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Impact of Monetary Policy Changes in a Semi-Global Economy: Evidence from Bangladesh

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Impact of Monetary Policy Changes in a Semi-Global Economy: Evidence from Bangladesh

Sayera Younus[1]

Abstract

The study examines the impact of changes in monetary policy in Bangladesh. Specifically, the study examines the impact of domestic and foreign monetary shocks on Bangladesh's major economic aggregates. In the context of a semi-global economy such as Bangladesh, the conduct of monetary policy becomes increasingly more difficult as globalization proceeds. It becomes important to examine the impact of changes in relevant 'foreign' variables (e.g., interest rate, money supply, exchange rate) while formulating domestic monetary policy. The empirical results of the present analysis show that innovations to foreign money supply have significant impacts on Bangladesh's real exchange rate, interest rate, and output. However, foreign money supply does not create much impact on Bangladesh's money supply or price level. The results also indicate that innovations to Bangladesh's money supply have significant impact on Bangladesh's interest rate, price level, and output.

Key Words: Monetary Policy, Macroeconomic Variables.
JEL Classification: E52, E63

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Impact of Monetary Policy Changes in a Semi-Global Economy: Evidence from Bangladesh

I. Introduction

In the context of growing openness of the domestic economy and increasing integration with the rest of the world, global economic and financial developments today make monetary policy decisions more complex than it was before. This paper aims to identify the impact of monetary policy changes resulting from both internal and external sources to assist in formulating sound monetary policy and increasing the resilience of the domestic economy to cope with changing global environment. Such considerations are important for a small open economy like Bangladesh which is extremely vulnerable to external factors including policy changes abroad.

There are three important factors that determine the extent to which a domestic economy can become vulnerable to foreign shocks e.g., the degree of integration of financial and goods markets, the relative size of the economy, and the exchange rate regime. In this context, Parry (1998) concludes that "....*greater integration of financial and goods markets has increasingly subjected domestic economies to the effects of changes in economic conditions abroad and has importantly affected the monetary policy transmission mechanism. However, these developments do not imply that domestic monetary policy is necessarily less effective...*".

In this backdrop, the study examines the impact of both domestic and foreign monetary policy changes on Bangladesh's economic aggregates. In this paper, India's money supply is used as the measure of foreign monetary policy change. The rationale for using India's money supply rests on possible contagious cross boarder effects. India's economy is large relative to that of Bangladesh and Bangladesh shares most of its border with India; India also is one of our major trading partners. Therefore contagious effect through border and trade can have significant impact on domestic macroeconomic variables particularly inflation and output.

The paper is organized as follows. The introduction of this section is followed by a review of the relevant literature in section II. In section III, Bangladesh's trade pattern covering major trading partners is analyzed. Section IV provides a comparative view of the monetary policies pursued by Bangladesh and India. Methodological considerations,, model variables and empirical results are discussed in section V while section VI provides the conclusions.

II. A Brief Review of the Literature

To understand the impact of monetary policy, one should examine the interdependence among policy and target variables. Two strands of literature are relevant. First, the literature that discusses the relationship among domestic money, the price level, interest rate, exchange rate and output. Second, the literature that deals with the impact of foreign monetary policy on the domestic macroeconomic variables. An increased degree of globalization plays an important role in transmitting economic shocks from a large country to a small country. In our study, Bangladesh is a small country relative to India.

Many studies have examined the relationship between monetary policy effectiveness and macroeconomic variables in developed countries. Examples of these studies include Bernanke and Blinder (1992), Friedman and Kuttner (1992), Leeper, Sims and Zha (1996), McCandless and Weber (1995), and Sims (1992).

Relatively few studies have examined the relationship between domestic monetary policy and macroeconomic variables in developing countries such as Bangladesh. Studies that do examine monetary effectiveness in Bangladesh include Parikh and Starmer (1988), Hossain (1996), and Ahmed (2002-03).

Using monthly data on the cost of living index of Dhaka middle-class families (P) and money supply (M1), Parikh and Starmer (1988) examine the impact of M1 on P during the period 1975:2 to 1986:4. Parikh and Starmer's (1988) results show that causality in Bangladesh runs from P to M1 and not from M1 to P. The results remain robust when M2 is used in place of M1 and the growth rate of the money supply and inflation are used in place of M1 and P.

Hossain (1996) uses data from 1973-1989 to examine the causal relationship between two definitions of money (M1 and M2) growth and wholesale price index inflation in Bangladesh. Hossain (1996) finds unidirectional causality running from M2 to WPI, but not from M1 to WPI. Unlike Parikh and Starmer (1988), Hossain (1996) does not find evidence of causality running from price level to money. Hossain's (1996) cointegration tests show that there are long-run equilibrium relationships between M1and WPI and M1 and WPI.

Ahmed (2002-03) examines the causal relationships between money, output, interest rates, and price level using quarterly data from Bangladesh, India, and Pakistan. Ahmed's results are based on Granger causality tests. For the period 1974:2 – 1998:4 Ahmed finds that changes in Bangladesh's broad money supply (M_2) do not lead to changes in Bangladesh's output, interest rate, or price level. However, output, the interest rate, and the price level each Granger cause M2.

Based on these studies, we cannot reach a conclusion regarding the relationship between money growth and inflation in Bangladesh. Ahmed (2002-03) and Parikh and Starmer (1988) find unidirectional causality from prices to money, while Hossain (1996) finds unidirectional causality from money growth to inflation. It is important to note that each of these studies suffers from omitted variables. The studies exclude potentially important variables including the exchange rate and

foreign variables.[2] Furthermore, Parikh and Starmer (1988) and Hossain (1996) base their results on bivariate causality tests.

