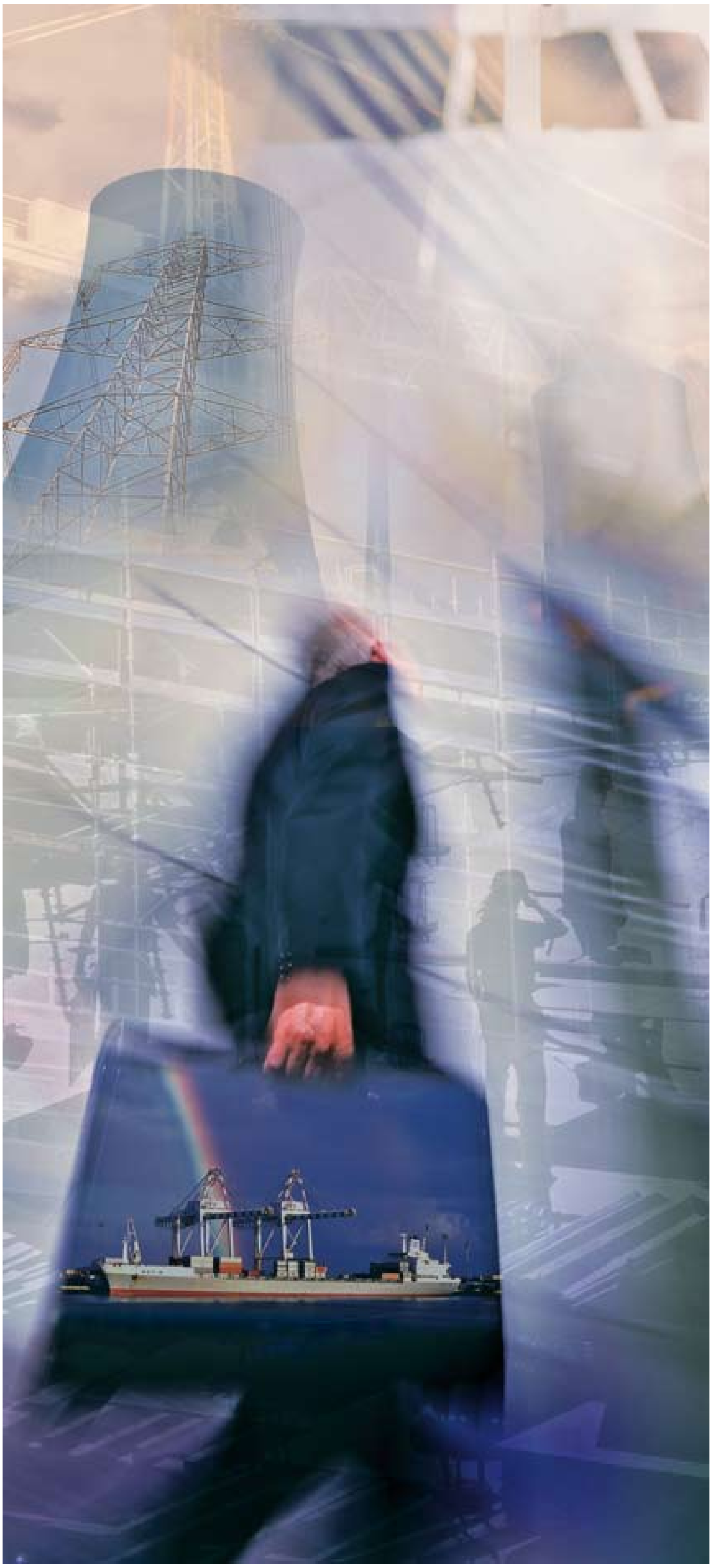

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Does Monetary Policy Matter in a Less Developed Economy? Evidence from Bangladesh

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Abstract:

This paper explores the role of monetary policy in the context of a less developed economy. Monetary transmission mechanisms in less developed economies can be quite different from an industrialized economy, as unlike industrialized countries, these economies are characterized by the small size of organized financial markets, limited substitutability between money and other assets and weak fiscal and monetary institutions. We utilize the Structural VAR approach to analyze the monetary transmission process and impacts of monetary policy on different macro variables in Bangladesh. Monetary policy shocks are identified using non-recursive contemporaneous restrictions, which are based on the Central Bank's reaction function and the structure of the economy. We found strong evidence for the interest rate channel of monetary policy in Bangladesh. Our findings indicate that monetary policy shocks are important sources of fluctuations in the rate of interest, output and prices. Expansionary monetary policies are found to be harmful for achieving price stability in Bangladesh, as they not only increase the prices permanently, but also make the price level more volatile. We also found the evidence of a long lasting effect of monetary policy on output, which suggests that contractionary policy measures may create sustained recession in Bangladesh.

JEL Classification: E52; C32; O23.
Keywords: Monetary Policy; Identification; Structural VAR.

1. Introduction

Measuring the effects of monetary policy is an important issue in empirical monetary economics. Considerable efforts have been made in examining the identification and macroeconomic impacts of monetary policy during past decades. Most of these studies are mainly based on industrialized economy[1] and only a few have focused on the monetary policy issues in the context of a less developed economy. Less developed countries are mostly characterized by the small size of organized financial markets and limited substitutability between money and other assets. These countries, on the one hand, are experiencing widespread poverty and low standard of living; and on the other hand, weak fiscal and monetary institutions and underdeveloped financial sectors make these economies relatively fragile. As a result, identifying monetary policy shocks and analyzing relevant transmission mechanisms for these economies can be quite different from a developed economy.

Bangladesh is among the less developed countries of the world. Its per capita income in 2005 was only US$ 470 (ADB, Key Indicators 2007) and social indicators reveal a situation of abject poverty for a large proportion of the population[2]. It is to be hoped that rapid and sustained economic growth can help Bangladesh become a Middle Income Country and break the vicious cycle of poverty[3]. The problem of inflation in Bangladesh cannot be overlooked either as there is a consensus that inflation hurts the poor more than the rich. Clearly monetary policies directed towards achieving a sound macroeconomic environment can play an important role in Bangladesh's transition to a Middle Income Country.

[1] These studies include among others Sims (1992), Bernanke and Blinder (1992), Gordon and Leeper (1994), Christiano et al (1996), Leeper, Sims and Zha (1997), and Bernanke and Mihov (1998) for the US monetary policy; Cushman and Zha (1997) for Canadian case; Brischetto and Voss (2000) for Australian monetary policy; Shioji (2000) and Ken Kasa and Popper (1997) for Japanese monetary policy and Kim and Roubini (2000) for monetary policies in the non-US G7 countries.

[2] ADB (2007) reports that about 40 percent of the population in Bangladesh remains below the officially defined poverty line.

[3] According to the World Bank's Classification, to become a Middle Income Country, a country needs to have a per capita income of at least US$ 875. World Bank (2007) observes that Bangladesh can be a Middle Income Country within a decade (by 2016) if it raises its per capita income growth to 6 percent, implying GDP growth at a challenging but not impossible rate of 7.5 percent.

In recent years, monetary policy has been one of the much discussed topics among the economists in Bangladesh. In particular, in the wake of recent price hikes in Bangladesh, there has been a renewed debate about the role of monetary policy in managing inflation. One view, in line with the outlooks of the IMF, the World Bank and the ADB, asserts that the Central Bank should employ a contractionary policy to hold back the demand-driven inflation. According to this view, the inflation rate should be the prime target of monetary policy and a contractionary monetary policy can help reduce inflation permanently. On the other hand, the alternative view of monetary policy emphasizes that inflation in Bangladesh is mainly caused by adverse supply shocks and a contractionary policy is of very little use in curbing inflation. This view advocates an expansionary monetary policy, which is expected to help achieve rapid output growth through stimulating the private investment.

