CRR and SLR to occupy greater importance in monetary control. BB revises reserve requirement ratio (SLR and CRR), taking into account the immediate objectives of monetary policy, in order to regulate the liquidity of the banking system and keep the money supply within preset parameters. Reserve requirement changes are seen as a sign that monetary policy has swung strongly in a new direction. The cash reserve requirement ratio (CRR) and the statutory liquidity ratio (SLR) are effective means of announcing the monetary policy stance (MPR, 2005). When these ratios are raised, it signals to the market that Bangladesh Bank has initiated a tight monetary policy stance. Raising SLR reduces loanable and investable fund in the scheduled banks which ultimately slowdown their lending activities and put pressure on their profitability. In order to maintain credit facilities to existing customers, banks are required to increase deposit rate to mobilize more savings. Changes in either CRR or SLR do not influence reserve money in the economy but changes in SLR influence money supply through the money multiplier. Since changes in CRR causes rearrangement of liquidity portfolio within the domain of

SLR and does not directly influence the credit multiplier, it can be argued that SLR is more instrumental in monetary management than CRR and it can be used as a proxy to understand the inverse causal relationship between monetary policy and stock prices. However, they are changed rather infrequently and have limitation for empirical study through time series analysis.

Bank Rate is the discount rate that BB charges financial institutions for short-term loans of reserves. A change in the discount rate can inhibit or encourage financial institutions' lending and investment activities by sending a signal about the BB's goals and by indirectly influencing the interest rates. The discount rate is changed infrequently. Preferential Credit Programs and associated refinance facilities for priority sectors were replaced by BB's general rediscounting facility at Bank Rate. Such facility is meant to assist the borrowing bank in maintaining an adequate short term liquidity position and not to provide a permanent source of fund. Access to discount window is not a matter of right but is discretionary on the part of the Bangladesh Bank. The underlying objective is that banks should rely on their own fund for lending programs. Since BB has practically abandoned discount facility to the scheduled banks, it is argued that traditional Bank Rate has not been effective in signaling monetary policy stance. The bank rate applies to the relatively modest amounts of refinancing/rediscounting that a few banks avail from the BB and has little general bearing on the market interest rates (BB Annual Report, 2002-03). In order to increase lending for productive activities through reduction of interest rate structure, BB reduced Bank Rate from earlier 6.50 percent to 6.00 percent in FY 2003-04 (BB Annual Report, FY04). Comparing all the alternatives, we use *yield rate on 28-day treasury bill as the monetary policy variable*.

As argued earlier that asset prices are driven by expectation of future economic fundamentals of a firm such as productivity and relative prices of input factors. Macroeconomic factor such as tax policy may also contribute to improving net present value of a firm through higher future return. These factors indeed provide incentives to the firm for higher production. Therefore, Industrial Production Index (IPI) can be argued as a reflection of economic fundamentals of firms and is used as a proxy for stock price movement due to rational exuberance.

Inflation may be measured by different indices such as Cost of Living Index (CLI), Consumer Price Index (CPI) and Wholesale Price Index (WPI). Since investment in stocks is considered as

speculative demand for money, either CLI or CPI may be a better representation to find link between inflation and stock price. Considering data availability, and given its wide use by other researchers, CPI is taken into consideration for inflation measurement. Stock index can be used as a proxy for stock price. But the methodology and base year for calculating stock index has been changed several times in the past. As an alternative to stock index, market capitalization may be employed as a representative variable. This variable is also influenced by injection of new shares through IPOs, right shares and bonus shares. In order to avoid such influences over the price, monthly average stock price has been used as a proxy variable for stock price movement.

Though many academics and professionals hypothesize that there is a close association between stock prices and monetary aggregates such as narrow money (M1) and broad money (M2), they could not reach consensus over which one should be a good measure. When central bank influences interest rate to fall by injecting reserves into the banking system, new investors (depositors) have two choices: either buy term deposit receipts or buy stocks. If relative benefit in buying shares is high, new depositors (investors), except risk averse depositors (investors), may not get incentive to invest money in term deposit. They would rather buy stocks. Existing depositors would wait till maturity of term deposits. After that they may not be encouraged to hold money again in fixed deposits due to high opportunity cost. If opportunity cost for holding term deposit is very high, some of the existing depositors may convert their long-term saving deposits to demand deposits for subsequent investment into stocks. Conversely, when central bank reduces liquidity by withdrawing reserves from the system and thereby influences nominal interest rate to rise, stockholders would like liquidate some of their stocks in order to buy fixed deposits. In both processes, the immediate effect of monetary policy is reflected in M1. We therefore argue that M1 may be a better representation of money supply to find its relation with stock price variable.

