Authors:
ABDUR RAHMAN FORHAD
Northern Illinois University, DeKalb, Illinois, USA
GHASTEMA. HOMAIFAR
Middle Tennessee State University, Murfreesboro, Tennessee, USA
ABUL HASANAT MUHAMMED SALIMULLAH
Middle Tennessee State University, Murfreesboro, Tennessee, USA

MONETARY POLICY TRANSMISSION EFFECT ON THE REAL SECTOR OF THE BANGLADESH ECONOMY:
AN SVAR APPROACH

ABSTRACT

This study examines the effectiveness of the monetary policy transmission of Bangladesh using Structural Vector Autoregressive model (SVAR) for the period of 1972-2014. The SVAR model investigates how a monetary policy shock defined as an unexpected rise in interest rate affects real and nominal macro variables; namely real output, prices, real effective exchange rates, and money supply. Our results suggest that a monetary policy shock does have a short run effect on real output, price level, and exchange rates. A monetary policy shock generates inflationary pressure leading to a devaluation of the Bangladeshi Taka. This paper suggests that the policy makers, to consider the trade-off between output and interest rate of Bangladesh.

Keywords: Bangladesh, Monetary Policy, SVAR
JEL Classification: E40, E50

RIASSUNTO

L’effetto trasmissione della politica monetaria sul settore reale dell’economia del Bangladesh: un approccio SVAR

Questo articolo esamina l’efficacia della politica monetaria del Bangladesh tramite il modello SVAR nel periodo 1972-2014. Tale modello esamina come uno shock di politica monetaria, definito come un aumento inatteso nel tasso di interesse, influenzi le macrovariabili reali e nominali: la produzione reale, il livello dei prezzi e del cambio reale effettivo, l’offerta di moneta. I risultati suggeriscono che uno shock di politica monetaria ha effetto nel breve periodo sulla produzione reale, sul livello dei prezzi e sui tassi di cambio. Uno shock di politica monetaria genera una pressione inflazionistica che porta ad una svalutazione del taka. Secondo questo
studio i governi dovrebbero considerare il *trade-off* tra produzione e tasso di interesse nel Bangladesh.

1. **INTRODUCTION**

Monetary policy may play a vital role in the economy, at least in the short run. Bernanke and Gertler (1995) and Bech *et al.* (2014) argue that the monetary policy has been very useful, especially in the developed countries such as USA, UK, Canada, Australia and other industrialized economies. These countries have successfully used instruments of monetary policy to mitigate their short-term crisis and have taken some unconventional monetary policy approaches. These are: large-scale assets purchases, extended maturity lending to banks, cutting the deposit rates near zero, purchase of asset-backed securities, and covered bank loans. Most of the policy makers consider the monetary policy instruments as a viable solution for impending crises in the real sector of the economy as elaborated by Bernanke and Gertler (1995). Mishkin (2009) and Kouri (1976) maintain that the monetary transmission channels include: the interest rate channel, exchange rate channel, price and credit market channels. The monetary policies are taken to have a short run impact in the economies, which can have a persistent effect in the long term.

Andries (2012) argues that the monetary transmission process can yield benefits, provided that the policy makers understand its effects on the economy for calibrating the monetary policy itself and secondly, to choose the appropriate instruments, in mitigating various short-run crisis in the real sector of the economy.

Bangladesh Bank, the central bank of Bangladesh, targets the money supply (M2) as an intermediate instrument and uses the reserve money as an operating tool to achieve the expected growth rates, price and exchange rate stability. As well as an equilibrium in the balance of payments and the development of the capital markets (Rahman, 2005), the primary functions of monetary policy in Bangladesh are: (1) to maintain reasonable price stability, (2) to ensure a stable balance of payment position and to provide an external competitiveness of the Bangladesh currency, and (3) to achieve sustained economic growth through increased production and employment.
The Bangladesh Bank influences reserve money through indirect market-based instruments such as Cash Reserve Ratio, Statutory Liquidity Ratio, repo, reverse repo, open market operations, and moral suasion as shown in Ahmed and Islam (2004).