There is widespread agreement that a monetary shock affects the real economy, at least in the short-run. However, there is far less agreement on the issue of the identification of monetary policy shocks and the channels through which monetary policy shocks are transmitted to the real activities. The most widely held view of monetary transmission channels is the interest rate channel[4], which states that an excess supply of money brings the real interest rate down, which in turn lowers the cost of capital, causing an increase in investment spending, and thereby a rise in aggregate demand and output. Since the beginning of the financial sector reform program in 1989-90, interest rates have been deregulated and open market operations have become an important monetary policy instrument in Bangladesh. As a result of the reforms, financial markets should now be able to transmit the money supply shock to interest rates and thereby affect other macroeconomic variables more effectively than in the past. In this paper we examine, among others, the dynamic response of the interest rate to the identified monetary policy shocks in an attempt to explore the feasibility of an interest rate channel.

As Bangladesh is a small open economy, the exchange rate channel may also be relevant for monetary policy in Bangladesh. The higher domestic price level stemming from an expansionary policy may increase the demand for foreign goods, which in turn puts

[4] For an overview of different monetary policy channels see Mishkin (1996).

pressure on the nominal exchange rate. This channel may also involve interest rate effects because when domestic real interest rates fall, domestic currency deposits become less attractive relative to deposits denominated in foreign currencies, leading to the depreciation of the domestic currency. The depreciation of the currency causes a rise in net exports, and thereby, leads to an increase in aggregate demand and output.

We use an open economy version of the Structural VAR model, within which the exchange rate channel of monetary policy can also be examined. The main technique is to estimate a Structural VAR model consistent with a monetary policy channel, and identify the monetary policy shock and examine its effects from relevant impulse response functions and variance decompositions. For example, for the interest rate channel, one would be interested in finding a significant negative effect of a positive monetary policy shock on the interest rate. The shock is also expected to raise the output level and with some delay, the price level. On the other hand, if the monetary policy is transmitted through the exchange rate channel, then we would expect the exchange rate to depreciate following an expansionary monetary policy.

Since the beginning of the financial sector reform programs in 1990, interest rates were deregulated and open market operations have become an important monetary policy instrument in Bangladesh. In recent years, the fiscal authorities have been successful in avoiding excessive budget deficits. Consequently, the government has had less need to borrow from the banking system, leaving more room for an independent monetary policy. In particular, the use of commercial banking has become widespread since the early 1990's. There is an indication of financial deepening with the M2-GDP ratio increasing from 22.2 percent in 1990 to 43.5 percent in 2006 (ADB (2007)). The monitoring and supervisory system of the Central Bank has also been strengthened in recent years.

In this paper we explore the identification of a monetary policy shock and its impacts on the economy in the context of a less developed country with a more decentralized and broadening financial environment. Although the size of the organized financial markets in Bangladesh is still quite small relative to the industrial countries, it is evident that there were significant developments in the financial sector in the last two decades; and all these developments have made monetary policy in Bangladesh an important area of study.

In this paper we proceed as follows:

Section 2 discusses basic concepts about the identification of monetary policy in a Structural VAR framework. Section 3 reviews critically relevant studies of monetary policy in Bangladesh. Section 4 presents a Structural VAR model of Bangladesh monetary policy. The identification of the monetary policy shock and dynamic responses of the price level, output level, interest rate and exchange rate to the monetary policy shock are examined in this section. In addition, this section also examines the implication of the identified monetary policy shock the variability in the price level. Section 5 concludes the paper.

2. Identification of Monetary Policy in the SVAR Framework

2.1 The SVAR Model: Basic Concept

To begin with, let us consider the following SVAR model:

$$\mathbf{A_0 X_t = A_1(L) X_t + B\varepsilon_t} \qquad [1]$$

where

$\mathbf{X_t}$ is an n-vector relevant variables; $\mathbf{A_0}$ and $\mathbf{B}$ are nxn matrix; and $\mathbf{A_1(L)} = \sum_{i=1}^{q} \mathbf{A_{1i} L^i}$ is a matrix polynomial in the lag operator. $\boldsymbol{\varepsilon_t}$ is an n-vector of serially uncorrelated, zero mean structural shocks with an identity contemporaneous covariance matrix, $\sum_{\boldsymbol{\varepsilon}} = E[\boldsymbol{\varepsilon_t \varepsilon_t'}] = \mathbf{I}$. One of these shocks represents an indicator of monetary policy.

Provided that $\mathbf{A_0}$ is nonsingular, solving for $\mathbf{X_t}$ yields the reduced form of VAR representation:

$$\mathbf{X_t} = \mathbf{A_0}^{-1}\mathbf{A_1(L)X_t} + \mathbf{A_0}^{-1}\mathbf{B\varepsilon_t}$$

or $$\mathbf{X_t} = \mathbf{C(L)X_t} + \mathbf{u_t} \qquad [2]$$

where $\mathbf{C(L)} = \mathbf{A_0^{-1}A_1(L)}$

and $$\mathbf{u_t} = \mathbf{A_0}^{-1}\mathbf{B\varepsilon_t} \text{ or } \mathbf{A_0u_t = B\varepsilon_t} \qquad [2A]$$

The residuals $\mathbf{u_t}$ in the reduced model are also presumed to be white noise, but they are correlated with each other due to the contemporaneous effect of the variables across equations.

We may also express equation [1] in moving average form as

$$\begin{aligned} &\mathbf{[A_0 - A_1(L)]X_t = B\varepsilon_t} \\ &\mathbf{X_t = [A_0 - A_1(L)]^{-1}B\varepsilon_t = D(L)\varepsilon_t} \end{aligned} \qquad [3]$$

where $\mathbf{D(L)} = \mathbf{[A_0 - A_1(L)]^{-1}B}$

Equation [1] is the structural model of the VAR. The reduced form represented in [2] is more familiar. The main technique here is to estimate equation [2] and recover the parameters and the structural shocks, $\boldsymbol{\varepsilon_t}$ in [1] from these estimates. Having identified the structural shocks, we can then find the impulse response of a variable to a one-time shock to any variable included in the model from equation [3].

The main problem with this kind of approach is that the number of parameters that need to be estimated in the structural model is larger than that of the estimated reduced form model (identification problem). In order to solve the identification problem, restrictions must be imposed on the elements of $\mathbf{A_0}$ and/or $\mathbf{B}$. To impose restrictions, many studies follow the Cholesky Decomposition, prescribed by Sims (1980 and 1986). According to this approach, the system is made recursive, where $\mathbf{A_0}$ should be made lower triangular with ones in its principal diagonal and $\mathbf{B}$ is assumed to be a diagonal matrix. These assumptions further require the accurate ordering of the variables in the model, which is popularly termed as Wold Causal ordering.

There are many empirical studies; mostly based on the post World War II US data, using the VAR approach to analyze the dynamic impacts of monetary policy. The main difference across these studies lies in different identification schemes used to specify the monetary policy shock[5]. Unfortunately, there is little agreement on which monetary stances most appropriately capture the conventional views of the impacts of monetary policy. VAR-based studies of monetary policy can be divided into two categories. The recursive assumption was popular in earlier studies of monetary policy [for example, Leeper and Gordon (1992), Bernanke and Blinder (1992), Sims (1992), Christiano, Eichenbaum and Evans (1996)]. In these studies, different researchers used different indicators of monetary policy. Bernanke and Blinder (1992) argued that the Federal funds rate should be the indicator of Fed's monetary policy stance. In a similar fashion, Sims (1992) used short-term interest rates as monetary policy indicators. Leeper and Gordon (1992) used growth of monetary aggregates as measures of monetary policy.

More recent studies, however, adopted the non-recursive structural system approach to identify the monetary policy shocks [For example, Gordon and Leeper (1994), Leeper, Sims and Zha (1996) and Bernanke and Mihov (1998), among others]. These studies take into account the endogeneity of monetary policy by proposing an explicit expression for 'monetary rule' and the monetary policy shock is identified by the deviations from the rule. Deviations from the rule can either be obtained by altering the parameters in $\mathbf{A_0}$ and $\mathbf{B}$ matrix or by concentrating on the exogenous shocks ($\boldsymbol{\varepsilon_t}$). The Structural VAR-based studies exclusively concentrate on modelling the exogenous shocks, leaving structural parameters unaltered (Favero (2001)).