4.1 A Structural VAR Model

Several studies such as Cook and Hahn (1989), Jensen and Johnson (1995), Thorbecke (1997), Lobo (2000), Bomfim (2001), Durham (2002), Ehrmann and Fratzscher (2004) have conducted *event studies* using daily data to observe how equity prices change in response to changes in monetary policy. This methodology has been adopted under the assumption of Efficient Market

Hypothesis, i.e., asset price should reflect all information available at any point in time. In the context of developing countries, where markets are considered either inefficient or semi-efficient, this assumption does not seem plausible.

A good number of papers have used structural VAR to get the effects of monetary policy on stock prices. The advantage of this method is that it allows one to simulate the dynamic effects of response variables to policy shocks. In this study the structural formulation for the VAR model is developed considering the sluggish adjustment procedure in a developing country context as well as plausible underlying relationships between policy and non-policy variables. For instance, in a developing country context we assume that price level responds to a particular monetary policy shock with some lag, i.e., price is not contemporaneously affected by the shocks in the monetary variables. However, we allow for contemporaneous effect from the monetary aggregate to industrial production. On the other hand, the central bank does not respond contemporaneously to changes in the output and price level. It sets the interest rate after observing the money stock. This is a reasonable assumption in this framework as information on real sectors variables is only available to the policy makers with lags. Besides the asset price variable, the stock market index of DSE is allowed to respond contemporaneously to all other shocks. We do not allow for contemporaneous effect from asset prices to monetary policy in line with Neri (2004), but in contrast to Bjørnland (2004) as our primary interest is to evaluate the effect of monetary policy on the stock market. As the role of stock market in the financial sector of the country is minimal in comparison to other developing countries, the monetary authority of Bangladesh may not react immediately to the changes in stock prices.

The primary effect of a contractionary monetary policy shock is expected to raise the short term interest rate and to reduce monetary aggregates. In the second round, the effect on price level would be negative and the effect on output is not certain. However, the effect on stock prices should be negative. Impulse response generated from the identified structural VAR model should reflect the above behavior of policy and non-policy variables to validate our proposed identification scheme. Following these arguments we impose restrictions for the specification of contemporaneous relationships among the variables in the SVAR. We imposed zero (exclusion)

restriction to recover the parameters of the structural form equations from the estimated parameters of reduced form equation as below:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & \beta_{24} & 0 \\ 0 & 0 & 1 & \beta_{34} & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & 1 & 0 \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_P \\ \varepsilon_Y \\ \varepsilon_R \\ \varepsilon_M \\ \varepsilon_{SP} \end{bmatrix} = \begin{bmatrix} \xi_P \\ \xi_Y \\ \xi_{MS} \\ \xi_{MD} \\ \xi_{SP} \end{bmatrix} \qquad (1)$$

Where, the vector on the left hand side includes the reduced form innovations, $\varepsilon_{P,}$ $\varepsilon_{Y,}$ $\varepsilon_{R,}$ $\varepsilon_{M,}$ and ε_{SP} and the vector on the right hand side comprises of five structural shocks, $\xi_{P,}$ $\xi_{Y,}$ $\xi_{MD,}$ $\xi_{MS,}$ and ξ_{SP}, namely adverse supply shock, industrial output shock, money supply shock, money demand shock and portfolio or stock price shock. Our identification scheme allows us to separate money demand shocks from the money supply shocks and we are able to estimate the following money supply and money demand equations from the structural model. However, the money demand shock is loosely identified.