This paper examines the effectiveness of monetary policy in Bangladesh. More specifically, using a structural vector autoregressive (SVAR) model, we review the impact of a monetary policy shock on both real and nominal macro variables, such as real output, prices, exchange rates and the money supply. The structure of this paper is as follows: we review the literature in Section 2; Section 3 presents data and methodology; estimation results are presented in the fourth Section, and the final section summarizes the findings.

2. A BRIEF LITERATURE REVIEW

There is a lively debate on the comparative effectiveness of monetary and fiscal policy as a stabilization mechanism in the economy. Right after the end of Great Depression 1929-1939, there was a strong belief that the fiscal policy was more effective as elaborated by Bernstein and Bernstein (1989). Keynes (2007) is the pioneer of advocating fiscal policy in mitigating undesirable effects of the great depression that is also advanced by Leeuw and Gramlich (1969), Schmidt and Waud (1973), Blinder and Solow (1974), and Gramlich (1971). The late sixties reveal the failure of 1968 surtax policy that paved the way for a new ground for monetarist attack. Claiming that the fiscal policy has the microscopic effect on aggregate demand and that the monetary policy is more useful than the fiscal stimulus.

To explain the relationship between money and output, the classic study by Friedman and Schwartz (1963) is still paramount and influential which indicates that the variation in the rate of money growth causes changes in real economic activity (Walsh, 2010). However, Tobin (1970), Friedman and Kuttner (1992) have challenged Friedman and Schwartz (1963) and argue that the causality might run both ways as changes in income inducing variations in the monetary aggregates and Vice-Versa.

Friedman and Kuttner (1992) reexamine money and income using time-series approach on extensive data through the 1980s and find that there is no close or credible relationship between money and income. However, they conclude that the spread of the commercial paper over Treasury bill rate may not have significant information about the movements in real income.
Andersen and Jordan (1968) use various measures of monetary and fiscal policy actions and show that monetary policy has greater, faster, and more likely impact on the economic stabilization.

Central banks actions influence economic activities through a transmission mechanism of monetary instruments in achieving noninflationary growth as elaborated by Kashyap and Stein, (1994). Taylor (1995) and Belke and Klose (2011) argue that the transmission of monetary policy is

“the process by which monetary policy decisions are transmitted in real GDP and inflation”.

There might be two approaches to explain the functions of the monetary policy transmission mechanism: 1) Monetary approach– where interest rate changes have a direct impact on investment and exchange rate, and 2) Credit-oriented approach– as intermediaries have a substantial role in the transmission of monetary impulses on production and prices. Cecchetti et al. (2000), Sukmana and Kassim (2010), and Adrian and Shin (2010) argue that the economists need to pay particular attention to the important role of the banking sector. The banking industry is an intermediary in the transmission mechanism of monetary policy impulses, particularly in the States having the financial system based mainly on banks.

Bryan and Cecchetti (1994) argue that the analysis of monetary channels has a significant impact on the real economy. Friedman (1995), as well as other studies unanimously, reflect that

“real effects of monetary policy are systematic, meaningful and significant”.

Most recent survey of money and income by Homaifar and Zhang (2008) reveal the following results for the United States. While there appears evidence of strong co-integration of the growth rate of M2 money and GDP over the long term as well as subsequent periods of 1958-1981, there is no indication of co-integration in the 1982-2005 per se, a period of low inflation in the United States. While inflation and above average growth have coincided in the past, it is important to appreciate that this can happen because growth may be related to other changes that induce upward pressure on the price level, not because growth is inflationary in nature. The policy makers should rethink the conventional wisdom of high growth and inflation.
There are very few empirical evidence on the effectiveness of the monetary policy in Bangladesh. Ahmed and Islam (2004) observe the impact of a shock to reserve money on output and price levels for the periods of 1979-2005. Using an unrestricted vector autoregressions VAR model, we find that monetary policy has no significant impact on price and output. Chowdhury et al. (1995) investigate the relationship between money, prices, output, and the exchange rate in Bangladesh during the 1974-1992 period. They find that the monetary policy has a significant impact on the production. Alam (2015) examines the effectiveness of the monetary policy in Bangladesh and has pointed out that monetary policy may not be effective in controlling short run economic fluctuations in Bangladesh.

