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Md. Ezazul Islam*

Abstract

Bangladesh Bank (BB) conducts monetary policy through targeting broad money (M2) as an intermediate instrument while reserve money (RM) serves as an operating instrument. The RM is influenced by BB through indirect market based instruments viz. SLR, CRR, repo, reverse repo, open market operation, and moral suasion. The success of monetary policy in achieving its objectives critically depends on the degree of controllability of RM and M2 by BB. This paper investigates the dynamic relationships among the money multiplier and RM components in the money supply process in Bangladesh. The empirical evidence is based on the structural vector auto regression (SVAR) model using quarterly data for the period from 1979:Q3 to 2007:Q2. The results indicate that the currency-deposit ratio component in the multiplier model and net government borrowing, and movement of net foreign asset components in RM are the major contributors to changes in money supply. Since these components limit the degree of controllability of BB over money supply, the conduct of prudent monetary policy in Bangladesh would crucially depend on taking into consideration the implications of changes in these key components.

Key words: Reserve Money, Money Multiplier, and Monetary Policy.

JEL classification: E51, E52, and E58.

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Money Supply Process in Bangladesh: An Empirical Analysis

Md. Ezazul Islam

I. Introduction

The control of money supply is an important policy tool in conducting monetary policy within the monetary targeting framework. The success of monetary policy critically depends on the degree of controllability that the monetary authority has over money supply. The implicit assumption is that the central banks can determine the growth of money supply. The monetarist in general argue that the monetary authorities can exercise effective control over the stock of money while the non-monetarists hold that the determination of stock of money is part of the simultaneous solution for all variables in the financial and real sectors of the economy. Apart from policy action by the central banks, money stock is determined by the behavior of the public in various asset and commodity markets. Opposing such non-monetarist arguments, the monetarists argue that the behavior patterns of the public and the banking system are stable and predictable enough to permit the monetary authorities to control the stock of money. While such opposing views have been widely debated, empirical evidence on the issue is critical to conducting monetary policy in practice.

The Bangladesh Bank (BB) implements monetary policy by setting the reserve money (RM) as the operating target and broad money (M2) as intermediate target in the monetary policy framework.[1] The RM is the main policy variable which is influenced by BB using various policy tools. The predictability, measurability and controllability of RM are therefore important for effective monetary targeting. In particular, the degree of controllability of BB over RM is important to achieving the target goal or objectives of monetary policy. Generally, four players exert influence in the money supply process: (i) BB; (ii) government; (iii) deposits money banks (DMBs); and (iv) public depositors and borrowers of DMBs. The successful policy achievement depends on controllability of money supply. Miskin (2004) argues that measurability, controllability, and predictability are important factors for both operating and intermediate target variables. If BB can control RM and M2, the next pertinent issue is the degree of controllability.

The BB sets safe limit of M2 growth target in line with projected GDP growth and inflation expectations.[2] The BB targets the RM expansion path which is consistent with

[1] The RM is decomposed both in terms of components (liability side) and sources (asset side). In component terms, RM = currency out side of bank (COB) + balance with BB of DMBs and other financial institutions (R) + cash in tills of DMBs (C); and in terms of sources, RM = BB's claims on government (net govt. credit) + claim on DMBs (commercial bank borrowing) + net foreign asset. On the other hand, M2 = narrow money (M1) + time deposits (TD), and M1= currency (C) + demand deposits (DD).

[2] The safe limit of M2 growth is usually worked out through applying classical quantity theory of money, i.e, MV = PQ, where, M = quantity of money, V = velocity, P = price and Q = goods and services (or GDP). So, growth of M2 = projected GDP growth + projected inflation rate – projected percentage change in velocity.

M2 projection. In practice, however, the behavior of targeted and actual money growth are not matched (Figure 1). The wide gap that exists between targeted and actual money growth indicates that BB has a rather loose control over money supply.