Price Equation $\varepsilon_{\mathrm{p}} = \xi_{\mathrm{p}}$ (2)

Money Supply Equation $\varepsilon_{\mathrm{R}} = \beta_{31}\varepsilon_{\mathrm{M}} + \xi_{\mathrm{R}}$ (3)

Money Demand Equation $\varepsilon_{\mathrm{M}} = \beta_{41}\varepsilon_{\mathrm{P}} + \beta_{42}\varepsilon_{\mathrm{Y}} + \beta_{42}\varepsilon_{\mathrm{R}} + \xi_{\mathrm{M}}$ (4)

Stock Price Equation $\varepsilon_{\mathrm{SP}} = \beta_{51}\varepsilon_{\mathrm{P}} + \beta_{52}\varepsilon_{\mathrm{Y}} + \beta_{53}\varepsilon_{\mathrm{R}} + \beta_{53}\varepsilon_{\mathrm{M}} + \xi_{\mathrm{SP}}$ (5)

Equation (3) is the policy reaction function of the central bank, which sets the short term interest rate after observing the money stock. The relationship between monetary aggregate and interest rate is expected to be positive, monetary authority raises the short term interest rate to restrain inflationary pressure which may result from exogenous increase in monetary aggregate.

On the other hand, the money demand function in equation (4) represents demand for real money balances as a function of a scale variable (industrial production index) and the opportunity cost of holding cash money and CPI. The scale variable Y (industrial production index) is expected to explain money demand for transaction purposes, which is expected to be positive. Rise in income

leads to increased demand for goods and services thereby increasing the demand for money. Where, negative relationship is expected between opportunity cost money (short term interest rate) and money demand. Here price equation is loosely identified as explained before. The equation simply says that reduced form error term in price equation is directly determined by structural price shocks of the identified SVAR. The stock price equation (5) is defined as a function of a scale variable (industrial production index), real interest rate, price level and the money supply. The scale variable Y (industrial production index) is expected to reflect economic fundamentals of listed companies, which in turn influences movement in the stock prices.

4.2 Data

The variables included in the econometric model are log of Consumer Price Index (LCPI), log of 12 months average industrial production index (LIP), policy rate (28-day treasury bill rate which is a proxy for monetary policy stance), log of real money supply seasonally adjusted by using moving average method (LM1), log of real all share price index, monthly average (LSP). We used monthly data from April 1997 to March 2006 for the five variable structural VAR model. Industrial Production Index (2000=100) and Consumer Price Index (2000=100) data are collected from *International Financial Statistics (IFS),* IMF online databases. Monthly weighted average of 28-Day Treasury bill rate is collected from the Monetary Policy Department (MPD), Bangladesh Bank. Money Supply (measured by M1) data are collected from the various issues of Economic Trend, Bangladesh Bank. Month ended All Share Price Index (ASPI) of Dhaka Stock Exchange (DSE) data are collected from the DSE Library.[4] The money supply (M1) and the stock index are converted to their real value by deflating with the monthly CPI (2000=100) index of IFS.

5. Empirical Results

5.1 Estimated Structural Shock Coefficients from the SVAR

Table 2 reports the estimated policy reaction function and money demand equation from identified structural VAR model, where p-values of the contemporaneous coefficients are reported below parenthesis of each equation. The estimated coefficient of the monetary aggregate in the policy reaction function is positive, which implies that monetary authority raises the interest rate in response to an unexpected increase in the monetary aggregate if the authority believes that such an

[4] DSE All Share Price Index Calculation Started on the basis of IFC designed formula in November 1, 1993.

increase may generate inflationary pressure in the economy. However, the coefficient is insignificant. All the coefficients of estimated money demand equation contain expected sign and are highly significant statistically. In conformity with standard theory of money demand, the estimated coefficient of the scale variable in the demand for money equation is positive and that of interest rate is negative. Income elasticity of demand for money is 1.87 (see Table 1 & 2), which is usual from a developing country perspective.

Table 1: Estimated Contemporaneous Coefficients of the Structural Model

	Coefficient	Std. Error	z-Statistic	Prob.
β_{41}	-1.85	0.45	4.13	0.00
β_{51}	-2.10	1.13	1.86	0.06
β_{42}	1.87	0.90	-2.09	0.04
β_{52}	-2.29	1.32	1.74	0.08
β_{43}	-0.04	0.02	2.61	0.01
β_{53}	-0.03	0.02	1.89	0.06
β_{24}	-0.04	0.03	1.05	0.29
β_{31}	5.89	4.88	-1.21	0.23
β_{54}	0.23	0.25	-0.92	0.36