Increased globalization plays an important role in transmitting economic shocks between countries. As stated by Fumio (1994), policy coordination between foreign and domestic variables during the 1980s became very important due to growing interdependence among nations. As international interdependence grows, changes in foreign economic policies exert greater influence on domestic economies. As a result, the ability of domestic policymakers to control the domestic economy declines. To measure effectiveness of domestic policy, it is necessary to consider the actions of foreign policymakers.

Many studies examine the impact of foreign monetary shocks on macroeconomic variables in developed countries. Examples include Amuedo-Dorantes and Wheeler (2001), Cushman and Zha (1997), Mixon, Pratt, and Wallace (1979), Selvor and Round (1996), and Sheehan (1992). In general, the literature on foreign monetary policy and domestic macroeconomic variables shows that U.S. monetary policy has a significant positive impact on macroeconomic variables in other developed countries. However, results vary across exchange rate regimes.

Relatively few studies have examined the impact of foreign monetary shocks on macroeconomic variables in developing countries, and none of the existing studies use data from Bangladesh. Farrell (1980) examines the impact of U.S. monetary policy on Mexico's monetary policy. Hoffmaister, Roldos and Wickman (1997) examine whether the external sector has an impact on macroeconomic variables in Sub-Saharan African countries.

Farrell (1980) shows that the U.S. monetary base has a significant impact on Mexico's monetary base, while the impact of the U.S. monetary base on the interest rate differential and inflation differential are not significant. Farrell (1980) suggests that Mexico's policy makers should keep an eye on the direction of U.S. money supply, rather than U.S. prices, while attempting to evaluate the impact of their own money supply.

Hoffmaister, Roldos and Wickman (1997) examine the sources of macroeconomic fluctuations in Sub-Saharan African countries. They divide the countries into CFA franc countries (where exchange rates are pegged with the French franc) and non-CFA franc countries (where exchange rates can adjust frequently).

Hoffmaister, Roldos and Wickman (1997) examine whether differences in macroeconomic fluctuations between CFA franc and non-franc countries are due to domestic shocks or external shocks. Variance decompositions and impulse response functions, derived from a five-variable SVAR, show that the main source of output fluctuations in Sub-Saharan African countries is domestic supply shocks. External shocks also have some impact on the domestic output, prices and the real exchange rate. The impacts are greater in CFA franc countries than in non-CFA franc countries.

[2] The results of Parikh and Starmer (1988) differ from those of Hossain (1996) in part due to differences in the specification of the inflation variable. Hossain (1996) uses the wholesale price index, while Parikh and Starmer (1988) use a consumer price index for Dhaka middle-income families.

The above studies suggest that foreign monetary policy may have a strong impact on the domestic economy of developing countries. Evidence shows that Mexican monetary policy is strongly influenced by the U.S. monetary policy. Studies based on Sub-Saharan African countries show that external shocks also have an impact on output and the price level.

III. Trade Pattern of Bangladesh

Bangladesh's direction of trade to major trading partners is shown in Table 1. In 2007, Bangladesh trade deficit with China was the highest followed by India, Singapore, Hong Kong and Japan and while Bangladesh enjoyed trade surplus with Unites States and Germany. The destination wise pattern of imports under cash during FY07 revealed that the People's Republic of China topped the list of suppliers. The major items imported from China were cotton (all types), cotton yarn/thread, cotton fabrics, boilers, machinery and mechanical appliances, electrical machinery etc. India is the second largest supplier followed by Singapore, Hong Kong and Japan. The main imported item from India were cotton (all types), cotton yarn/thread and cotton fabrics, cereals, mineral fuels, mineral oils, boilers, machinery and mechanical appliances etc. On the other hand, the USA was the most prominent buyer followed by Germany, United Kingdom and France. The major export items were readymade garments, fish, shrimps and prawns, jute manufactures, leather and leather manufactures etc. Analyses of trade pattern reveal that Bangladesh imports similar products from all major importing countries while the cost of imports varies over countries. India is the nearest neighbor; therefore, imports from India give the opportunity to import at low cost contributing to further economic integration.

Table 1: Bangladesh Trade Balance with Major Trading Partners in 2007

	TW (avg. of FY00 and FY 01)	Export (million US$)	Import (million US$)	Trade balance (million US$)
China	0.0699	87.84	2771.64	-2683.80
India	0.1734	209.71	2646.58	-2436.87
Singapore	0.0850	50.08	1137.49	-1087.41
USA	0.2155	2930.68	470.41	2460.27
Hong Kong	0.0598	113.33	769.05	-655.72
Japan	0.0906	114.45	653.84	-539.39
Germany	*	1648.1	413.68	1234.42