In order to maintain RM at the desired level in line with targeted M2 growth, BB uses direct and indirect monetary policy tools.[3] The main tools are: the bank rate/discount rate, SLR, CRR, repo, reverse repo, open market operation, intervention (sale and purchase of foreign currency) in the foreign exchange market, and moral suasion. The net effect of these tools on RM is shown in Box 1. Before implementing the financial sector reforms since the early 1990s, BB frequently changed CRR, SLR, and the bank rate along with other direct instruments. Since the beginning of the 1990s, BB switched over to open market operations mainly through government treasury bills (T-bills) auction. Later on, BB introduced its own T-bills (30-day and 90-day). By off loading or holding T-bills, it determines cut off price in line with the money market conditions and the monetary policy stance. In order to streamline liquidity management and effective control of money supply, BB introduced repo and reverses repo instruments in 2003. It also introduced inter bank repo for meeting short term liquidity of DMBs. In view of changing debt management by the government, BB re-introduced its own bills (30-day and 90-day) in October 2006.

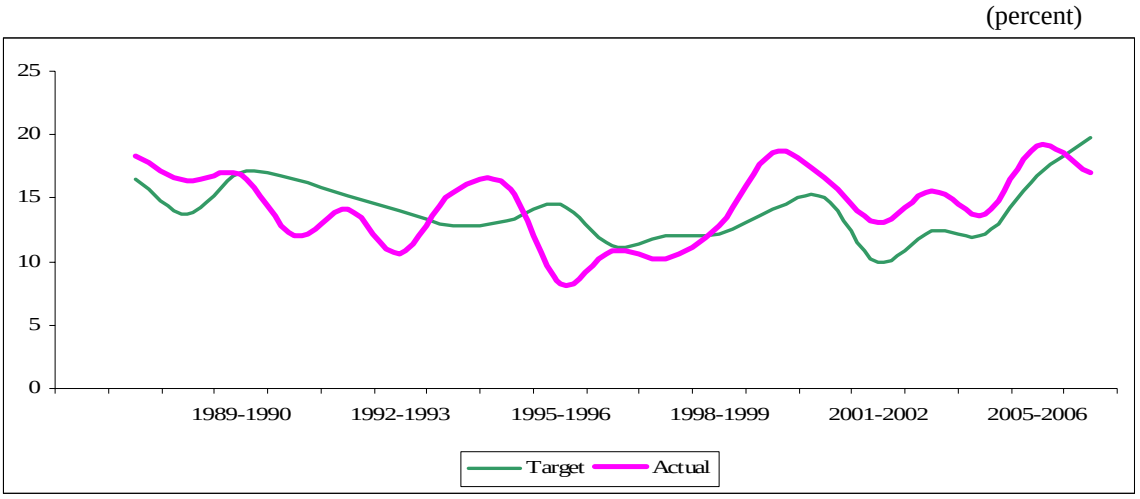
Box 1: Net Policy Tools Effect on Variation of RM

Name of Policy Tool	Increase (+)	Decrease(-)
1. Repo		
Issue	+	
Maturity		-
2. Reverse Repo		
Issue		-
Maturity	+	
3. G-treasury bills / bond		
Issue		-
Maturity	+	
4. Bangladesh Bank bill		
Issue		-
Maturity	+	
5. Foreign Exchange		
Purchase	+	
Sale		-
6. Loan and advances		
loan disburse	+	
loan return		-

Source: Author's compilation.
Note: Agreement (repo) was introduced in July 2002 while reverse repo was introduced in April 2003.

[3] Direct tools are interest rate control, credit ceiling, and directed lending policy. Before 1990, BB used these tools.

Figure 1: Growth of Actual and Targeted M2



Source: *Annual Report* (various issues), Bangladesh Bank.

Like in many other countries, the financial system, monetary policy framework, and the policy tools have been undergoing changes over time in Bangladesh. In order to improve the financial system, BB adopted financial sector reforms in the 1990s covering liberal interest rate policy and market based policy tools instead of direct tools including a flexible exchange rate system in 2003. The BB introduced the practice of announcing the bi-annual monetary policy stance through the monetary policy statement (MPS) since January 2006. In view of the changing environment, it is important to know the process of money supply for conducting a pragmatic and a credible monetary policy.