Estimation Results: Model Validation Parameter

Over-identifying restriction test Likelihood Ratio (LR) test for over-identification:
Chi-square (1) - 0.22 P-value - 0.64

Table-2: Money Supply and Money Demand Equation

Money Supply Equation $\varepsilon_R = 5.89\ \varepsilon_M + \xi_R$
(0.23)

Money Demand Equation $\varepsilon_M = -1.85\ \varepsilon_P + 1.87\ \varepsilon_Y + -0.04\ \varepsilon_R + \xi_M$
(0.00) (0.04) (0.01)

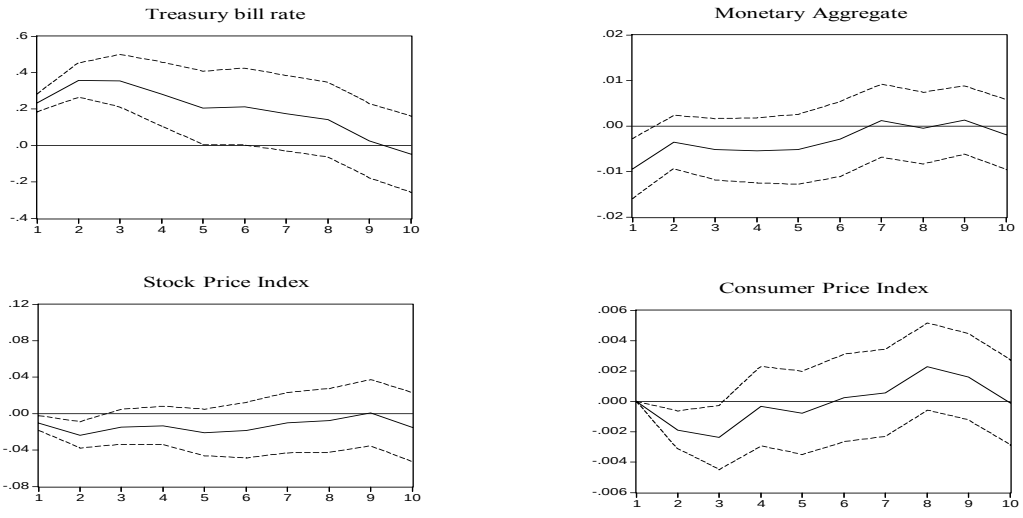
Note: p-values are reported in parenthesis.

5.2 Estimated Impulse Responses to Different Structural Shocks

Empirically, we have evaluated the effects of monetary policy shocks by means of impulse response. Impulse responses of different variables of interest to contractionary monetary policy shocks, measured by exogenous increases in the short-run policy interest rates, as shown in Figure 1 establish the theoretical underpinnings of asset price channel to monetary policy shocks. We find that contractionary monetary policy shocks have, on average, small and negative transitory effects on stock market indices. The impulse response of monetary aggregate in response to contractionary monetary policy shock is negative in the first two forecast horizons, i.e., there is a monetary contraction in response to rise in short-term interest rate. This finding confirms evidence of liquidity effect in the short run. Thus our estimated impulse response to contractionary money supply shock shows no evidence of so called "liquidity puzzle".

Contractionary monetary policy shock causes prices to decline, after the first forecast horizon CPI started falling, and remains significant up to three months. In other words, contractionary monetary policy reduces inflation in the economy for a short horizon, however, the effect become insignificant in the higher forecast horizons. Therefore, there is no evidence of "price puzzle".

Figure-1: Impulse Response for Contractionary Monetary Policy Shock



Contractionary monetary policy shock which raises the short run policy rate causes a fall in stock prices in the short run -impulse response of stock price is negative and statistically significant in the first two forecast horizons and the effect becomes become insignificant after three months. Results show that when policy rate increases, supply of narrow money in the economy declines which is consistent with monetary policy objective. In response to contractionary monetary policy shock, stock index falls after one month and continues for about 6 months, though the effect varies in subsequent months. The effect is prominent between first and second months; remains steady in the third month and then became insignificant. In terms of magnitude, the effect is not large, i.e., above 0.02 percent. This finding is consistent with the standard argument of asset price valuation model.