Monetary policy can have an impact on the stock market. Ahmed et al. (2006) examine the effect of contractionary monetary policy shock on the stock price index using structural VAR approach and find that the contractionary monetary policy shock, measured by increases in short-term interest rates have negligible yet negative and short-lived effect on the stock price index. Narayan et al. (2012) argue that there are two key features in the literature which have relevance to the empirical analysis. The first characteristic of this literature relates to econometric methodology. Most studies have used a VAR model to analyze monetary transmission. The second most commonly used algorithm is co-integration and an error correction framework.

Most of the previous studies use a simple recursive model, which does not support the theoretical background and do not check the effectiveness of the monetary policy incorporating the stock price indices and short-term interest rates simultaneously. Therefore, this study uses the non-recursive methodology to assess the efficiency of the monetary policy with real GDP, money supply M2, the Real Effective Exchange Rate (REER), the consumer price index CPI and the real interest rate (IR). None of the studies reviewed here have used a structural VAR model. A structural VAR model offers to impose theoretically motivated restrictions on the potential relationship between interest rate and other macro variables. Our modeling framework follows a structural VAR model. The second feature of our investigation is that the bulk of the studies are based on developed countries. Monetary policy is also relevant for developing countries, particularly in judging the effectiveness of monetary policy instruments.
3. METHODOLOGY AND DATA

3.1 Methodology

Vector autoregressive models (VARs) are used for understanding the effects of monetary policy on the economy as demonstrated by Jääskelä and Jennings (2011). VAR is a very useful tool, and to some extent as a macroeconomic forecasting tool. However, the ability of VAR model to differentiate the correlation and causation has remained contentious. The SVAR approach stemmed from the seminal contributions of Cooley and LeRoy (1985), Sims (1986), and Blanchard and Watson (1986), who made use of economic theory to estimate the structural parameters and to recover the underlying independent structural disturbances.

The Structural VAR (SVAR) can help to resolve various economic issues concerning the identification of contemporaneous and dynamic relationships among macroeconomic variables. There are various ways of specifying the restrictions to achieve identification of the structural parameters. One approach to identifying is an SVAR that uses the constraints implied by an entirely defined theoretical macroeconomic model. For example, Blanchard and Watson (1986) used economic theory to incorporate short-run restrictions, while Shapiro and Watson (1988) and Blanchard (1989) used economic theory to justify the inclusion of long-run restrictions.

A structural VAR model can help to impose theoretically motivated restrictions on the potential relationship between the income and other macro variables. This study uses a five-variable Structural SVAR model to obtain the underlying shocks of Bangladesh. The variables are endogenous as real GDP, consumer price index (CPI), money supply (M2), interest rate (IR), and the real effective exchange rates (REER).

Consider a time series \( x_t \), where \( x_t = [y_t, p_t, M_{2t}, i_t, e_t]' \). The variables are: real GDP \((y_t)\), price level \((\text{consumer price index, CPI; } p_t)\), money supply \((M_{2t})\), real interest rates \((i_t)\), and the real effective exchange rates \((e_t)\) respectively. All the variables except the real interest rates are in log form. The real GDP is approximated by a vector autoregression of finite order \( p \). The objective is to identify the parameters of the structural vector autoregressive model as:

\[
B_0x_t = B_1x_{t-1} + B_2x_{t-2} + ... + B_px_{t-p} + u_t
\]

where \( u_t \) is the vector of structural shocks:
\[ u_t = \{u^y_t, u^p_t, u^m_t, u^i_t, u^e_t\} \]

The functional form in the above equation consists of the output shocks \( u^y_t \), the inflation shocks \( u^p_t \), money supply shocks \( u^m_t \), interest rate shocks \( u^i_t \), and exchange rate shocks \( u^e_t \) respectively. And it is also assumed that these shocks \( u_t \) are serially uncorrelated and unconditionally homoscedastic, unless noted otherwise. The variance-covariance matrix of the structural shocks is normalized as:

\[
E(u_t u_t') = \Sigma_u = I_n, \tag{2}
\]

where the structural shocks \( \Sigma_u \) are mutually uncorrelated by definition, which implies that the \( \Sigma_u \) is diagonal. Assume that the \( \Sigma_u \) is normalized to unity. The following normalization does not involve a loss of generality, as long as the diagonal elements of \( B_0 \) remain unrestricted.