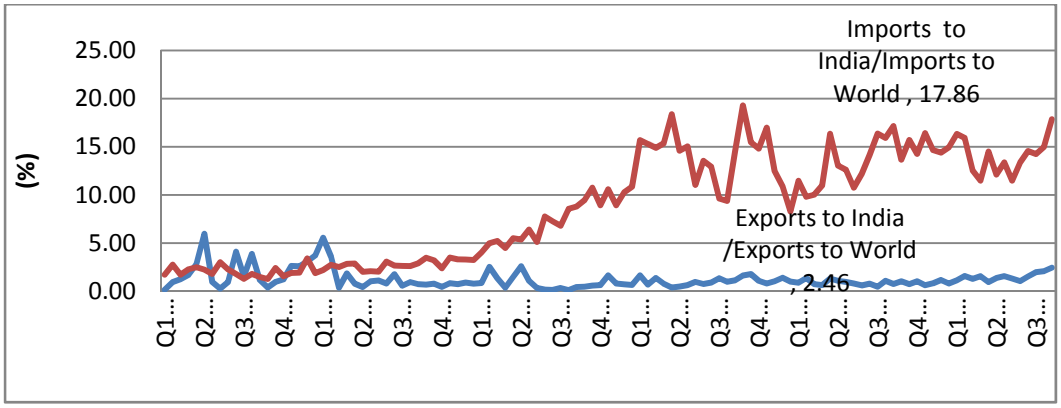
TW=Trade weight

*Trade Weight for Germany alone is not available while trade weight for total Euro area is 0.2318

Source: *Direction of Trade Statistics*, YEARBOOK 2008, IMF.

From Figure 1 it is evident that since 1990 Bangladesh's imports from India increased significantly from 4.02 percent to 17.86 percent in 2008 while export increased moderately from 0.85 percent to 2.46 percent over the same period.

Figure 1: Trends in Bangladesh's' Export and Import



Source: *Direction of Trade Statistics, 2008,* IMF publication.

It is possible that the Bangladesh economy is vulnerable to shocks from each of the major trading partners which may transmit through either the level of integration or relative size of the economy or the exchange rate policies. Since Bangladesh's capital accounts are not fully open, trade can play an important role to transmit the shocks to the domestic economy. In this paper, we use Indian money supply as a foreign variable because India is large relative to Bangladesh and the level of integration through trade is strong. The study may be extended in future to incorporate other major trading partners as well.

Figure 2: Taka/Rupee Exchange Rate

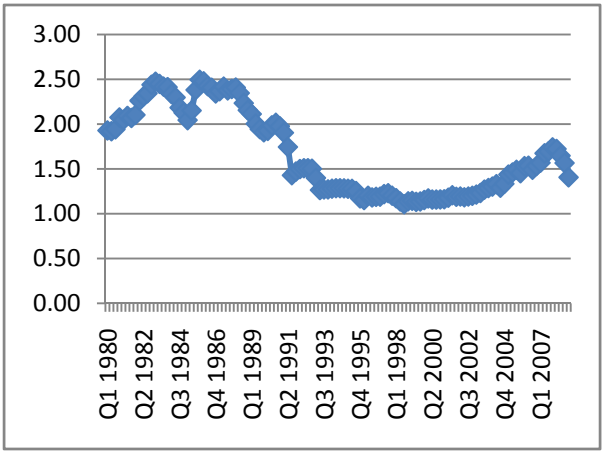
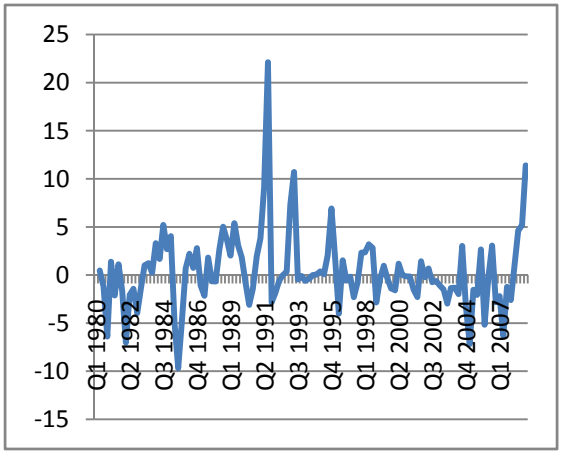


Figure 3: Appreciation (+)/Depreciation (-) of Taka against Indian Rupee



Source: International Financial Statistics, IMF, 2008.

In a small open economy like Bangladesh, the exchange rate plays an important role in affecting macroeconomic variables. In order to reduce balance of payment deficits, Bangladesh devalued its currency several times from 1972 to 2002.[3] Therefore, besides domestic and foreign money supply, this paper uses real exchange rate between Bangladesh's Taka and the Indian Rupee to see whether depreciation/appreciation of the exchange rate between Taka and Indian Rupee had any significant impact on domestic output. Figure 2 shows the trend of Taka/Rupee exchange rate while Figure 3 shows the rate of appreciation and depreciation Taka vis-a-vis Indian Rupee. The figures reveal that Taka lost competitiveness in the 1990s due to 22 percent appreciation of Taka against Rupee in Q3 1991 and further in 1993. During 2008, Taka per Indian rupee appreciated from 0.99 percent in Q1 2008 to 11.38 percent in Q4 2008.

During the 1990s, Taka remained relatively expensive to Rupee which among others helped to increase imports from India because Bangladeshi consumers enjoyed lower prices of imported products compared with domestic products. Given the potential key role of the interest rate in monetary transmission mechanism, the model also includes a domestic (Bangladesh) interest rate because after the FSRP in the 1990s liberalization of interest rates was a prime area where reforms took place.

However, the perceived benefits and costs of economic integration of a country with a larger country have to be seen in the context of the economy's resilience to possible shocks within the open economy framework and the quality of its macroeconomic framework and institutions. Hence, we examine the impact of India's money supply on Bangladesh's money supply to see whether India's monetary policy has any influence on Bangladesh's money supply, interest rate, price level, and output.

IV. Monetary Policy in Bangladesh and India

Monetary Policy in Bangladesh[4]

Bangladesh gained independence in 1971. The country went through a turbulent period of economic and political crisis during 1974-1975. This was in the midst of a historically high inflation of about 40 percent per annum during 1972-1975. Available studies suggest that the main source of high inflation of the period was excessive money supply growth in a war-ravaged economy (Hossain, 1995, 2000).