Our impulse responses of different variables of interest as captured by the given model to one standard deviation structural shock of adverse supply are found in the first column of figure-2 (see Appendix). First, due to structural adverse supply shock the response of price is positive and it remains effective up to 5 forecast horizon. The initial response of policy interest rate (T-bill) is negative, however, it start rising after three months. Though, this effect is insignificant in all the forecast horizons. In an inflationary environment, demand for money exceeds the level of money stock. Consequently, contractionary monetary policy would be the normal stance to be adopted which is reflected by higher policy rates. The response of money stock to adverse supply shock is negative for the first three forecast horizons, and then it became insignificant. Estimated impulse response of money stock seems compatible with the argument that central bank accommodates the current year's price level while shaping and initiating monetary policy. However, once the monetary policy initiated any change of price level due to adverse supply shock may not be accommodated in the policy matrix during the program period because contemporaneous information on price variable may not be available to policy makers while moderating monetary policy stance. The response of stock price to adverse supply shock is negative and remains significant up to 8 forecast horizons. The standard asset price valuation theory supports negative impact on asset price of rising price level due to adverse supply shock.

We have chosen to leave the stock price equation completely unrestricted by assuming that all variables in the structural VAR model can have a contemporaneous impact on this variable. In

other words, all structural shocks in the model have a contemporaneous effect on stock prices. The responses of different variables of the model to real stock price shock were presented in column-3. Stock price shock has no significant effect on prices, policy interest rate and money supply. However, stock price index initially rises in response to stock price shock.

5.3 Estimated Results of Variance Decomposition

In variance decomposition technique we estimate Forecast Error Variances (FEVs) which convey essentially the same information as the real stock price impulse responses but in a different form in the sense that in the latter the FEVs are numerical value of the proportion of variation of stock price explained or contributed by a certain variable. The FEVs are presented in Table 3 for a forecast horizon of maximum 15 months based on one unit shock (one standard deviation, sd) to the system. The FEVs of stock index explained by contractionary monetary policy shock are reported in column 5. Contractionary monetary policy shock explains just around 5.7 percent FEVs of stock price in the first month, which increases to 18.4 percent in the second month. This varies within the range of 18.0 to 11.1 percent up to 8 months. On the other hand, about 14.6 percent of FEVs of consumer prices is explained by contractionary monetary policy shock in the second month, which increases to 15.9 percent in the 15th forecast horizon. Forecast error variance of money supply is also significantly explained by the contractionary monetary policy shock, which account for 29.7 percent variation in money supply in the first month and reduced to around 18 percent in the 15th forecast horizons.

Table-3: Variance Decomposition of Variables: Contractionary monetary policy shock

Horizon	LCPI	LIP	TR28	LM1	LSP
1	0.0	1.2	88.4	29.7	5.7
2	9.7	0.5	90.2	25.8	18.4
3	14.6	0.3	90.5	24.7	18.0
4	11.7	0.6	87.1	25.5	17.3
5	10.6	0.5	82.4	25.3	17.4
6	9.5	0.4	79.2	23.1	16.3
7	9.0	0.3	78.1	20.4	13.4
8	12.3	0.4	76.3	19.6	11.1
9	13.0	0.3	71.8	18.8	9.6
10	11.8	0.5	65.9	18.3	9.7
11	12.5	0.9	60.8	17.9	9.3
12	14.8	1.5	56.4	17.2	8.6
13	15.8	1.7	53.2	16.4	8.1
14	15.8	1.7	50.8	17.3	7.8
15	15.9	1.7	49.2	17.9	7.5

6. Conclusion

In this paper we have studied the effects of contractionary monetary policy shock on asset prices, particularly on stock prices using structural VARs. We have identified the effects of a set of important policy shocks including some related macro shocks endogenous to the structural system relying on short run restrictions. The estimated coefficients of money supply and money demand equations from the structural VAR model are theoretically consistent, suggesting that the short run identification restrictions are valid. The estimate confirms that a contractionary monetary policy shock, measured by increase in the short-term policy interest rate has small negative effect on the stock price index and the effect do not persist for long. After a few forecast horizons the effect becomes insignificant which indicate that decline in stock prices in response to rise in short term interest rate is short lived. These results are roughly in line with some previous works that have used the same empirical methodology for different countries and sample periods.

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Appendix

Figure-2: Impulse Responses of Model Variables to Various Shocks