The above examples of identification of monetary policy are essentially based on the developed economies. Although Bangladesh is a developing country, the financial sector is growing fast, and its current monetary policy is more independent and market oriented than it was previously. It is quite possible that, with some adaptation, we can apply the model of developed economies for Bangladesh.

[5] See Christiano, Eichenbaum and Evans (1999) for an excellent survey of VAR-based studies of monetary policy.

3 Reviews of Relevant Studies on Bangladesh

So far only a very small number of studies have focused on the issue of identifying monetary policy in Bangladesh. Most of these papers are either working papers or unpublished research work. Below we examine some of these VAR-based studies.

Chowdhury, Dao and Wahid (1995) is one of the earliest studies to use the VAR method to analyze the impacts of monetary policy in Bangladesh. This paper examined the relationship between money, prices, output and exchange rate in Bangladesh during the 1974-92 periods. Quarterly data were used to estimate two alternative 4-variable VAR models. To identify the money shock and derive the variance decompositions and impulse response functions, the study used the Cholesky ordering. The study found that inflation contributes to a significant proportion of the variation in money. The causality from output to money did not appear to be very strong, while a significant causal relationship existed from money to the output growth. Both the inflation rate and money stock were found to explain a significant portion of variations in the exchange rate. The impulse response functions in the estimated VAR models showed that a shock to money supply initially had a negative effect on inflation, which do not reflect the real world situations. This problem is often referred to as the ‘price puzzle’ in the VAR analysis of monetary policy. Responses of other variables to the shock in money supply were not reported in the paper.

Ahmed and Rao (2006) analyzed the macroeconomic impacts of money supply shocks in Bangladesh and two other South Asian countries. The money supply shock is identified utilizing a recursive approach in a 4-variable VAR model. For the analysis on Bangladesh, quarterly data covering the period 1974:Q2-2000:Q4 were used. The variance decomposition results showed that money innovation had low predictive power (compared to innovation in prices or output) in explaining the variation in output and prices in the long-run. The dynamic responses of the prices and output appear to be consistent with the conventional beliefs; however, the interest rate response showed the ‘liquidity puzzle’ as the interest rate increased (though insignificantly) when there was a positive shock to the money supply.

Younus (2003) used a measure of Indian money supply along with five other domestic macro variables in the VAR model *s*o as to see if domestic monetary policy in Bangladesh is independent of foreign monetary policy. Quarterly data were used covering the period 1975:1 to 2001:4. The study found that innovation to the foreign money supply explained a significant portion of the forecast error variance of domestic money supply, output, interest rates and the exchange rate. Foreign money, however, was not found to explain any significant portion of variations in the domestic price level. An innovation to the domestic money supply explained a significant portion of the forecast error variance in the price level and domestic money itself. However, domestic money did not seem to explain forecast error variances of the interest rate, exchange rate, and output level at any time horizon. The dynamic responses of the price level to a positive money supply shock were initially negative, indicating a 'price puzzle'. This study found that the negative response of the interest rate to the money supply shock became significant only after more than two years, which is also hard to rationalize.

Younus (2004) focused on the effects of monetary policy on banks' portfolios in Bangladesh. It particularly tried to figure out whether monetary policy transmits through credit channel or traditional money channel[6]. The Structural VAR modeling was introduced for this purpose. Quarterly data covering the period 1975:1 to 2000:4 were used to estimate a 6-variable VAR system. In order to estimate variance decompositions and impulse response functions, non-recursive restrictions were imposed on contemporaneous relations among the variables. From the variance decompositions derived from the structural VAR, it was observed that monetary policy did not explain a significant portion of the forecast error variances of deposits and credit. This was also the case for other macroeconomic variables. The impulse response functions of deposits and credits also failed to show any significant response to a shock in the identified monetary policy. There was no indication of a liquidity effect; the interest rate showed significant positive effects after 4 quarters of the shocks, which remained positive for 12 more quarters.. The price level went up at the fifth quarter and remained significant until 9th

[6] This study described the credit channel as one that works through the asset side of the banks' portfolio. The money channel, which is equivalent to the traditional interest rate channel, was assumed to function through banks' liabilities.

quarter after a shock occurred. The response of output to the monetary policy shock was negative, though insignificant.

Ahmed S. and Islam (2006) used two alternative VAR specifications to examine the transmission mechanism of monetary policy in Bangladesh. The two VAR models correspond to two different channels, namely the bank lending channel and the exchange rate channel. Each of these VAR models used quarterly data covering full-sample period of 1979:3 – 2005:2 and the sub-sample period of 1990:1 – 2005:2. To identify the monetary policy shock, this study applied the Choleski decomposition. The findings of this study are not promising, as responses of different variables to the monetary policy shocks were mostly insignificant. The variance decomposition results indicated that the monetary policy shock had very little explanatory power in predicting the movements of other variables.

Ahmed K., Akhtaruzzaman and Barua (2006) analyzed the effects of monetary policy on the stock price index in a SVAR framework. The main purpose of the study was to examine the existence of asset price channels in Bangladesh. The VAR model used monthly data covering the period 1997:04-2006:03. This study found that a contractionary monetary policy shock raised the interest rate significantly up to 5 months after a shock took place. It also led to a significant fall in monetary aggregates and stock prices although the effects were short-lived. Traditional theories of monetary economics postulate that a monetary policy shock increases the price level with some delay and the effect should persist for long period. Quite the opposite of this view, this study found that the effects on the price level were immediate and very short-lived. The variance decomposition results showed that the identified policy shock had very little contribution in forecasting the error variance of output.

The findings in most of the studies on Bangladesh are not consistent with the postulates of conventional monetary theories. Many of these studies suffer from either the price puzzle or the liquidity puzzle. These anomalies might have been due to the inappropriate specification of the VAR model and/or wrong identification of monetary policy shocks. For example, a few studies did not incorporate in their analysis major changes in the policy environment that took place in the early 1990's. The use of wrong money supply variable might have been the source of liquidity puzzle often observed in previous VAR-based studies of monetary policy in Bangladesh. Most of these studies used either M1 (narrow money) or M2 (broad money) as a measure of money supply. It is questionable whether monetary aggregates like M2 and M1 can be used as a measure of the monetary policy stance of the Central Bank. In the recent VAR studies (for example Bernanke and Mihov (1998)) it is often claimed that these monetary aggregates represent money demand behaviour, and the Central Bank has little control over M1 and M2. In fact, the Bangladesh Bank follows a monetary targeting policy where monetary base is the immediate target. It tries to influence the base money through the open market operations. Thus the monetary base (equivalently reserve money) could be a better choice to represent money supply than M1 or M2.

4. Monetary Policy Shocks: An Identification Scheme for Bangladesh

4.1 The Monetary Policy Framework in Bangladesh

Monetary policy in Bangladesh is formulated and implemented by the Bangladesh Bank. The broad objectives of the Bank are[7] :

a) To regulate the issue of the currency and the keeping of reserves;
b) To manage the monetary and credit system of Bangladesh with a view to stabilizing domestic monetary value;
c) To preserve the par value of the Bangladesh Taka;
d) To promote and maintain a high level of production, employment and real income in Bangladesh; and to foster growth and development of the country's productive resources for the national interest.

[7] These are taken from the official website of the Bangladesh Bank. For details of the monetary policy framework in Bangladesh, see Bangladesh Bank (2005).

In a recent publication regarding 'Monetary Policy Review', the Bangladesh Bank put emphasis on two major goals stating that "the appropriate monetary policy strategy in the Bangladesh context would be to achieve the goals of (a) price stability and (b) sustained and stable output growth"[8]. In accordance with the broader macro objectives and in the context of the Financial Sector Reform Program (FSRP) aimed at making the economy market oriented, current monetary policy in Bangladesh uses indirect monetary management methods where Reserve Money is the operating target. A target for broad monetary expansion is set taking the growth in real income, the general price level and movements in income velocity of money into consideration; and the required growth of Reserve Money is determined on the basis of this targeted expansion of broad money (Bangladesh Bank (2005)).