The equation (1) can be rewritten as:

\[
B(L) x_t = u_t, \tag{3}
\]

where \( B(L) = B_0 + B_1 L + B_2 L^2 + \ldots + B_p L^p \)

The above functional relationship is the polynomial autoregressive lag order of \( p \). The equation (1) implies as:

\[
x_t = A_1 x_{t-1} + A_2 x_{t-2} + \ldots + A_p x_{t-p} + \epsilon_t, \tag{4}
\]

where \( \epsilon_t \) is the shocks from the reduced model, and \( A_i = B_0^i B_1 \) for \( i = 1, 2, \ldots, p \), and \( \epsilon_t = B_0^i u_t \).

The equation (4) can be written as:

\[
A(L) x_t = \epsilon_t, \tag{5}
\]

where \( A(L) = I_n - A_1 L + A_2 L^2 + \ldots + A_p L^p \)

The above model is the polynomial autoregressive lag order of \( p \). We can obtain the estimated reduced-form parameters \( A_i \), the reduced-form shocks \( \epsilon_t \), and their variance-covariance matrix \( E(\epsilon_t \epsilon_t') \equiv I_n \).

It is evident by inspection that the reduced-form innovations \( \epsilon_t \) are in general a weighted average of the structural shocks \( u_t \). As a result, studying the response of the vector \( y_t \) to reduced-form shocks \( \epsilon_t \) will not identify about the reaction of \( u_t \) to the structural shocks \( \epsilon_t \). It

---

1 See also Lütkepohl and Krätzig (2004).
is the latter response that is of interest if we want to learn about the structure of the economy. These structural responses depend on $B_i$, where $i=0,1, ..., p$. The central question is how to recover the elements of $B_0^{-1}$ from consistent estimates of the reduced-form parameters as knowledge of $B_0^{-1}$ would enable us to reconstruct $u_t$ and $B_t$ from $u_t = B_0 \varepsilon_t$ and $B_t = B_0 A_t$ respectively.

Thus we have,

$$\varepsilon_t = B_0^{-1} u_t.$$  \hspace{1cm} (6)

Hence, the variance of $\varepsilon_t$ is $E(\varepsilon_t \varepsilon_t') = B_0^{-1} E(u_t' u_t) B_0^{-1'}$, which implies $\Sigma_\varepsilon = B_0^{-1} \Sigma_u B_0^{-1'}$. We define $\Sigma_\varepsilon = B_0^{-1} \Sigma_u B_0^{-1'}$ where $\Sigma_u = I_n$, as $\Sigma_\varepsilon$ is a function of $B_0^{-1}$. This system can be solved for the unknown parameters in the matrix of $B_0^{-1}$ using numerical methods, provided that the number of unknown parameters in $B_0^{-1}$ does not exceed the number of equations. Furthermore, imposing additional restrictions on selected elements of $B_0^{-1}$ (or, equivalently $B_0$).

These types of restriction may take the form of exclusion restrictions, proportionality restriction, or other equality constraints. The most common approach is to impose the zero restrictions on selected elements of $B_0^{-1}$.

3.2 SVAR Model, Restrictions and Identification Conditions

There is a debate on how to define the SVAR model to explain the economic activity in which the theoretical and economic restrictions are properly incorporated into the design. The SVAR can serve as a battleground between alternative economic theories, especially in addressing various issues that arise when identifying the monetary policy of small open economies by individual researchers. Identification of monetary policy shocks requires adequate short-run restrictions on the SVAR model. Therefore, we need some parameter restrictions on the contemporaneous matrix ($B_0$) in SVAR model defined in equation (1). The literature suggests that there are two identification structures, namely recursive and non-recursive identifying structures which can

---

2 Please also see Kilian (2012).
be imposed on the contemporaneous matrix, to identify the Bangladesh SVAR model, where we can have the following restrictions.