The major objective of this study is to explore the dynamic causal relationships among the components of RM and money multiplier (MM) and identify the controllability of BB over the components of RM and the MM.

The reminder of the paper is organized as follows. Section II provides a review of the relevant literature, while section III examines the behavior of money supply and its causative factors. Section IV provides the estimation methodology and analyzes the data, followed by discussion of estimated results in section V. Finally, section VI contains the conclusions and policy implications.

II. Literature Review

The issues related to money supply and money multiplier behavior have been widely studied in both developed and developing countries. For example, Bomhoff (1997), Johannes and Rasche (1979), Hafer and Hein (1984), Lavoie (1992), Scheide (1993), Zaki (1995), Ford and Morris (1996), Agung and Ford (1999), Baghestani and Mott (1997), Arby (2000), Darba (2002), Park (1980), and Khatkhate et al.(1980) conducted empirical studies on money supply and money multiplier in different countries highlighting the degree of controllability over money supply by the monetary authority,

determinants of money supply, stability and predictability of money supply, and policy implications for conducting monetary policy.

In Bangladesh, Hossein (1993) examined the behavior of money multiplier components by employing a simple money multiplier model on quarterly data for the period 1972-1993. He finds that only the currency-deposit ratio equation is stable and M1 and M2 multiplier are unstable. He argues that the instability in money multiplier makes it difficult to conduct effective monetary policy in Bangladesh.

Hassan, et. al. (2003) examined both long-term and short-term dynamic relationships among money supply and its components for the Bangladesh economy within an Engle-Granger error-correction framework using yearly data for the period of 1972-1997. They find that M1 and M2 money supply have predictable long-run relationships with components but no short-run relationship exits among M2 and its components indicating the absence of a developed money market in Bangladesh.

The present study differs from the above studies in several ways. *First*, the present study uses most recent quarterly data covering the period of 1980-2007 for MM model and yearly data from 1980 to 2007 for RM model. The study excludes the data for the period 1972 to 1979 mainly due to the repressive nature of the financial system during the period including lack of competition among the banks in absence of private banks, practice of fixing deposits and landing rates by BB, and the existence of limited financial products.[4] *Second*, the present study provides a detailed analysis of the components of both MM and RM and their causative factors. *Finally*, the present study uses sophisticated structural vector autoregression (SVAR) model to examine dynamic causal relationships among the component of RM and MM.

Section III: Behavior of Money Supply and Causative Factors

Bangladesh Bank (BB) injects or absorbs money in the economy by changing the RM. The linkage between RM and money supply stock (M) can be defined by a simple standard money supply model. In analyzing the behavior of money supply and its determinants, we use the following simple money supply model:

$$M2 = mm \times RM \quad (1)$$

where M2= monetary aggregate or money supply stock,

mm= multiplier,

RM= reserve money or high powered money.

The above simple monetarist theory of money supply indicates that money supply can increase (decrease) either because of an increase of (decrease) in mm or an increase in

[4] Mckinnon (1973) and Shaw (1973) conceptualize and analyze the repressed/restricted nature of the monetary sector in the developing countries. The prominent features include the imposition of foreign exchange controls, interest rate ceiling, high reserve requirements, and the suppression or no development of private capital market (Fry 1989).