Weekly Treasury Bills auctions are used in regulating the Reserve Money level, along with a fine-tuning of the daily Repo (Repurchase Agreement) and Reverse Repo auctions. At present, 28-day, 91-day, 182-day, 364-day, 2-year and 5-year government Treasury Bills are auctioned every week. The Repurchase Operation (Repo and Reverse Repo) is used as an indirect monetary tool for day-to-day liquidity management, in response to temporary and unexpected disturbances in the supply of and demand for money[9]. The Bangladesh Bank occasionally changes the Statutory Liquidity Ratio (SLR) and the Cash Reserve Requirement (CRR) to change its policy stance. In its actual conduct of monetary policy, the Central Bank takes into account information about liquidity and credit situation, short-term interest rates, the inflation rate, foreign reserves, exchange rates and several other macro and financial variables.

Before 2003, the Bangladesh Bank followed a combination of fixed and flexible exchange rate policies. It used to announce a US Dollar per taka rate, but the actual foreign exchange rates were allowed to change within a pre-determined band. The official rate was adjusted from time to time with a view to keeping the real exchange rate stable. The Bangladesh Taka effectively became a floating currency from 31 May 2003; the exchange rate bands were abolished, and at present, transactions of foreign currencies

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[8] Bangladesh Bank (2005, p 14)
[9] Repo and Reverse repo have been introduced in May 2003.

take place without following any official rate or pre-determined band. However, even under the floating system the Bangladesh Bank indirectly influences the exchange rate through controlling the money supply in order to smooth short-run fluctuations in the exchange rate.

4.2 Model Specification

This section, within the framework of a Structural VAR modelling, proposes an identification scheme for the monetary policy in Bangladesh and analyzes the impacts of a monetary policy shock on different macro variables. The SVAR approach is now widely accepted as a standard econometric apparatus in the dynamic empirical analysis of monetary policy. Having specified the 'policy rule' by an explicit dynamic model, the SVAR approach concentrates on the deviation from the rule, which is indicated by the innovations (ε_t) in the SVAR system. As shown by the equation 2A in Section 2, deviation from the rule, that is, the policy shock can be identified from the residuals of the equation representing monetary policy stance of the Central Bank.

Our structural VAR modelling is largely motivated by the analysis of Kim and Roubini (2000). The main advantage of that paper is that it considered the case of an open economy by which the feasibility of an exchange rate channel of monetary policy can be analysed. We have, however, made one important modification over this study. Unlike Kim and Roubini (2000), which considered the interest rate as monetary policy indicator, we identify the monetary policy from the shock to the supply of reserve money. In terms of the actual conduct of monetary policy, the Bangladesh Bank pursues its monetary policy within a framework of monetary targeting with reserve money as the operating target (Bangladesh Bank (2005)). Thus it is more reasonable to use reserve money than an interest rate variable as the main policy indicator.

In the VAR system, we primarily include such variables that are important for the money market and the goods market. Money supply, interest rate, aggregate output level and the general price level are the obvious choice. In order to examine the exchange rate channel, we have also included the nominal exchange rate in our structural VAR model. Definitions of these variables are given below[10]:

M = Log of Reserve Money

r = Short-term (3 – 6 months) Deposit Rate

Y = Log of the Industrial Production Index

P = Log of the Consumer Price Index

Exc = Log of the Nominal Exchange Rate expressed as Taka per US dollar.

In analysing the case of non-US G-7 countries, Kim and Roubini (2000) considered some foreign variables like World Oil Price, the US Federal Fund Rate and the World Commodity Price Index on the ground that the Central Banks of these industrial countries react to the shocks in these external variables. But for Bangladesh it is unreasonable to assume that these variables influence the Bangladesh Bank's policy reaction function. The oil price is heavily subsidized by the Bangladesh government, and hence the World Oil Price may have direct implications for the fiscal authority but not for the monetary authority[11]. With restrictions on capital flow, the US interest rate is not an important variable for the Central Bank of Bangladesh[12].

Monthly data covering the period from 1993:07 to 2006:04 are employed for our analysis. All data are taken from the *International Financial Statistics* online database. The main reason why we do not choose data covering earlier periods is that Bangladesh started to introduce indirect monetary policy tools only at the beginning of 1990s, and it took an additional couple of years to accommodate all the major changes in monetary policy. We need recent data to see how effectively Bangladesh Bank is using these policy instruments. In doing this, we will also be able to avoid possible problems associated with the policy regime shift which occurred in the early 1990's.

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[10] Mortaza (2006) used similar set of variables in a VAR analysis to examine the sources of inflation in Bangladesh.

[11] Here we are ignoring the indirect implication of the higher oil price for the monetary authority, which may arise because of changes in the government borrowing from the Central Bank due to increased government subsidy.

[12] The US is the largest destination for Bangladesh exports, while India is the single most important source of imports for Bangladesh. The Central Bank of Bangladesh may be concerned about these two economies while conducting its policy. We experimented (not reported here) with the alternative SVAR models that include the US output and Indian output and prices in alternative models, the results however, are similar to the model we present here.

All variables are seasonally adjusted using Census X12 procedure. Despite the fact that most of the variables are nonstationary, we use all the variables in log level (except for r, which is used in level). A VAR in differenced form may suffer from a misspecification problem if the true process is not in a VAR in differences or if there exists some linear combinations of non-stationary variables that are stationary; i.e., if the nonstationary variables are cointegrated. Thus, if we use the variables in 'difference form' (in order to induce the stationarity), we must also incorporate the cointegrating relations (if any) in the VAR system. This specification is known as VECM. Specifying correct cointegrating relations is not straightforward, especially when there are several variables in the model. There are possibilities of having more than one cointegrating relation and the combinations of variables in a cointegrating relation are often determined a priori. Nevertheless, doing this must be backed by economic theories as well as by the empirical evidence. Again imposing wrong cointegration restrictions will lead to misspecification of the model and biased estimates. Following many studies of VAR based monetary policy; we thus use the 'log-level' form of the variables in the VAR model, which at least guarantees the consistent estimation of the parameters.

For choosing the lag order of the VAR system, we primarily looked at criteria like Akaike Information Criterion (AIC), Final Prediction Error (FPE), Hannan-Quinn Criterion (HQC) and Schwarz Criterion (SC). For a maximum of 12 lag, AIC, FPE and HQC suggest only two lags, whereas SC suggests a lag order of one. Considering a lag order of two to be too low to capture the dynamics of the variables, we reconsider the maximum lag to be 18. This time, the AIC suggests a lag order of 18, FPE and HQC suggest a lag order of 2 and SC suggests a lag order of one. As different criteria indicate different lag order with a lag order of 2 as the most common one, we first estimate a VAR of five variables using 2 lags. The OLS method is applied to estimate the VAR. However, the correlogram of some of the residual series shows significant autocorrelations at lags 6, 7 or 8. It implies that the respective residual series are not white noise and that relevant equations should include these lags. To ensure the white noise properties for all residuals, we thus decide to use a lag order of 8. Re-estimation of the model with a lag order of 8 resulted in insignificant auto correlations in all residual series for the lags up to 12.

4.3 Identification

Restrictions are imposed on the contemporaneous relations between the reduced form VAR residuals (u's) and the structural shocks (ε's). This can be represented in matrix form as:

$$\underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ a21 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & a34 & a35 \\ a41 & a42 & a43 & 1 & 0 \\ a51 & a52 & a53 & 0 & 1 \end{bmatrix}}_{\mathbf{A_0}} \underbrace{\begin{bmatrix} u^Y \\ u^P \\ u^M \\ u^r \\ u^{Exc} \end{bmatrix}}_{\mathbf{u}} = \underbrace{\begin{bmatrix} b11 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 \\ 0 & 0 & 0 & 0 & b55 \end{bmatrix}}_{\mathbf{B}} \underbrace{\begin{bmatrix} \varepsilon^Y \\ \varepsilon^P \\ \varepsilon^{MS} \\ \varepsilon^{MD} \\ \varepsilon^{Exc} \end{bmatrix}}_{\boldsymbol{\varepsilon}} \qquad [4]$$

Here the coefficients in the matrix $\mathbf{A_0}$ give the contemporaneous relationships between the variables. This can be seen from the two equivalent representations in equation [1] and [2A] discussed in Section 2.1. The coefficients in the main diagonal of the **B** matrix give estimates of standard deviations of the structural shocks. Here u is the vector of residuals obtained from the OLS estimation of the VAR model and ε is the vector of one-standard deviation structural shocks.