**Recursive Structure:** The recursive structure assumption is established based on successive relationships between monetary policy variables and non-monetary policy variables of monetary authorities. These identifying assumptions correspond to the notion that the economic variables are determined in a block recursive way. First, the non-policy variables (output and price) are defined, followed by the Central Bank policy instruments (interest rate and money supply), and finally, the remaining parameters known as the money market variables.

The restrictions on the $B_0$ matrix are summarized in equation (7):

$$
\begin{bmatrix}
    u^y_t \\
    u^p_t \\
    u^m_t \\
    u^i_t \\
    u^e_t
\end{bmatrix} = 
\begin{bmatrix}
    1 & 0 & 0 & 0 & 0 \\
    b_{21} & 1 & 0 & 0 & 0 \\
    b_{31} & b_{32} & 1 & 0 & 0 \\
    b_{41} & b_{42} & b_{43} & 1 & 0 \\
    b_{51} & b_{52} & b_{53} & b_{54} & 1
\end{bmatrix}
\begin{bmatrix}
    \varepsilon^y_t \\
    \varepsilon^p_t \\
    \varepsilon^m_t \\
    \varepsilon^i_t \\
    \varepsilon^e_t
\end{bmatrix}
$$

where the recursive structure assumes that price level (CPI) has no immediate effect on output (GDP). The money stock ($M^*_2$) has no immediate effect on prices; monetary policy shock ($i_t$) has no immediate effect on the money stock ($M^*_2$), and the real effective exchange rate (REER) has no immediate effect on monetary policy ($i_t$).

**Non-recursive Structure:** The notion of recursive relationship may not be appropriate to identify the simultaneous contemporaneous relationships between policy instruments and money market variables (Zha, 1997).

To determine the dynamics of the structural shocks of monetary policy and to mitigate its effects, we employ a useful tool that is a non-recursive SVAR, which relaxes the restrictive

---

4 For details, see Christiano et al. (1999), Dungey and Pagan (2000).
assumptions in the recursive model. The non-recursive structure allows in explaining the simultaneous contemporaneous interactions between policy variables and other market variables. For example, to understand the effect of interest rate innovation on the exchange rate, one has to consider the interest rate innovation \textit{a priori}, which implies, that monetary policy is not responsive to contemporaneous changes in the exchange rate\textsuperscript{5}.

The non-recursive VAR model has the following restrictions:

\[
\begin{bmatrix}
u_t^y \\ u_t^p \\ u_t^m \\ u_t^i \\ u_t^e
\end{bmatrix} =
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 \\ b_{21} & 1 & 0 & 0 & 0 \\ b_{31} & b_{32} & 1 & b_{34} & 0 \\ 0 & 0 & b_{43} & 1 & b_{45} \\ b_{51} & b_{52} & b_{53} & b_{54} & 1
\end{bmatrix}
\begin{bmatrix}
\epsilon_t^y \\ \epsilon_t^p \\ \epsilon_t^m \\ \epsilon_t^i \\ \epsilon_t^e
\end{bmatrix}
\]

The first equation in the non-recursive VAR structure reveals no contemporaneous relationship between real GDP and the other nominal variables. The second equation represents a contemporaneous response of inflation to real GDP, but not to nominal variables. These first and second equations are related to goods market behavior. The price level is assumed to be affected contemporaneously by the output shocks but not by the interest rate and exchange rate shocks. A positive shock to output supply reduces the price level, which implies a positive sign for \(b_{21}\).

The third and fourth equation represent the money market behavior. The third equation can be perceived as a short-run money demand function, as money demand is allowed to respond contemporaneously to shocks to real GDP prices and the short-term interest rate. In the fourth equation, we assume that the output doesn’t have any contemporaneous response to the interest rate, which implies that \(\epsilon_{41} = 0\), as the central bank is setting the money supply, assuming the money supply is not respondent to the interest rate in the short run (\(\epsilon_{42} = 0\)). The fourth equation is similar to the monetary policy reaction function: the short-term interest rate is allowed to respond contemporaneously to money demand and exchange rate shocks.