RM. An increase or decrease in both mm and RM also changes money supply. In particular, an increase in mm for the same RM target would loosen the monetary condition. The mm movement depends on many behavioral factors which include currency-deposit ratio (cd), reserve-deposit ratio (rd), and the excess reserve-deposit ratio (ed). The money multiplier function is thus

$$mm = f(cd, rd, ed) \quad (2)$$

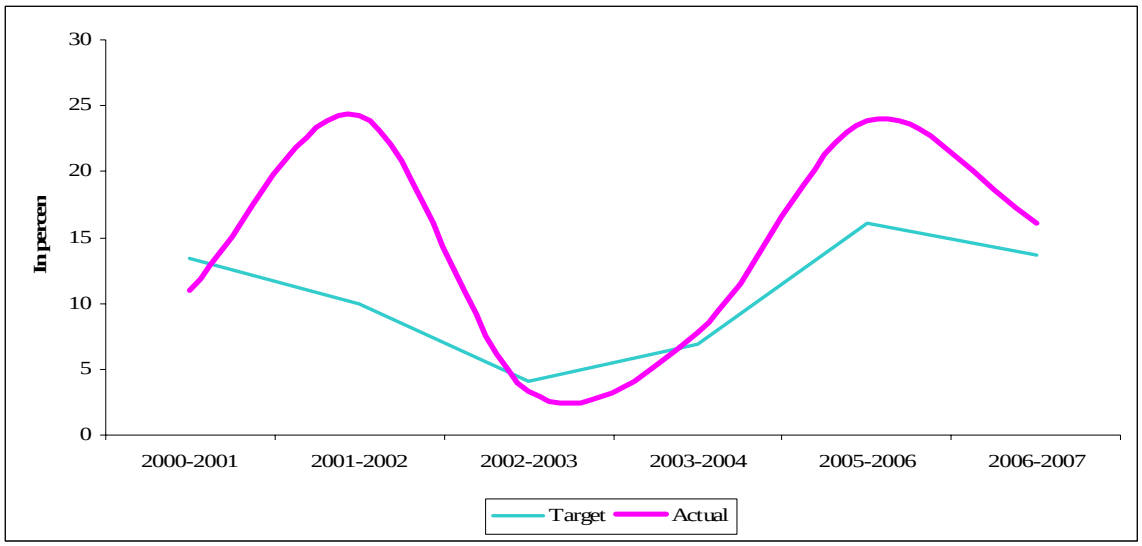
The aggregate RM is the asset/liability of the central bank. On the asset side of RM, the main components are net foreign asset (fa), government borrowing (g), and banks and financial institutions' borrowing (sb). The movement of RM depends on net foreign asset of BB originating from external sector performance, government borrowing originating from fiscal deficit, and commercial bank borrowing from BB. The RM function is thus

$$rm = f(g, sb, fa) \quad (3)$$

III.1. Movement of Reserve Money and Its Determinants

The general perception is that if BB has enough control over RM, it can implement effective monetary policy. So it is important to understand the movement of RM and its determinants which affect the degree of controllability of BB. Figure 2 indicates that during 2001-2002 actual RM was above the targeted RM. During 2003 and 2004, it generally matched with its target; but during 2005 and 2006, a wide gap was created between targeted RM and actual RM. The analysis of RM sources (asset side of BB) shows that BB's claim on government has been increasing over time. The average share was about 16 percent (five year moving average) in 1995 which jumped to 53 percent in 2007. High variation of government borrowing originating from financing fiscal deficit was one of the major factors which changed RM beyond its targeted level. The analysis shows that government borrowing contributes to loosening the power to control RM by BB.

Figure 2: The Growth in RM, FY01- FY07



Source: *Annual Report* (various issues), Bangladesh Bank.