On the economic front, there was a modest breakthrough during the mid-1980s. The economy started to grow at a steady pace of about 4.5 percent per annum (Hossain, 1995, 1996). Data for the past few years show that the economy has moved to an upward growth path of about 6 percent per annum. Therefore the 1980s and the 1990s represent a phase of moderate inflation and a relatively high economic growth.

[3] With effect from May 31, 2003 Bangladesh entered a regime of floating exchange rate where the exchange rate is determined through demand and supply of the currency

[4] Source: Unpublished review on Monetary Policy, 2004.

On the financial front, the Bangladesh Bank is responsible for formulation and implementation of the country's monetary policy. According to the Bangladesh Bank Order of 1972, the aim of monetary policy is "to support highest sustainable output along with reasonable price stability". The major instruments that are presently used are: Bank Rate, Cash Reserve Requirement, Statutory Liquidity Requirement and Open Market Operation, and Repo and Reverse Repo Operation. Bangladesh Bank sets target of growth of broad money (M2) keeping in view the expected growth of real income, permissible rate of inflation and the change in income velocity of money.

During the period of 1970s and 1980s, the yearly average growth rate of broad money was recorded at 17.70 percent and 21.59 percent respectively. This steep rise in money supply was backed by sectoral credit policy and easy refinances facility of the monetary authority. Throughout the 1970s and 1980s, both selective and quantitative credit control measures were adopted to provide adequate credit to the state owned enterprises and other priority sectors to achieve the government's development objectives at the cost of inflation. Average inflation in 1970s was 16.76 percent, which went down to 10.18 percent in the 1980s. Since the adoption of the Financial Sector Reform Program in 1990, the policy stance shifted toward indirect control. The growth of broad money was to be maintained at levels consistent with real output growth and stable, moderate inflation using indirect monetary instruments. Money supply registered a lower yearly average growth of 12.90 percent in the 1990s. The yearly average inflation declined to 5.69 percent during the same period. However, broad money grew at a comparatively higher rate of 15.11 percent during 2001-2003. Inflation did not increase due to increase in GDP. During 2001-2003, GDP increased by 5.01 percent compared to 4.81 percent in the 1990s. Average inflation further declined to 3.04 percent.

A market based floating exchange rate system was introduced in Bangladesh from May 31, 2003. This is expected to bring adjustment of the exchange rate to changing market and economic conditions. Prior to its floatation, the Taka was pegged to a basket of hard currencies and the exchange rate was adjusted occasionally depending on the trend of appreciation of the real exchange rate of Taka, originating from a relatively high rate of inflation in Bangladesh vis-à-vis its trading partners. The switch of the exchange rate regime from the pegged to a floating one took place in an environment of balanced economic fundamentals. The Taka remained relatively stable after the float. Thus, despite some concern, the transition turned out to be smooth. The dealers in the market have now adjusted to the new environment. With the floatation of the exchange rate, the monetary authorities have gained greater control over monetary instruments.

Bangladesh is practicing monetary targeting since her independence in 1972 under different exchange rate regimes. Prior to 1990, the policy was based on direct control of various instruments, such as volume and direction of credit and interest rates. Since the adoption of Financial Sector Reform Program in 1990, the policy stance has shifted toward indirect control.

Until 1990, the deposit and lending rates were administered interest rates. During that period, interest rates were revised rarely to adjust to inflation. However, in order to introduce market based interest rate system, a new interest rate policy was put in place in early 1990. Under this policy, banks were allowed to determine their interest rates for both deposit and lending. Initially Bangladesh Bank used to prescribe the interest rate bands for different categories of lending. And the banks were allowed to move freely within the bands. Gradually the interest rate bands for lending were widened and ultimately withdrawn in April 1992, except three priority sectors (agriculture, export and small and cottage industries). Interest rate bands for lending to agriculture and small and cottage industries were lifted in August 1999. Still there is interest rate ceiling for export loans. Floors on deposits, were in force until February 1996, thereafter they were withdrawn.

Though Cash Reserve Requirements and/or Statutory Liquidity Requirements are direct in nature, these are being used as effective instrument from the beginning. Banks were required to maintain 5 percent of their total time and demand deposits as cash reserve requirement and 25 percent of time and demand deposits as statutory liquidity ratio until mid 1980s. In1987, cash reserve requirement was raised to 10 percent and continued until 1990. Thereafter prescribed liquidity ratio of scheduled banks was gradually reduced to 20 percent of which 5 percent was the cash reserve requirement. The cash reserve requirement was lowered to 4 percent in late 1999. In view of injecting more liquidity in the economy, however, the liquidity ratio was further reduced to 16 percent effective from November 2003, leaving cash reserve requirement unchanged at 4 percent. However, in the face of upward inflation in the domestic economy, the CRR was raised to 5 percent with effect from March 01, 2005 and SLR from 16 percent to 18 percent on October 1, 2005.

Open market operation as policy instrument was not much effective until 1990. In 1990, Bangladesh Bank introduced its own security called “90-Day Bangladesh Bank Bill”. Later “30-Day Bangladesh Bank Bill” was also introduced in 1995. Until 1997, Bangladesh Bank Bills were bought and sold through auctions as a part of its open market operation. The process of auction through market based interest rates was also extended to government treasury bills from early 1990s. In 1997, auction of Bangladesh Bank Bills was discontinued and government treasury bills are being used as instruments for open market operation since then.