The last equation represents the exchange rate response, which assumes that the exchange rate is affected contemporaneously by the output, the price level, and the money supply.

3.3 Data

This study uses annual data for the real gross domestic product (GDP), real price level (CPI), real interest rates (IR), money supply (M2), and real effective exchange rate (REER) over the period 1972-2014. All data are from the International Financial Statistics (IFS). At the first run, the trends of those macroeconomic variables are presented in Figure 1.
4. RESULTS AND ANALYSIS

4.1 Descriptive Economic Conditions

After the independence, Bangladesh began to turn its attention to developing the industrialization policy. In the mid-1980s, the authorities encouraged the privatization and reinstating budgetary discipline. The government successfully followed a structural adjustment facility (ESAF) with the blessing of the International Monetary Fund from 1991 to 1993. However, failed to follow through on reforms in large part due to domestic political trouble. In the late 1990s, the government’s economic policies became more entrenched, adopting the open economic policies of the world trade organization.

Bangladesh with the highest rural population density is one of the most promising developing countries, which maintains around 6 percent GDP growth rates over the last decade despite the global financial crisis of 2008. The economy has evolved through the export-oriented industrialization. The garments industry brings the key export earnings along with the remittances, pharmaceuticals, shipbuilding, ceramics, and leather goods. GDP per capita in Bangladesh in 1970 was 107 US dollars. According to this it’s ranked 164th in the world, which became a lower-middle-income country as its per capita income rose to $1,314 by 2015. The sectoral composition of the Bangladesh economy over the past decades is presented in the following figure.

**FIGURE 2 - Sectoral Composition of Bangladesh Economy**

---

6 Also, see World Bank at http://data.worldbank.org/country/bangladesh.
Figure 2 shows that the real GDP is growing at a higher rate after 2000. It is also evident that the money supply is increasing at a higher rate since 2000 than the previous periods. Also, there is no structural break in the trends of real GDP, money supply, and real consumer price index. The real interest rates seem stable since 1990. The real effective exchange rate is decreasing, which implies the Bangladesh government is depreciating their currency to promote exports.

*Unit Root Test:* All return series are in the natural log except for the real interest rates. The ADF (Augmented Dickey-Fuller) test is applied to check whether the series are stationary or not in their level form. The money supply, price level, and interest rates are found nonstationary in level and log form. To produce a time series that is stationary in nature, the first difference is taken. The Akaike information criterion (AIC) is applied to find the optimal lag length of 3 for each of these variables. Table 1 confirms that all the variables except IR are stationary at the 1% level of significance after the first difference is taken. Note that we use the standard form of the money supply and the money demand function that is specified as a function of the inflation in level. For example, Taylor (1995) describes the U.S. monetary policy reaction function, which depends on changes in inflation, output, or other economic parameters.

<table>
<thead>
<tr>
<th>Variable</th>
<th>tau-Statistics in level</th>
<th>tau-statistics after difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP (Y)</td>
<td>0.378492</td>
<td>-5.276381(1)</td>
</tr>
<tr>
<td>Consumer Price Index (P)</td>
<td>-1.556057</td>
<td>-5.904890(1)</td>
</tr>
<tr>
<td>Real Interest Rate (IR)</td>
<td>-4.488120</td>
<td>-</td>
</tr>
<tr>
<td>Money Supply (M2)</td>
<td>-1.415144</td>
<td>-5.219159 (1)</td>
</tr>
<tr>
<td>Real Effective Exchange Rate (REER)</td>
<td>-4.069179</td>
<td>-6.265325(1)</td>
</tr>
</tbody>
</table>