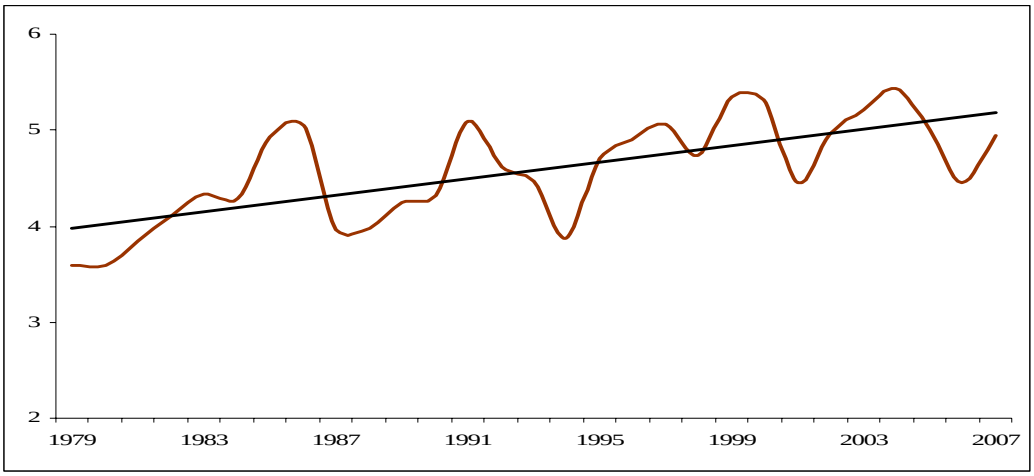
The movement of the share of net foreign asset, another unpredictable component of RM, indicates that it varied widely during 1991-2007. The variation range differed from 17 percent to 83 percent. During the period, it exhibited more volatility (standard deviation was about 17). The accumulation of net foreign asset in BB depends on foreign exchange market condition which is influenced by import growth, export growth, and inflow of remittances, aid flow, and foreign exchange transaction by the commercial banks. The commercial banks can surrender their foreign reserve to BB or they can sell it in the inter bank foreign exchange market if their exposure's limit exceeds. Sometimes, they buy foreign exchange from BB if their requirements exceed availability. BB also intervenes in the foreign exchange market aiming to stabilize the exchange rate at the desired level. In the face of high prices of essential commodities and persistence high inflation, BB has recently sold foreign exchange to ADs in order to mitigate the market pressure and dampen the cost of imports. As such, it is rather unpredictable to measure the movement of net foreign asset position of BB.

Borrowing by the commercial banks from BB is another major component of RM. The average share of borrowing by DMBs in RM was 68 percent in the 1980s, which declined to 34 percent in the1990s, and further to 13 percent during 2001-2007. BB can influence the borrowing by DMBs through changing the discount rate (bank rate) and hence BB has controlling power over such borrowing.

III.2 Determinants of Money Multiplier

The broad money multiplier (mm) showed a fluctuation trend during 1980-2007 (Figure 3).[5] The stability of mm is important for conducting monetary policy. High volatility means money supply is unpredictable. The volatility of mm, as measured standard deviation, witnessed a higher trend during the 1980s and the 1990s relative to 2001-2007 period (Table 1). The movement of mm depends on many factors which are examined below.

Figure 3: Trend in Broad Money Multiplier



Source: *Economic Trends*, Bangladesh Bank and author's calculations.

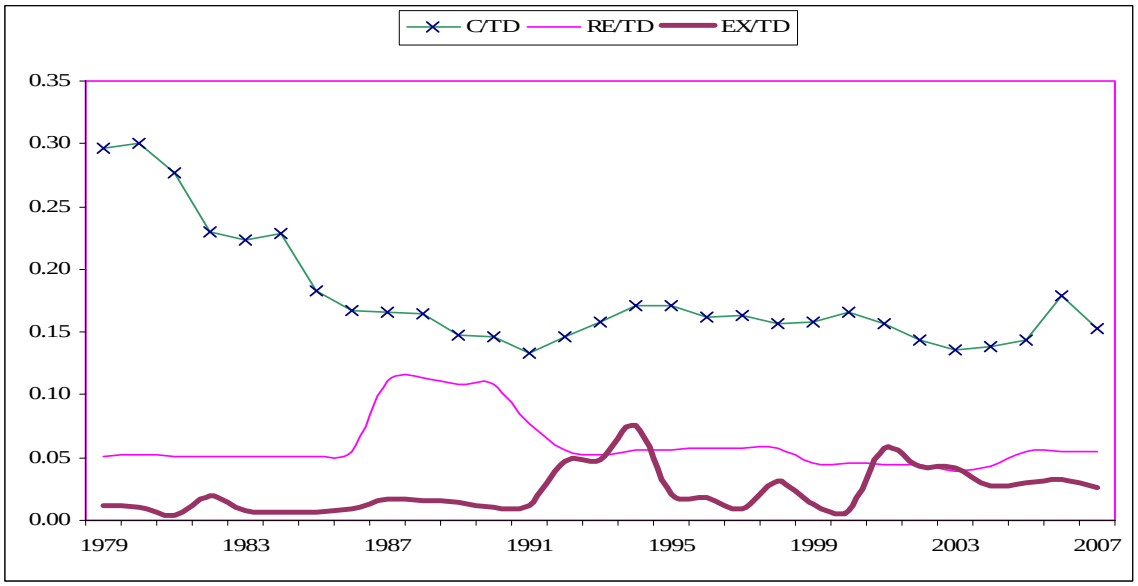
[5] Broad money multiplier = M2/RM, where M2 = broad money, and RM= reserve money.