The first two rows are related to goods market behaviors. Since output is relatively slow to change, it is assumed that the output level is not contemporaneously affected by any other shock except own shock. The price level is assumed to be affected contemporaneously (in the same month) by the output shock but not by the shocks to money stock, the interest rate or the exchange rate. A positive shock to output supply reduces the price level and hence a positive sign is expected for a21. The third and fourth rows represent money market behaviors. The equation for the supply of money is specified by the third row, which shows that the monetary authority reacts to the changes in the interest rate and exchange rate while changing the supply of reserve money. The basic idea is that the monetary authority gets information of the interest rate and exchange rate movement instantaneously and reacts to the movements in these variables. However, as information on output and prices are available only after some delay, the corresponding coefficients are restricted to zero. A higher interest rate is a signal for a higher demand for money and the Central Bank increases the money supply when the interest rate goes up. On the other hand, the Central Bank may reduce the money supply when there is a depreciation of the exchange rate as it may want to nullify the likely future effects of inflation caused by depreciation. Thus we expect to have a negative sign for a34 and a positive sign for a35. The monetary policy shock is specified by the money supply shock ε^{MS}.

The inverted money demand relation is shown by the fourth row, which implies that nominal money demand is related to the interest rate, output and the price level. Real money demand increases with an increase in the output level (transaction variable) and a fall in the interest rate (opportunity cost). We thus expect to have a negative sign for a41 and a42 and positive sign for a43. Here ε^{MD} is the exogenous money demand shock.

The last row represents the exchange rate response, which assumes that the exchange rate is affected contemporaneously by the output level, the price level and the money supply. As there are restrictions on capital movements, we assume that exchange rate does not respond to the changes in interest rate within the same month. The exchange rate will depreciate with a higher output level (because of higher imports). A higher domestic price may lead to depreciation of the nominal exchange rate in order to keep the real exchange rate fairly stable. Higher money supply worsens the balance of payment situation and thereby may also lead to depreciation of the foreign exchange rate. Thus we expect negative sign for a51, a52 and a53.

It can be verified that [4] is over-identified by one restriction. The Maximum likelihood method using the scoring algorithm (see Amisano & Giannini (1997)) is applied to estimate the coefficients in [4]. The estimates of A_0 and B are shown in Table 1. The LR test for overidentifying restriction indicates that we cannot reject the overidentified model at any reasonable level of significance (the chi-square statistic is 0.028 with p-value of 0.5966).

Table 1: Estimated Contemporaneous Coefficients

$$\mathbf{A_0} = \begin{bmatrix} 1.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ -0.0036\ (0.0128) & 1.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 1.0000 & -0.1410\ (0.1212) & 0.3687\ (0.6984) \\ -0.8255\ (0.4567) & -3.8434\ (2.7979) & 4.7372\ (3.3627) & 1.0000 & 0.0000 \\ -0.0191\ (0.0158) & -0.0134\ (0.1012) & -0.0377\ (0.0390) & 0.0000 & 1.0000 \end{bmatrix}$$

$$\mathbf{B} = \begin{bmatrix} 0.0404\ (0.0024) & 0.0000 & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0063\ (.0004) & 0.0000 & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.0378\ (0.0131) & 0.0000 & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 0.1957\ (0.0563) & 0.0000 \\ 0.0000 & 0.0000 & 0.0000 & 0.0000 & 0.0076\ (0.0004) \end{bmatrix}$$

Log Likelihood: 2348.8695

LR Test: Chi^2: 0.2802 , Prob: 0.5966

Note: Figures in parentheses are corresponding standard errors.

Some of the coefficients in $\mathbf{A_0}$ are found insignificant[13] as respective standard errors are relatively large. However, the signs of the coefficients are mostly what we would expect a priori and this is an indication of the appropriateness of our identification scheme. Moreover, the result of the impulse response functions are often more informative than the structural parameters themselves (Breitung *et al.* (2004)). The corresponding impulse response functions and their standard errors to be explained in Section 4.5 suggest that total uncertainty is not as high as represented by the large standard errors of the individual coefficients. The estimated standard errors of the shocks as shown by the elements in the principal diagonal of the Matrix **B** are all highly significant.

Having estimated the components of $\mathbf{A_0}$ and $\mathbf{B}$, we can now identify the monetary policy shock (ε^{MS}) as well as all other shocks using the relation expressed in the equation system [4]. From the third row of [4], we can write

$$u^{M} + a34(u^{r}) + a35(u^{Exc}) = b33(\varepsilon^{MS})$$

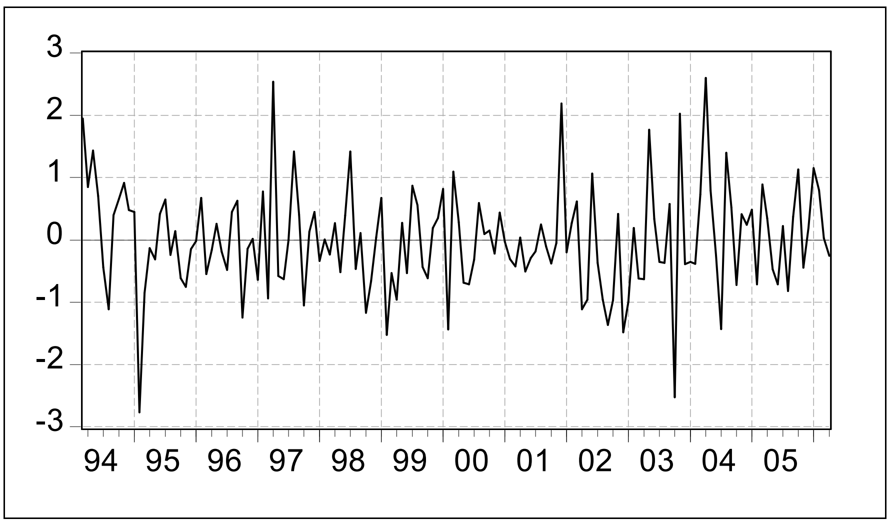
[13] Large standard errors and insignificant coefficients are not unusual in SVAR models; see for example, Kim and Roubini (2000), Sims and Zha (1998) and Brischetto and Voss (1999).

which can be rearranged to obtain the one standard deviation money supply shock:

$$\varepsilon^{MS} = \frac{1}{b33}u^{M} + \frac{a34}{b33}u^{r} + \frac{a35}{b33}u^{Exc}$$

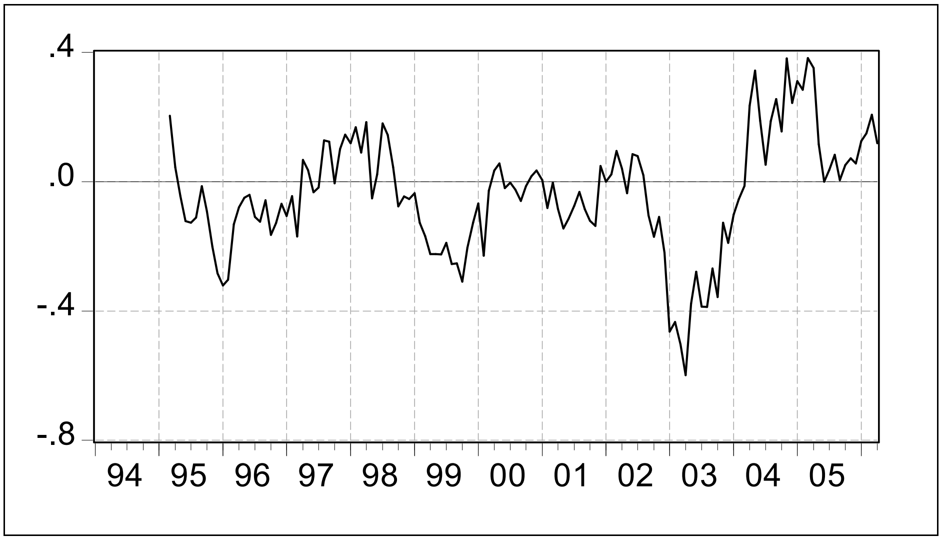
We obtained u^{M}, u^{r} and u^{Exc} from the respective reduced form VAR residuals. The parameters a34, a35 and b33 are obtained from the estimation of our identified model. The constructed one standard deviation money supply shock is shown in figure 1. It shows that strong contractionary policy was taken in February 1995 and October 2003, while extreme expansionary policy was adopted in April 1997, December 2001 and April 2004. During these periods the shocks were significantly different from zero as they exceeded the +/-2 standard deviation bands.