4.2 Non-recursive VAR and IRF

The impulse response function (IRF) of the monetary shocks on output, price, real effective exchange rate, and the generated non-recursive SVAR is shown in figure 4.2. We can see the same trends of the IRF obtained from the recursive VAR. Table 2 demonstrates estimation results of the non-recursive model. Coefficients of the SVAR identification restrictions are
estimated using the OLS method. We present our results in Table 2. The estimated structural contemporaneous parameters support their respective equations as shown in Table 2. In particular, the parameters of the monetary policy reaction function are statistically more significant than are the other equations, indicating that innovations in IR work more efficiently than other monetary policy shocks. The significant and negative coefficient of real GDP in the money supply equation shows that the rise in IR reduces the output. The negative value of the estimated coefficient of the consumer price index reveals that the domestic price level declines when the IR increases. The positive value of the estimated coefficient of the consumer price index shows that the monetary authority increases the IR when it detects an unexpected rise in the price level, indicating that the Bangladesh Bank tightens monetary policy when it faces inflationary pressure. The coefficient of the CPI enters the output equation positively and the inflation equation negatively – circumstances that run counter to standard economic theory. However, the coefficient of CPI is not statistically significant.

**Table 2 - Estimated Contemporaneous Coefficients of SVARs: Non-recursive Model**

<table>
<thead>
<tr>
<th>Restriction</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>b_{21}</td>
<td>0.722</td>
<td>0.398</td>
<td>1.814</td>
<td>0.070</td>
</tr>
<tr>
<td>b_{31}</td>
<td>-2.258</td>
<td>0.799</td>
<td>-2.825</td>
<td>0.005</td>
</tr>
<tr>
<td>b_{51}</td>
<td>2.023</td>
<td>1.036</td>
<td>1.953</td>
<td>0.051</td>
</tr>
<tr>
<td>b_{32}</td>
<td>0.046</td>
<td>0.309</td>
<td>0.148</td>
<td>0.882</td>
</tr>
<tr>
<td>b_{52}</td>
<td>-0.565</td>
<td>0.365</td>
<td>-1.549</td>
<td>0.121</td>
</tr>
<tr>
<td>b_{41}</td>
<td>-1.377</td>
<td>7.627</td>
<td>-0.181</td>
<td>0.857</td>
</tr>
<tr>
<td>b_{53}</td>
<td>0.045</td>
<td>0.189</td>
<td>0.240</td>
<td>0.810</td>
</tr>
<tr>
<td>b_{54}</td>
<td>-0.003</td>
<td>0.004</td>
<td>-0.972</td>
<td>0.331</td>
</tr>
<tr>
<td>b_{11}</td>
<td>0.010</td>
<td>0.001</td>
<td>8.828</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{22}</td>
<td>0.024</td>
<td>0.003</td>
<td>8.831</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{33}</td>
<td>0.047</td>
<td>0.005</td>
<td>8.832</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{43}</td>
<td>2.475</td>
<td>0.280</td>
<td>8.832</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{55}</td>
<td>0.055</td>
<td>0.006</td>
<td>8.832</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Log likelihood 245.5907

The following figures explain the estimated impulse response function used to understand the dynamic reactions of internal variables to multiple domestic and foreign monetary policy shocks.
within the SVAR system. The figures describe the estimated impulse response of the variables over a 20-month period to the structural (one-standard-deviation) monetary policy shocks. In each figure, each of the two dashed lines represents the 95% confidence band.

**Figure 3 - Non-recursive Impulse Response Function**

*Note:* The above figure shows the Impulse Response Function (IRF) of the real interest rates on real effective exchange rates, real price level, and real income.

Figure 3 also shows that the monetary policy shocks have a temporary adverse effect on the real output in response to interest shock. In fact, the central bank of Bangladesh and the fiscal authorities at times may disagree on the extent of expansion or contraction of the amount of money supplied to the system. We find that the monetary policy shocks in Bangladesh trigger positive response to the price level up to three years forward, then declining slowly over time. This price response is consistent with the conventional view that the prices respond to the monetary policy as the cost of investment increases. One of the primary objectives of Bangladesh Bank is to maintain a stable price level. The IRF function is not supportive of this aim.

Monetary policy shock has a positive effect up to two years forward on the real effective exchange rates. The above relationship implies that the monetary policy shocks may cause a
depreciation of the domestic currency in the short run. However, beyond two years in future, the effect on the exchange rate is to cause a revaluation of the exchange rate provided that the policy remains in place.