Changes in Currency-Deposit Ratio

An increase in currency-deposit (C/D) ratio means that depositors are converting some of their checkable deposits into currency. Checkable deposits undergo multiple expansions while currency does not. Hence, when checkable deposits are being converted into currency, there is a switch from a component of the money supply that undergoes multiple expansions to one that does not. The overall multiple expansion declines, and so the money multiplier.

The C/D ratio measures the behavior of the public which declined over time with some fluctuations during 1980-2007. It averaged 20 percent in the 1980s, which declined to 16 percent in the 1990s, and 15 percent during 2001-2007 (Table 1 and Figure 4). It exhibited more or less a mild volatility during 1980-2007. Currency holding by the public mainly depends on two factors viz. (i) income; and (ii) deposit interest rate (opportunity cost of holding currency). Besides, increase of bank branches, financial innovation, and cost of financial transaction also affects C/D ratio. The number of bank branches in the country was 3,750 in 1980; which went up to 5,552 in 1990 and to 6,625 in 2007. The average GDP growth rate was 3.7 percent in the 1980s, 4.8 percent in the 1990s, and 5.8 percent during 2001-2007. An analysis of deposit rates indicates that the nominal deposit interest rate (weighted average) showed a declining trend while the real rate showed an upward trend during 1980-2007 (Table 2). The weighted average real deposits rate was (-) 2.8 percent in the 1980s, which turned into positive at 2.5 percent in the 1990s and 0.6 percent during 2001-2007. The trend in volatility shows that C/D ratio is more or less predictable.

Figure 4: Trends in Currency-Deposit, Reserve- Deposit and Excess Reserve-Deposit Ratios



Source: *Economic Trends* (various issues), Bangladesh Bank, and author's calculation

The banks and NBFI's offer different types of saving product and they face increasing competition among themselves over time for savings mobilization. Consequently, savers receive a good return from their savings. Depositors try to minimize currency holding as

against their deposit to the banks in order to minimize the opportunity cost. In spite of availability of varied saving products offered by the banks and NBFIs and a growing capital market, estimates show that the influence of income has been prominent than the deposit rate in the sensitivity of currency holding by the public during the period 1980-2007 (Box 2).

Table 1: Movement of C/D, R/D and E/D Ratios					
Variable		1980-1990	1991-2000	2001-2007	1980-2007
C/D	Mean	0.20	0.16	0.15	0.17
	STDEV	0.053	0.011	0.015	0.041
R/D	Mean	0.07	0.06	0.05	0.06
	STDEV	0.030	0.009	0.006	0.022
E/D	Mean	0.01	0.03	0.04	0.02
	STDEV	0.005	0.022	0.011	0.018
mm	Mean	4.24	4.81	4.92	4.61
	STDEV	0.437	0.442	0.363	0.018
Source: *Economic Trends*, Bangladesh Bank and author's calculation					