Figure 1: Identified Monetary Policy Shock



By construction, there is a lot of noise in the identified monetary policy shocks. In order to have a general idea about the Central Bank's average policy stance, we compute the 13-month moving average of the shocks, which is shown in figure 2. Here the j-month moving average at period t is the arithmetic mean calculated over the period (t–j) to t.

Figure 2: 13-Month Moving Average of the Monetary Policy Shock



It is apparent from figure 2 that in recent years (since 2003) there are larger fluctuations in the average shocks than in previous years. It may be noted that the Bangladesh Bank introduced Repo and reverse Repo in 2003. The exchange rate was also made flexible in the same year. These two major changes in policy environment may have contributed to making the policy shock more volatile than before. Since 2004 the monetary policy has been expansionary on average.

We also attempt to find the correlation between our identified policy shock and several other variables that could possibly be considered as monetary policy indicators. Table 2 reports the correlation coefficient between our identified monetary policy shocks and alternative indicators. The indicators considered are percentage change of broad money $\Delta(m2)$, changes in short-term deposit rate $\Delta(r)$, changes in call money rate Δ (CMR) and changes in the cash reserve requirement $\Delta(CRR)$.

The highest correlation is found between identified policy shock and the interest rate (-0.5276). The correlation between the identified shocks and movements in M2 is about 31 percent, which is much lower than the corresponding absolute figure for the interest rate. This indicates that movements in the short-term deposit rate contain more important information (than movements in M2) about the Central Bank's policy stance.

Table 2: Correlation Coefficient between Identified Shock and Other Indicators

ε^{MS} and $\Delta(m2)$	ε^{MS} and $\Delta(r)$	ε^{MS} and $\Delta(CMR)$	ε^{MS} and $\Delta(CRR)$
0.3146*	-.5276*	0.1521	.1300

Note: CRR implies the cash reserve requirement. Significance at five percent level is indicated by *. The standard error of the correlation coefficients is calculated as $1/\sqrt{N}$, where N is the number of observations. As call rate data are available only since 1997, we used shorter sample size (1997:2 – 2006:4) for calculating the correlation coefficient between ε^{MS} and $\Delta(CMR)$. For all other cases, we use data spanning 1994:3 – 2006:4.

The corresponding coefficients in relation to CMR and CRR have the wrong signs, as an increase in the call money rate and CRR is equivalent to a contractionary policy. The call money rate in Bangladesh is very volatile and an increase in the rate often indicates a high demand for bank reserves. The positive relation (although insignificant) between the identified policy shock and the call money rate may imply that the Bangladesh Bank increase the supply of money if there is an additional demand for bank reserves.. The CRR has been changed only four times since 1993. The infrequent changes in CRR may be the main reason for the wrong direction of its correlation with the identified monetary policy shock. The opposite sign of the correlation coefficients shows that the call rate and CRR do not necessarily reflect the policy stance of the Central Bank (if our identification scheme is correct).

4.4 Are Monetary Policy Shocks Important?

Monetary policy shocks, as identified from the shocks to the money supply in our SVAR model, are found to be important sources of fluctuations in the rate of interest, output and prices. Table 3 reports the proportion of k-month ahead forecast error variances in each of the five variables that is accounted for by the identified monetary policy shocks.

Monetary policy shocks account for about 64 percent of the fluctuations of money stock, whereas about 44 percent of the fluctuations in the interest rate is explained by the identified policy shocks at impact. These two figures contrast sharply with those in previous studies of Bangladesh, which mostly found that variations in money supply and the interest rate are primarily caused by the own shocks and the contributions of own shocks were often close to 100 percent at impact period. Our findings indicate that the endogenous responses of monetary policy are an important source of forecast error variance of money supply and the interest rate. The importance of policy shocks gradually diminishes over time; and after four years, about 40 and 32 percents of the fluctuations in money supply and the interest rate are determined by the monetary policy shocks.

Table 3: Error Variance due to Monetary Policy Shock

Time Horizon (k)	*Proportions of Forecast Errors in*				
	Y	P	M	r	Exc
0	0.00	0.00	0.64	0.44	0.01
6	0.02	0.02	0.64	0.40	0.07
12	0.07	0.04	0.63	0.43	0.06
24	0.15	0.12	0.55	0.45	0.04
36	0.20	0.20	0.47	0.35	0.05
48	0.22	0.24	0.40	0.32	0.09

The importance of policy shocks for the fluctuations in goods market variables increases over time. About 24 percent of the price variability is due to monetary policy shocks after four years, whereas about 22 percent of the output fluctuations get attributed to policy shocks. These figures are reasonably high and in sharp contrast with previous studies on Bangladesh, which mostly ended up with the conclusion that money has very little role in explaining the movements in goods market variables, in particular, fluctuations in the output level. Our identified monetary policy shock, however, appears to be less important source of variation in the exchange rate, as only nine percent of the variation in the exchange rate is due to the identified policy shocks after four years.

4.5 Effects of Identified Monetary Policy Shocks

The dynamic effects of a positive monetary policy shock are graphed in figure 3. Impulse response functions to a one standard deviation policy shocks are plotted for a period of 32 months. For each response function, we also report a 95 percent confidence interval generated by Hall's bootstrap method (using 1000 repetition)[14].