Repurchase Agreement (Repo) and reverse Repo were introduced for banks and financial institutions as indirect monetary policy tools for day-to-day liquidity management in response to temporary and unexpected disturbances in the supply and demand for money. Repo auction enables banks to place bids for funds collateralized by treasury bills. The Bangladesh Bank accepts the bids to the extent needed to maintain the intended level of market liquidity. Reverse Repo auction is the counterpart of Repo auction, in which the banks submit offers of their excess funds, which the Bangladesh Bank accepts to the extent needed to maintain the intended level of liquidity. The inflow of liquidity with Repo operations helps in easing seasonal volatility in the call money rate and stabilize the money market. To encourage and facilitate inter-bank Repo operations with same day recording of the transfers of securities, steps, such as the introduction of primary dealership system, were taken to activate the secondary market for government treasury bills/bonds. To establish a

high-tech standard transaction mechanism for various government bills/bonds in primary and secondary markets, an on-line system has been put in place since October 20, 2003.

Monetary Policy in India

Like other developing countries, the broad objectives of monetary policy in India are to maintain a reasonable degree of price stability and to help to accelerate the rate of economic growth. The relative emphasis placed on price stability and economic growth is changed according to the circumstances prevailing at a particular point in time, clarified from time to time in the policy statements of the Reserve Bank (Reddy, 2007). The monetary and credit policy is the policy statement traditionally announced twice a year. There are four main channels which the Reserve Bank of India looks at: (a) quantum channel: money supply and credit (affects real output and price level through changes in reserve money, money supply and credit aggregates) (b) interest rate channel (c) exchange rate channel and (d) asset price channel.

The Indian economy has emerged as a high-growth economy with the average growth rate of 8.6 percent per annum during FY05 to FY07 where in the last two years the growth rate has averaged 9.1 percent. The average growth rate of the Indian economy over a period of 25 years since FY81 (India's fiscal year is from 1 April to 31 March) has been about 6.0 percent, which is a significant improvement over the annual growth rate of 3.5 per cent over the previous three decades of FY51 to FY80 (Reddy, 2007). Macroeconomic and financial stability together with domestic consumption, investment and export demand are also contributing factors behind higher growth in India. The strengthening of economic activity has been supported by persistent increase in domestic investment rate from 22.9 per cent of GDP in 2001-02 to 33.8 per cent in 2005-06 coupled with an efficient use of capital. Domestic saving rate has also improved from 23.5 per cent to 32.4 per cent during the same period due to improvements in both public and private corporate saving (Annual Report, RBI, FY07).

During last one and a half year, the Indian economy has also gone through a lot of changes. Among the changes, increasing openness of the Indian economy plays an important role in achieving higher growth. During this period, India's economic relationship with the rest of Asia was built up through sustained expansion in trade and financial relationships. The share of exports to developing Asia in India's total exports more than doubled from 14 per cent in 1990-91 to almost 30 per cent in 2005-06. The corresponding share of the region in India's imports also increased from 14 per cent to 21 per cent during this period (Mohan 2006).

Monetary policy framework has also gone through a lot of significant changes. For example, the broad money (M3) was used as the nominal anchor from the mid-1980s based on the assumption of a stable relationship between money, output and prices which was changed in the late 1990s due to ongoing financial openness together with increasing evidence of changes in underlying transmission mechanism.

The Reserve Bank, formally adopted a multiple indicator approach in April 1998 where interest rates or rates of return in different financial markets along with data on currency, credit, trade, capital flows, fiscal position, inflation, exchange rate, etc., are put side by side with the output data for drawing policy perspectives (Reddy, 2007). Such a shift implemented gradually over the reform period since the early 1990s enabled the economy to gain required flexibility to respond to changes in domestic and international economic environment and financial market conditions more effectively.

In the changing process, reliance on direct instruments was reduced greatly and a policy preference for indirect instruments became the basis of monetary policy operations. In so doing, the Reserve Bank pursues, *inter alia,* a policy of active liquidity management through open market operations (OMO) and daily reverse repo and repo operations under a Liquidity Adjustment Facility (LAF), Market Stabilization Scheme (MSS) and cash reserve ratio (CRR), and uses the mix policy instruments flexibly as necessary for the situation. However, the traditional emphasis on the use of broad money as an intermediate target has been de-emphasized although the growth in broad money (M3) continues to be used as important indicators. Since 1998-1999, the Reserve Bank of India has been adopting a multiple indicators approach in its monetary policy.

Some of the important changes in monetary policy framework and operating procedures in India during the 1990s include de-linking of budget deficit from its automatic monetization by the Reserve Bank, deregulation of interest rates, and development of the financial markets with reduced segmentation through better linkages and development of appropriate trading, payments and settlement systems along with technological infrastructure (Reddy, 2007). In addition, improved monetary and fiscal coordination helped inflation outcome to come down significantly during the second half of the 1990s.The inflation rate declined from an average of 11.0 per cent during 1990-95 to 5.3 per cent during the second half of the 1990s. Lately, despite sustained external capital inflows and continued surge in fuel and food prices in the domestic and external market during 2005-06, the average headline inflation rate remained at about 4.5 percent and inflation expectations remained well contained despite continued dominance of adverse supply-side factors due mainly to more focused macroeconomic and monetary management and increasing trade openness. The headline inflation, as measured by the Wholesale Price Index (WPI), was 5.5 percent during January-March 2008, which was 6.7 percent during the same period preceding year.