4.3 Recursive VAR and IRF

The recursive VAR model is used to examine the robustness of the previous results. Equation (7) can be used to check whether the monetary policy shocks in Bangladesh is persistent with the previous results. In this case, we use the three months T-bill rates as a proxy for the interest rate. Table 3 shows our estimation results from the recursive model. The results in Table 3 present the proportion of variations in the main economic variables that can be explained by shocks to other economic variables in the equation system. Our findings suggest that apart from their shocks, much of the output variation is explained by the IR innovation and, to a lesser extent, by inflationary pressure and the U.S. IR shocks. Compared to other innovations, IR shocks seem to explain much of the consumer price variation, while less of the variation is explained by REER and aggregate monetary shocks.

<table>
<thead>
<tr>
<th>Restriction</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>b_{21}</td>
<td>-0.695</td>
<td>0.393</td>
<td>-1.767</td>
<td>0.077</td>
</tr>
<tr>
<td>b_{31}</td>
<td>2.672</td>
<td>0.738</td>
<td>3.621</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{32}</td>
<td>-0.424</td>
<td>0.292</td>
<td>-1.452</td>
<td>0.147</td>
</tr>
<tr>
<td>b_{41}</td>
<td>-2.626</td>
<td>16.735</td>
<td>-0.157</td>
<td>0.875</td>
</tr>
<tr>
<td>b_{42}</td>
<td>-104.335</td>
<td>5.875</td>
<td>-17.758</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{43}</td>
<td>-7.347</td>
<td>3.173</td>
<td>-2.316</td>
<td>0.021</td>
</tr>
<tr>
<td>b_{51}</td>
<td>0.290</td>
<td>0.982</td>
<td>0.296</td>
<td>0.768</td>
</tr>
<tr>
<td>b_{52}</td>
<td>-1.925</td>
<td>1.051</td>
<td>-1.831</td>
<td>0.067</td>
</tr>
<tr>
<td>b_{53}</td>
<td>-0.706</td>
<td>0.199</td>
<td>-3.553</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{54}</td>
<td>-0.014</td>
<td>0.010</td>
<td>-1.427</td>
<td>0.154</td>
</tr>
<tr>
<td>b_{55}</td>
<td>0.009</td>
<td>0.001</td>
<td>8.721</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{22}</td>
<td>0.022</td>
<td>0.003</td>
<td>8.717</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{33}</td>
<td>0.040</td>
<td>0.005</td>
<td>8.719</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{44}</td>
<td>0.773</td>
<td>0.089</td>
<td>8.718</td>
<td>0.000</td>
</tr>
<tr>
<td>b_{55}</td>
<td>0.045</td>
<td>0.005</td>
<td>8.718</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Log likelihood 304.5951
The impulse response function in equation (7) is shown in the following Figure 4, having the same effect derived from the recursive model.

**Figure 4 - Recursive Impulse Response Function**

- **Response to Cholesky One S.D. Innovations ± 2 S.E.**
  - Response of real GDP to interest rate
  - Response to price level to interest rate
  - Response to money supply to interest rate
  - Response to REER to interest rate

Note: This figure reveals the Impulse Response Function (IRF) of the real interest rates on real effective exchange rates, real price level, and real income.

5. **Conclusion**

This paper examines the monetary policy transmission mechanism for Bangladesh, using Structural VAR model for the period 1972-2014. This study identifies the monetary policy shocks with a non-recursive contemporaneous restriction based on the Bangladesh Bank's reaction function and her economic nature. Bangladesh monetary policy relies on the interest rate targeting. This paper finds that the monetary policy in Bangladesh is slightly effective to the dynamics of the output in the short run, albeit to its inflationary pressure in nature, that is contrary to the objective of raising short-term interest rates. About 25% people are living under
the poverty line, which may not shift to savings as interest rates increase. The empirical findings indicate that the monetary policy shocks are one of the important sources of fluctuation of Bangladesh real output and price levels. We also find that there is a trade-off between the interest rate and output in the short run. Bangladesh Bank may consider making policy decisions based on the movements of the monetary policy instruments in shaping the Bangladesh economy.

REFERENCES