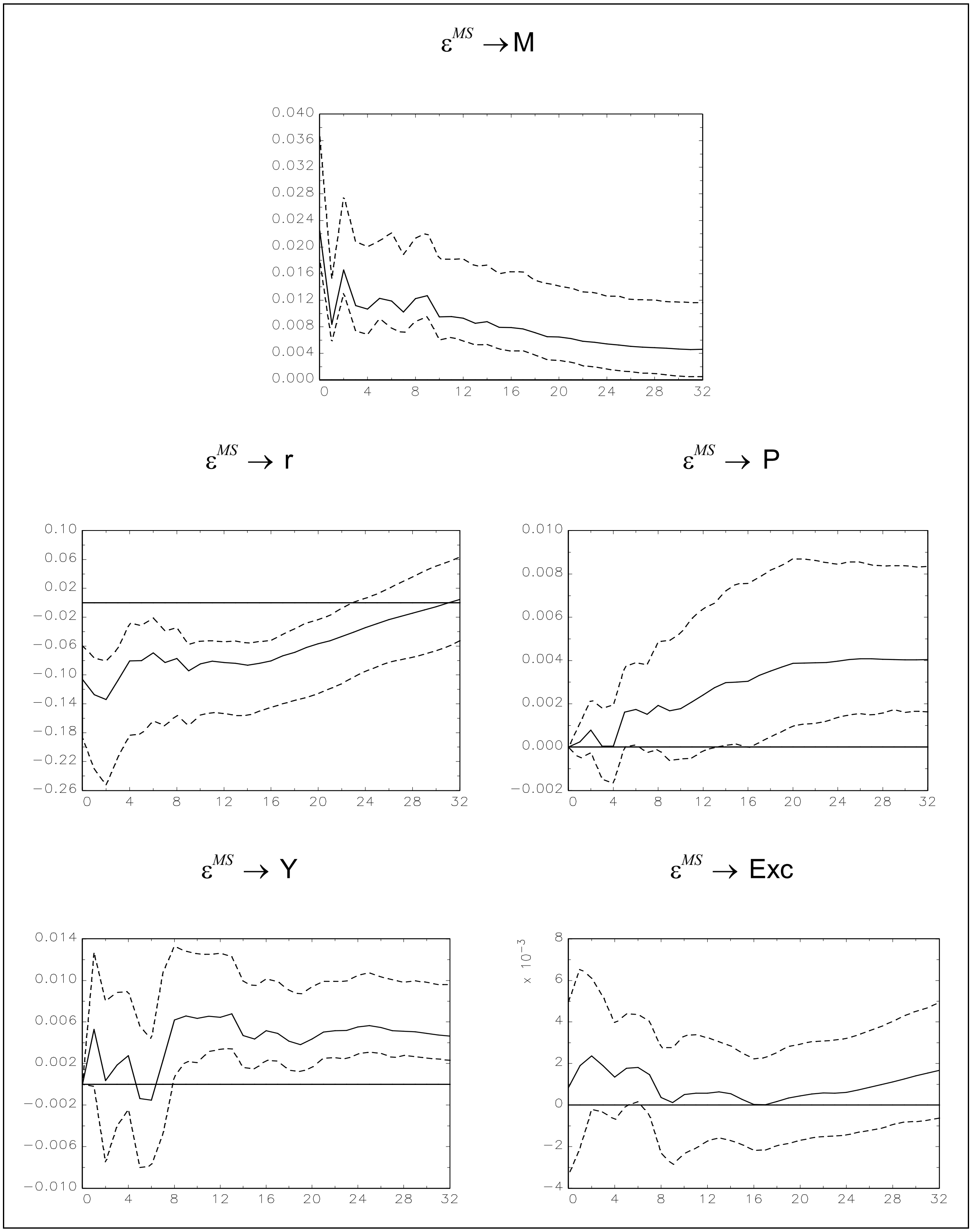
The response of money supply to an expansionary monetary policy shock is positive and significant, as expected. The effect is quite persistent, as responses are significant even after 32 months following a shock. The immediate response of interest rate is negative and significant. The interest rate falls immediately after a positive money supply shock and the negative effect persists for about 22 months. This indicates presence of a strong liquidity effect in Bangladesh, which other studies on Bangladesh monetary policy failed to establish. The liquidity effect, a negative response of nominal interest rates to a positive money supply shock, is a basic feature of the money market. The absence of a liquidity effect (the liquidity puzzle) in empirical models is often caused by failure to isolate the money supply shocks from the money demand shocks. Presence of strong liquidity effect in our analysis is an indication of appropriate identification of the monetary policy shocks.

The price level starts to increase significantly after 12 months following a shock and the rise in the price level appears to be permanent. The price response is consistent with the conventional view that prices respond to monetary policy with some delays and the belated response sustains for long.

The output level begins to rise significantly about eight months after a loosening of monetary policy. The monetary policy shock appears to have lasting effect on real activity as the rise in the output level sustained even after 32 months following a monetary policy shock. In fact, for a developing country like Bangladesh, a persistent effect of monetary policy on output is not unusual. While the overriding concern in a mature economy is to keep output and employment close to the long-run potential, the challenge in developing world is how to augment the capacity output through productivity growth as well as via installation of additional capacity (Bangladesh Bank, 2005). Our finding indicates that an expansionary monetary policy may contribute to the long-run growth of the economy.

[14] Hall (1992) gives details of this method. See also Breitung, Brüggemann and Lütkepohl (2004).

Figure 3: Response of Different Variables to a Monetary Policy Shock



A solid line represents the impulse responses of a variable to a one standard deviation shock to the monetary policy. The dotted lines are the 95 percent bootstrapped confidence intervals

Lucus (1972) argued that imperfect information leads to an effect of money supply shock on output in the short-run. This is because firms misperceive the money shock as relative changes in prices. The issue here is about how this initial misperception could create long lasting effects on the output level. "If the initial misperception led firms or workers to change a state variable, a variable which affected their decisions in subsequent periods, the initial impulse would have lasting effect" (Blanchard 1987). For example, the initial misperception may lead a firm to install new technology, which may increase the output level permanently. In a less developed country like Bangladesh, information flows are much more constrained than in a developed economy. If direct information about nominal shocks is not available even ex post, large permanent changes in money can be misperceived for relative price changes for a long time, during which they would have an effect on output (Blanchard 1987).

This finding, however, is in sharp contrast with the previous SVAR–based studies of Bangladesh monetary policy. These studies either found no effect or a very short lived positive effect of a monetary policy shock on the output level. As we have already argued, most of these studies suffered from the mis-specified policy shock and that might be the main reason of their different findings.

The point estimates of the responses of the nominal exchange rate are positive, implying depreciation of currency due to a positive shock in money supply. The direction of the exchange rate response is quite in line with the idea that excess money supply worsens the balance of payment situation, which causes depreciation of currency. However, exchange rate responses are not significant at any time horizon, which is also consistent with our earlier findings on relevant variance decompositions. The exchange rate in Bangladesh was not fully flexible before May 2003; Bangladesh was following adjustable fixed exchange rate system in which the Central Bank used to adjust the nominal rate from time to time. Lack of flexibility in exchange rate responses may be the main cause of the insignificant effects of monetary policy shock on the exchange rate.

4.6 Interest Rate or Exchange Rate Channel?

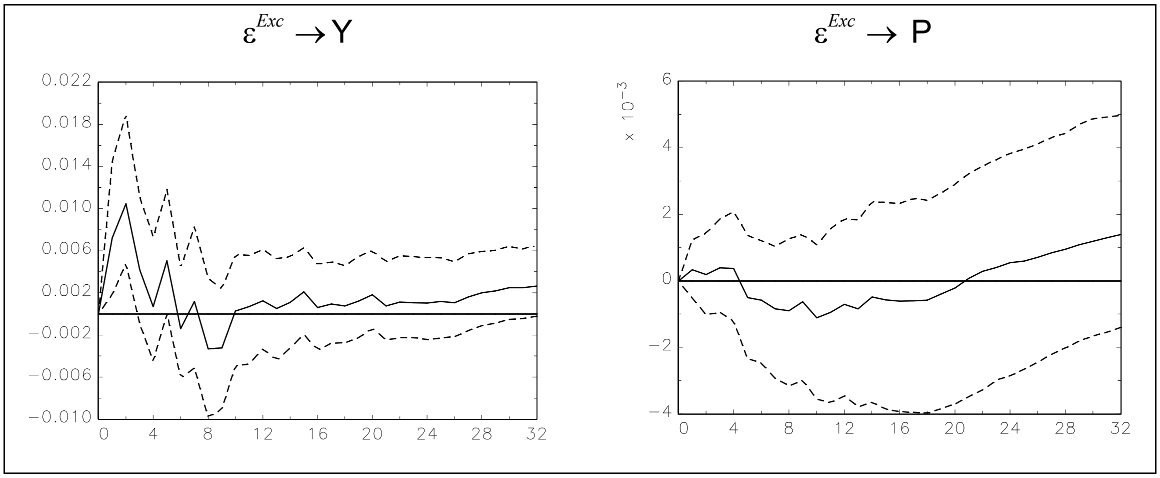
The dynamic response patterns of different variables to a policy shock discussed above hint that monetary policy in Bangladesh is transmitted through the interest rate, but not through the exchange rate channel. An unanticipated positive money supply shock causes the short-term interest rate to fall for about two years. The long-lasting decline in the nominal interest rate is expected to be translated to the decline in real interest rate because of the stickiness in the movement of the price level. The decline in real interest rate increases aggregate demand and the output level. Although the nominal interest rate eventually comes back to its initial level (after 22 months), the effects of money supply on the output level does not appear to decline over time[15].