This study examines the impact of monetary shocks on Bangladesh. In doing so, we examined the impacts of both domestic and foreign monetary policy on Bangladesh's economic aggregates. Because Bangladesh Bank uses M2 as an intermediate target, we use M2 as our measure of monetary policy shocks. For purposes of comparison, we use India's M2 as our measure of foreign monetary shocks. We examine the impact of domestic and foreign monetary shocks on domestic output (industrial production), the price level (CPI), interest rate (lending rate), and the real exchange rate. India's money supply is used as a measure of foreign monetary policy.[5]

V. Methodology, Estimation, and Empirical Results

A near vector autoregressive (NVAR) model is an appropriate econometric technique when we are interested in dynamic relationships among variables in presence of different explanatory variables (Enders, 1995). Based on the assumption that India is a large country relative to Bangladesh, NVAR is estimated. The NVAR contains five variables from Bangladesh and one variable from India. The five equations for the Bangladesh variables are standard VAR equations. That is, in these equations, all model variables enter each equation. Because India is assumed to be a large country relative to Bangladesh, the equation for MI contains lagged values of MI only. Bangladesh variables are not allowed to have an impact on India's money supply.[6]

The NVAR is used to derive VDCs. The VDCs show the portion of the forecast error variance in each variable due to innovations to all system variables. Our concern is with the portion of forecast error variance in LR, CPI, Y, and RER explained by the change in India's monetary (MI) and Bangladesh's monetary policy (MB). If MI explains a significant portion of the forecast error variance in domestic variables, then foreign money has a significant impact on the domestic economy. If MB explains a significant portion of the forecast error variance in domestic variables, then domestic money has a significant impact on the domestic economy.

Akaike's AIC is used to determine the optimal lag length for the NVAR; the maximum lag length examined is eight quarters. As Enders (1995) notes, in the case of an NVAR, seemingly unrelated regression (SUR) estimation provides efficient estimates. Hence, our model is estimated with iterative SUR. The AIC reaches a minimum at lag eight. Q-statistics provide evidence that lag 8 is adequate; Q-statistics indicate that the residuals from each NVAR equation are white noise.[7]

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[5] India's economy is large relative to Bangladesh's, and Bangladesh shares most of its border with India. Hence, we examine the impact of India's money supply on Bangladesh's money supply. We also examine the impact of India's money supply on the real exchange rate and Bangladesh's money supply, interest rate, price level, and output.

[6] A series of Granger-causality tests confirms that Bangladesh variables do not have significant impacts on the Indian money supply.

[7] With one exception, major policy implications are unchanged when the NVAR lag length is arbitrarily set at four. When the lag length is set at 8, as the AIC suggests, the VDCs indicate that shocks to MI explain a significant portion of the forecast error variance in Y. When the NVAR lag

To estimate VDCs, orthogonal residuals are required. We use a Cholesky decomposition to orthogonalize the residuals. A Cholesky decomposition requires the variables to be ordered in a particular way. Due to cross-equation residual correlation, when a variable higher in the ordering changes, all the variables lower in the ordering are assumed to change. That is, variables placed higher in the ordering are assumed to have a contemporaneous impact on variables lower in the ordering. Variables lower in the ordering do not have a contemporaneous impact on variables higher in the ordering.

The Cholesky ordering used in this paper is: MI, RER, MB, LR, CPI, Y.[8] This ordering implies that the MI innovation is contemporaneously exogenous. MI has a contemporaneous effect on other model variables, but the other model variables have no contemporaneous impact on MI. This is consistent with the assumption that India is a large country relative to Bangladesh. The exchange rate is placed second in the ordering because, in a small open economy, a shock to foreign money will transmit to the domestic economy through the exchange rate. MB is the Bangladesh Bank's policy variable. Because of this, MB is placed third in the ordering. The simple Keynesian view of monetary policy indicates that shocks to the money supply are transmitted to prices and output through the interest rate. Hence, we place the lending rate (LR) above the CPI and Y in the ordering.[9] We assume that prices are sticky with respect to changes in output—at least in the current period. Because of this, we place CPI above Y in the ordering. This allows changes in the price level to have a contemporaneous impact on output. However, output does not have a contemporaneous impact on the price level.

Model Variables

Bangladesh switched from a fixed exchange rate to a floating exchange rate regime in May 2003. Because of this, our sample period covers 1976:1 to 2002:4; quarterly data.[10] To examine the dynamic relationships among foreign money, domestic money, the exchange rate, the interest rate, the price level and output, a six-variable NVAR model is estimated.[11] The variables used in the model are:

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length is reduced to 4, shocks to MI do not explain a significant portion of the forecast error variance in Y. In is important to note that when the NVAR lag length is reduced to 4, the NVAR's Y equation does not produce white noise errors.

[8] The model has also been estimated where RER and MB are switched in the ordering. Policy conclusions are unchanged with this change in the ordering.

[9] Efficient market arguments would place LR last in the ordering. Policy conclusions are unchanged by this change in the ordering.

[10]Extending the estimation period to 2006:2 produces similar results to those obtained from the sample period that ends in 2002:4. This result is not surprising. Bangladesh devalued its currency approximately 120 times between 1972 and 2001. In some sense, Bangladesh did not have a fixed exchange rate regime prior to May 2003.