Table 2: Trend in Deposits Rates and Inflation				
	1980s	1990s	2001-2007	1980-2007
All deposits (percent)				
Mean	8.02	7.01	6.42	7.22
STDEV	0.84	1.27	0.54	1.15
Savings deposits (percent)				
Mean	9.12	7.15	5.09	7.34
STDEV	0.28	1.63	0.68	1.90
Short term deposits (percent)				
Mean	3.77	4.88	3.98	4.26
STDEV	0.69	0.77	0.57	0.84
Fixed deposits (percent)				
Mean	13.85	9.04	9.05	10.93
STDEV	0.430	1.70	0.96	2.64
Rate of inflation (percent)				
Inflation(def)	9.41	4.04	3.85	5.93
CPI (p-t-p)	10.80	4.51	5.79	7.20
GDP growth	3.70	4.8	5.8	4.7
Source: *Scheduled Bank Statistics* and authors' calculation.				

Recently, the banks and NBFI's have introduced a wide variety of innovative banking products viz. consumer credit, cash credit, debit card, credit card and others and modern transaction facility viz. ATM, e-banking, and online banking which affect the currency-deposit behavior of the public.

Changes in Excess Reserve-Deposit Ratio

The average excess reserve-deposit (E/D) ratio, which measures the behavior of the banks, increased to 4 percent in the 1990s from only one percent in the 1980s. During 2001-2007, it showed a declining trend and averaged 2 percent. In view of efficient fund

management of the banks, the higher E/D ratio means higher opportunity cost for the banks. The opportunity cost in terms of the market interest rate is very crucial for fund management by the banks. Primarily, in order to meet unexpected outflow of deposits and to face abnormal behavior in the money market, banks keep the excess reserve. This behavior is also affected by aggregate credit demand which originates from overall economic activities. Since, excess reserve does not earn any interest income, the tendency of the banks would be to minimize through adopting efficient fund management.

Box 2: Estimates of Currency Holding by the Public

To quantify the causal relationship between currency holding by the public (c) with interest rate (di) and income (gdp) , we employ a log linear model:

$$\ln c = \alpha + \beta_1 \ln ngdp + \beta_2 \ln di + \varepsilon \qquad (1)$$

where, ln c= natural log of currency holding by the public,
ln ngdp= natural log of nominal gross domestic product,
ln di= natural log of weighted average deposit rate in the banking system,
ε = stochastic error term.

Equation (1) has been estimated using OLS with yearly data for the sample period 1979-2007. The regression results are given in Table 1.

Table 1: Determinants of Currency Holding by the Public

	Dependent variable: In c
Independent variable	Coefficient
ln ngdp	1.22(0.04)
ln di	-0.52(-0.16)
Constant	3.76(25.59)
R^2	0.98
Sample size	28

Note: Figures in parentheses are robust standard errors.

The estimated elasticity of currency holding with respect to nominal income shows that if income increases by one percent, then currency holding would increase by 1.2 percent. On the other hand, if deposit rate increases by one percent, currency holding is likely to decrease by 0.5 percent.

Changes in Reserve-Deposit Ratio

The reserve-deposit ratio (R/D) reflects the BB's policy stance in order to achieve the monetary policy goals. The BB uses CRR to change the R/D ratio. Before the 1990s, CRR was used frequently as a tool; although its use has become less frequent in recent years after the introduction of government T-bill auctions in 1995. It is still a good weapon to control money supply or the monetary base. The R/D ratio shows that it averaged 7 percent in the 1980s, then declined to 5 percent in the 1990s, and again increased to 6 percent during 2001-2007. An econometric analysis shows that the C/D ratio is more powerful in influencing the money multiplier than E/D and R/D ratios (Box

3). This indicates BB's less control over money supply and the need to put emphasis on factors which influence C/D ratio in designing the monetary policy. The detailed estimates are given in Box 3.

Box 3: Estimates of Money Multiplier

To quantify the contribution of currency-deposit ratio, reserve-deposit ratio, and excess reserve-deposit ratio in changing the money multiplier (mm), we employ a log linear model which is estimated by OLS:

$$\Delta \ln mm = \alpha + \beta_1 \Delta \ln cd + \beta_2 \Delta \ln rd + \beta_3 \Delta \ln ed + \varepsilon$$

where ln mm= natural log of money multiplier,
ln cd= natural log of currency-deposit ratio,
ln rd= natural log of reserve-deposit ratio,
ln ed= natural log of excess reserve-deposit ratio,
ε = stochastic error term.