Our finding shows that exchange rate may not be a channel of monetary policy in Bangladesh. As Bangladesh was under pegged exchange rate system prior to May 2003, the Central Bank's international reserve situation might be the more important factor than the money supply in altering the exchange rate. In fact, exchange rate itself might have been an instrument for the Central Bank, which was mainly used to keep the international reserve position at targeted level. However, an exchange rate shock (depreciation) is supposed to increase net export and thereby aggregate demand and the output level. Below we have shown the effects of output and prices to a shock in the exchange rate. The output response shows that an unanticipated depreciation of currency increases the output level significantly for about four months. With the demand for imports being inelastic, depreciation of currency is often thought to be followed by inflation in Bangladesh; however, the insignificant response of prices indicates that this may not be the case in Bangladesh.

Thus even though money supply does not transmit through the exchange rate channel, an exogenous shock to the exchange rate itself increases the output level in the short-run, but not in the long-run. However, at present the Bangladesh Bank has limited ability to increase the output level by influencing the exchange rate, as it has switched to the fully flexible exchange rate system recently.

[15] Our analysis is not designed to examine the existence of a credit channel. However the negative interest rate response of a monetary policy shock does not rule out the co-existence of a credit channel. In particular, a change in the interest rate may imply a balance sheet channel which works through changes in the firms' net worth.

Figure 4: Output and Price Responses to the Shocks in the Exchange Rate

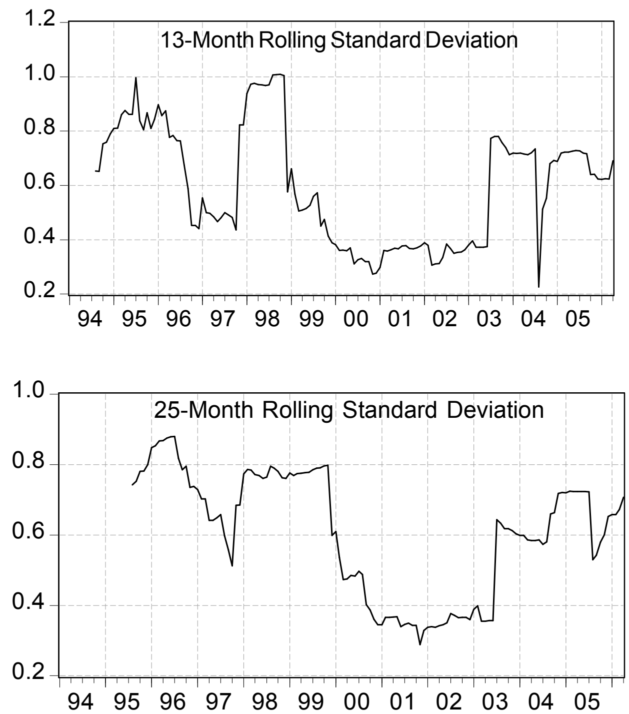


4.7 Price Stability and Monetary Policy

Price stability is one of the main objectives of monetary policy in Bangladesh. In the previous section, we saw that the identified monetary policy shock has a permanent positive effect on the price level. The policy shock also accounts for a reasonably large proportion of the forecast error variance of the price level over the long horizon of time. This section tries to find the answer to the question: Does an expansionary monetary policy increase the price volatility? In particular, we examine the nature of price volatility in Bangladesh and its relationship with our identified monetary policy shocks.

In order to build intuition about the price volatility, calculate rolling standard deviation of the changes in the price level. We use the 13 and 25 months windows to calculate the rolling standard deviation. Here the j-month rolling standard deviation at period t is the standard deviation calculated over the period (t – j) to t. These standard deviations are calculated for the first difference of the price level (multiplied by hundred). The computed standard deviations are shown in figure 5.

Figure 5: Rolling Standard Deviation of the Price Changes



In general, there is a declining trend in the price variability. However, the 25-month rolling standard deviation shows that, in recent years, in particular since 2003, prices have become more volatile than they were in previous years. As mentioned previously, the Bangladesh Bank has introduced new tools, namely, Repo and Reverse Repo in 2003 in conducting its monetary policy, which may lead to increased volatility in the price level. This indicates that there might be a close relation between monetary policy and the price variability.

In order to verify this issue, we calculate simple correlation coefficients between the policy shocks (13-month moving average) and the leads of the 13-month rolling standard deviation of the price changes, which is shown in Table 4. Consistent with our earlier presumption, the monetary policy shocks appeared to be correlated significantly with the leads (at the period 0, 1, 2, 3 and 12) of the price variability.

Table 4: Cross Correlation between Average Monetary Policy Shocks (at period t) and Rolling Standard Deviation of Price Changes at period (t + i)

i = 0	i = 1	i = 2	i = 3	i = 4	i = 5	i = 12
0.1896*	0.2063*	0.2062*	0.1699*	0.1489	0.1341	0.1624*

A * shows the statistical significance at 5 percent level. The standard error of the correlation coefficients is calculated as $1/\sqrt{N}$, where N is the number of observations.

The result has important implication for maintaining price stability in Bangladesh. Our results suggest that expansionary policy shock increases both mean and variance of the price level. Thus it is indicative that the Central Bank may be able to ensure price stability through contractionary policy measures.

5. Summary and Conclusion

This paper utilizes the Structural VAR approach in order to identify monetary policy shocks and their impacts on different macro variables in Bangladesh. Monetary policy shocks are identified with non-recursive contemporaneous restrictions based on the Central Bank's reaction function and the structure of the economy. In particular, we define shocks to the supply of reserve money as monetary policy shocks. However, movements in the interest rate appear to contain important information about the Central Bank's policy stance implied by our identified policy shocks. The importance and impacts of monetary policy shocks are examined from the relevant variance decompositions and impulse response functions.

Our empirical findings indicate that monetary policy shocks are important sources of fluctuations in the rate of interest, output and prices. However, monetary policy shocks are not found to be an important source of fluctuations in the exchange rate. The responses of different macroeconomic variables to a monetary policy shock are consistent with the conventional views on the effects of monetary policy. In particular, our identification scheme does not lead to any price puzzle or interest rate puzzle. Both price and output responses indicate the lasting effects of monetary policy on these two variables. The monetary policy shock does not appear to have any significant effect on the exchange rate, although the exchange rate shock itself affects the output level for a very short period of time.

As price stability is one of the main objectives of monetary policy in Bangladesh, we have also examined the volatility in price changes and its relation with the identified monetary policy shocks. The computed rolling standard deviation of the price changes suggest that price volatility declined during the period 1994-2003, however, there is somewhat an increasing trend in the price volatility in more recent years. The cross correlations between the rolling standard deviation of price changes and our identified monetary policy shock suggest that an expansionary monetary policy shock is positively related to the price variability.

Our finding has important implication for the goals and strategies of monetary policy in Bangladesh. In recent years a number of industrial countries adopted a framework for conducting their monetary policy, which is known as 'inflation targeting'. The inflation targeting approach is consistent with the growing consensus of maintaining price stability and controlling inflation as a basic goal of the monetary policy. Our findings, however, suggest that concentrating solely on inflation or price stability may not be an appropriate strategy for Bangladesh. We found that expansionary monetary policies are harmful for achieving price stability in Bangladesh, as they not only increase the price level permanently, but also cause high volatility in prices. However, expansionary policies lead to lasting increases in the output level. Clearly there is a trade-off between the two major goals of monetary policy. Thus in combating inflation, the Central Bank of Bangladesh needs to be cautious in implementing its contractionary policy as this may lead to a sustained recession.

Appendix

Data and Their Sources

We use monthly data covering the period 1993:07 – 2006:04. Definitions of the variables that are used in the Structural VAR model are given below.

Y = Log of Industrial Output Index (2000 =100). Source: IMF (International Financial Statistics Online Database).

P = Log of Consumer Price Index (2000 = 100). Source: IMF (International Financial Statistics Yearbook and Online Database).

M = Log of Reserve Money (in Million Taka). Source: IMF (International Financial Statistics Online Database).

r = Short-term (3 – 6 months) Deposit Rate (in percentage). Source: IMF (International Financial Statistics Online Database).

Exc = Log of Nominal Exchange Rate (expressed in Bangladeshi Taka per US Dollar). Source: IMF (International Financial Statistics Online Database).

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