[11]Following Bernanke, Gertler, and Watson (1997), Cushman and Zha (1997), McMillin (1996), and Sims (1992), we have chosen to estimate our NVAR with the variables in levels (LR) and log levels

MI=log of India's real money supply (M2);
MB= log of Bangladesh's real money supply (M2); [12]
LR= Bangladesh's lending rate on commercial bank loans;
CPI=log of Bangladesh's consumer price index;[13]
Y= log of Bangladesh's real output measured by industrial production.
RER= log of real exchange rate.[14]
Seasonally adjusted data are used for all the variables with the exception of interest rate. A description of the variables is given in detail in the data appendix.[15]

Empirical Results

The empirical results are contained in the VDCs which are reported in Table 2. The estimates of the forecast error variance are considered significant if the point estimate is at least two times as large as its standard error. Five thousand bootstrap simulations are used to construct the standard errors. Because MI is assumed to have exogenous influence on Bangladesh, we report the VDCs for Bangladesh variables only.

The results in Table 2 show that shocks to MI have significant impacts on the real exchange rate (RER), the domestic money supply, and output. At longer time horizons, shocks to MI explain over 45 per cent of the forecast error variance in both LR and Y. Hence, shocks to MI have significant impacts on Bangladesh's domestic economy.

The results in Table 2 also show that innovations to MI explain significant portions of the forecast error variance in RER at all time horizons. In fact, innovations to MI explain over 85 per cent of the forecast error variance in RER at each time horizon, while innovations in MB explain less than 4 per cent of the forecast error variance in RER at each time horizon.

Further analysis of Table 2 shows that innovations to MI explain significant portions of the forecast error variance in LR and Y. At longer time horizons, innovations to MI explain almost 50 per cent of the forecast error variance in LR, while innovations to MB explain at most 13.4 per cent of the forecast error variance in LR. This result has important implications for monetary policy in Bangladesh. Shocks to India's money supply have much larger impacts on interest rates in Bangladesh than do shocks to Bangladesh's own money supply.

(MI, MB, CPI, Y, RER). Sims, Stock, and Watson (1990) discuss the appropriateness of estimating models in levels.

[12] A model has also been estimated with M1 in place of M2 for both India and Bangladesh. Policy implications with respect to the impact on MI and MB on other model variables are unchanged when M1 is used in place of M2.

[13] Data on the wholesale price index for Bangladesh is available on annual basis only.

[14] We use the real exchange rate as a channel through which foreign monetary policy transmits to the domestic economy. Adding a trade volume variable to the model might also be useful.

[15] A fiscal variable, such as the government budget deficit, might also be an informative model variable. However, quarterly data on the government budget deficit are not available.

Table 2

Variance Decomposition of Bangladesh Variables

Real Exchange Rate (RER)

Horizon	MI	RER	MB	LR	CPI	Y
4	85.2* (4.5)	11.8 (3.3)*	0.7 (0.7)	1.7 (1.0)	0.2 (0.4)	0.3 (0.5)
8	88.3* (4.5)	6.7 (2.4)*	2.7 (1.6)	1.7 (1.0)	0.4 (0.5)	0.2 (0.4)
12	87.1* (5.8)	5.3 (2.2)	3.1 (1.9)	2.7 (1.6)	1.2 (1.0)	0.7 (0.7)
16	87.0* (6.2)	5.1 (2.2)	3.1 (2.0)	2.8 (1.8)	1.2 (1.1)	0.8 (0.9)

Real Money (MB)

Horizon	MI	RER	MB	LR	CPI	Y
4	8.7 (15.6)	2.1 (4.1)	83.4 (14.8)*	0.7 (2.2)	3.3 (3.5)	1.8 (3.3)
8	6.0 (15.5)	3.9 (5.3)	71.6 (14.2)*	0.6 (4.2)	11.9 (6.6)	5.9 (5.7)
12	13.6 (17.2)	5.9 (5.2)	60.1 (13.5)*	0.5 (4.8)	10.8 (5.5)	9.1 (5.7)
16	24.2 (19.1)	5.3 (4.7)	48.1 (12.9)*	0.6 (4.8)	8.9 (5.1)	12.9 (5.7)*

Lending Rate (LR)

Horizon	MI	RER	MB	LR	CPI	Y
4	4.9 (12.5)	3.0 (4.4)	3.1 (5.0)	76.5 (13.8)*	10.8 (8.0)	1.7 (3.1)
8	43.5 (19.1)*	1.6 (3.3)	2.8 (3.6)	43.7 (14.0)*	7.1 (4.8)	1.3 (2.8)
12	48.0 (18.9)*	1.8 (3.6)	7.2 (4.9)	34.1 (12.1)*	6.8(4.3)	2.1 (3.3)
16	47.3 (18.5)*	1.5 (3.5)	13.4 (6.7)*	27.0 (10.7)*	8.7 (4.5)	2.1 (3.2)

Price Level (CPI)

Horizon	MI	RER	MB	LR	CPI	Y
4	2.6 (10.4)	14.1 (7.2)	32.1 (10.5)*	10.2 (7.2)	39.6 (9.3)*	1.5 (2.4)
8	2.6 (13.8)	9.9 (5.9)	31.0 (9.7)*	10.8 (6.9)	43.6 (10.3)*	2.0 (3.3)
12	7.6 (16.7)	8.9 (5.3)	29.8 (8.9)*	10.7 (6.2)	40.5 (9.6)*	2.4 (3.4)
16	16.7 (18.2)	7.9 (4.8)	26.0 (8.0)*	10.4 (5.8)	36.7 (8.9)*	2.2 (3.1)

Output (Y)

Horizon	MI	RER	MB	LR	CPI	Y
4	16.4 (15.3)	5.9 (4.5)	13.5 (7.8)	3.0 (3.8)	6.6 (4.5)	54.7 (11.3)*
8	33.1 (15.5)*	5.6 (3.8)	12.7 (6.3)*	1.9 (2.9)	5.1 (3.5)	41.6 (9.2)*
12	45.3 (16.0)*	6.3 (3.8)	10.4 (6.0)	1.5 (2.7)	5.3 (3.3)	31.2 (8.2)*
16	56.3 (16.2)*	5.3 (3.6)	7.5 (5.5)	1.6 (2.8)	4.4 (3.1)	24.9 (7.9)*

Note: The entry in each cell represents the point estimate for the percentage of the forecast error variance in a given Bangladesh variable explained by innovations to the indicated variable. Standard errors are in parentheses. Point estimates are considered significant if they are twice as large as the standard error. * indicates significance of the point estimate.

The lower portion of Table 2 shows VDCs for output in Bangladesh. These VDCs show that, at longer time horizons, innovations to MI explain over around 50 per cent of the forecast error variance in Y. In contract, innovations to MB explain at most 13.5 per cent of the forecast error variance in Y.

Table 2 also reveals that innovations to MB explain significant portions of the forecast error variance in Bangladesh's CPI and MB itself. The shocks to MB are particularly important in explaining the forecast error variance in CPI. Regardless of the time horizon, shocks to MB explain over 25 per cent of the forecast error variance in CPI. This amount is significant at each time horizon.

Shocks to MB also explain over 25 per cent of the forecast error variance in MB at each time horizon. It is interesting to note that, although shocks to MI explain

significant portions of the forecast error variance in LR at each time horizon, shocks to MI never explain significant portions of the forecast error variance in MB.[16] That is, shocks to India's money supply have significant impacts on Bangladesh's interest rate, but not Bangladesh's money supply.

VI. Conclusions

In this paper, we have examined the impact of monetary shocks on economic aggregates in Bangladesh. Specifically, the impact of monetary shocks in altering key macroeconomic variables such as the interest rate, price level, exchange rate and output was examined. Since the impact of both domestic monetary shocks and foreign monetary shocks was examined, the Indian money supply was used as the measure of foreign monetary shocks.

Our results indicate that domestic (MB) monetary shocks have significant impacts on domestic variables. Perhaps more importantly, our results indicate that shocks to MB have significant impacts on domestic price level (CPI) and domestic income (Y). Our results also show that shocks to MB have significant impacts on LR at longer time horizons. Our results also show that shocks to MB have significant impact on CPI. This is not the case of MI. Shocks to MI do not appear to have an influence on CPI.

The results also show that shocks to Indian money supply (MI) have important impact on Bangladesh's domestic variables. Specifically, shocks to MI have significant impacts on the real exchange rate (RER). In this paper, we used Taka/Rupee exchange rate which works in favor of India which increased India's export to Bangladesh. The VDCs show that shocks to MI have larger impacts on Y than shocks to MB which also make sense due to higher degree of integration in terms of goods and services and cross border effect and favorable exchange rate policy of India.

The results are not surprising in the context of an integrated world economy. In this regard, the results of the study by Ozdemir (2008) may be cited which conclude that the indirect effects originating from a trade partner are found to have significant impact on a small open economy more than equal sized shocks coming from non-partner countries. The partner country's indirect effect is found to be mitigated by participating in a monetary policy coordination regime. Therefore, in order to avoid contagion effect originating from trade partner countries, Bangladesh should start persuading coordinated monetary policy.

[16] At the 16 quarter time horizon, the point estimate for the amount of the forecast error variance in MB explained by shocks to MI approaches 25 per cent. However, due to the large standard error, this point estimate is not considered significant.

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Data Appendix
Description of Variables

CPI is the log of Bangladesh's domestic consumer price index (2000=100); the cost of living index of Dhaka middle income families. The seasonally unadjusted data on CPI are seasonally adjusted using the X11 procedure in SAS. Unadjusted quarterly data on consumer price index are available from Economic Trends, a Bangladesh Bank publication.

CPI_I is the log of foreign (India) consumer price index (2000=100); the cost of living index for the industrial workers of seventy industrial centers in India. Seasonally unadjusted data on CPI_I are seasonally adjusted using the X11 procedure in SAS. Unadjusted quarterly data on CPI_I are available from International Financial Statistics (IFS) CD-ROM.

MB is the log of Bangladesh's seasonally adjusted real money supply (M2) in Crore Taka. Seasonally unadjusted data on nominal M2 and CPI are seasonally adjusted using the X11 procedure in SAS. The seasonally adjusted money supply is divided by the seasonally adjusted CPI to get the seasonally adjusted real money supply. Unadjusted quarterly data on M2 are available from Economic Trends.

MI is the log of India's real money supply (in Crore Taka). India's M2 is seasonally adjusted using the X11 procedure in SAS. The data on India's money supply were initially in national currency (Billions of Rupee). To place India's money supply in domestic monetary terms, the data on India's money supply was transformed into crore taka by dividing by Taka/Rupee nominal exchange rate. The real money supply is the nominal money supply divided by CPI_I. Quarterly data on India's money supply from the IFS CD-ROM.

RER is the log of real exchange rate (TK/RU). RER is calculated by multiplying the unadjusted nominal exchange rate by the ratio of CPI_I and CPI. Data on the nominal exchange rate is available from the IFS CD-ROM.

Y is the log of real output (2000=100). Unadjusted data on industrial production are seasonally adjusted using the X11 procedure in SAS. Unadjusted quarterly data on industrial production are available from the IFS CD-ROM.

LR is the commercial bank lending rate on individual and business loans. The data on lending rates are available from the IFS CD-ROM.