For the yearly data covering 1979-2007, augmented Dickey-Fuller test indicates that all variables are non stationary (I(1)) in level form and these are stationary (I(0)) in first difference. To avoid spurious regression results, we estimate regression function by taking all variables in growth form. The results are given in Table 1.

Table 1: Determinants of Money Multiplier

	Dependent variable: lnmm
Independent variable	Coefficient
ln cd	-0.60
	(-13.55)
ln rd	-0.27
	(-10.34)
ln ed	-0.09
	(-8.64)
constant	3.76
	(25.59)
Adjusted R^2	0.92
DW	1.78
Sample size	28

Note: Figures in parentheses are t value. Autocorrelation is corrected by Cochrane-Orcutt estimation method

The estimated results indicate that the currency-deposit ratio is more powerful in influencing the mm than the other two ratios.

IV. Estimation Methodology and Data Analysis

Data

Quarterly data for the sample period from 1980.Q3 to 2007.Q4 have been used in the present study. Quarterly data on broad money multiplier (mm), currency-deposit ratio (cd), excess reserve-deposit ratio (ed), and required deposit ratio (rd) have been complied from various issues of *Economic Trends* published by the Bangladesh Bank. Yearly data on reserve money (rm), government borrowing from BB (g), net foreign asset of BB (fa), and deposits money bank's borrowing from BB (sb) for the sample period have been collected from Annual Reports of the Bangladesh Bank.

Estimation Methodology

In order to estimate the dynamic relationships among money multiplier components and reserve money components, the structural vector autoregression (SVAR) model has been used. As is well known, Sims (1986) introduced the SVAR model to overcome the limitations in VAR. The impulse response function (IRF) and variance decomposition (VDC), two main tools for describing the dynamic relationship among the variables included in the system, have been estimated on the basis of identified structural VAR. According to SVAR, we define functional relationships among *mm* components and *rm* components by imposing short run restrictions as follows:

(1) Identification of money multiplier component:

$$e_t^{cd} = \varepsilon_{1t} \quad (1)$$

$$e_t^{rd} = \varepsilon_{2t} \quad (2)$$

$$e_t^{ed} = \varepsilon_{3t} \quad (3)$$

$$e_t^{mm} = A_{41}\, e_t^{cd} + A_{42}\, e_t^{rd} + A_{43}\, e_t^{ed} + \varepsilon_{4t} \quad (4)$$

(2) Identification of reserve money component:

$$e_t^{g} = \varepsilon_{1t} \quad (5)$$

$$e_t^{sb} = \varepsilon_{2t} \quad (6)$$

$$e_t^{fa} = \varepsilon_{3t} \quad (7)$$

$$e_t^{rm} = A_{41}\, e_t^{g} + A_{42}\, e_t^{rd} + A_{43}\, e_t^{ed} + \varepsilon_{4t} \quad (8)$$

In the above system of equations, e_t^i is the estimated residual of i^{th} equation from standard VAR model, A_{ij} is the short run response of i^{th} variable to j^{ith} structural shock and ε_{ij} is the structural shock from the i^{th} variable in the system. The restrictions have been imposed in the mm model in such a way that the short run impact of cd, rd, and ed

on mm can be identified. Similarly, restrictions have been imposed to measure the short run impact of g, sb, fa on rm in the reserve money model.

Data Analysis

Before estimating SVAR, it is important to ascertain whether the data are stationary or non-stationary. For the purpose, we employ augmented Dickey-Fuller (ADF 1981), Phillips-Perron (PP 1988) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS 1992) tests. All these tests have been performed in log forms. The test results, given in Table 3, indicate that there is no systematic pattern in the variables. The same variables show I(0) and I(1) in different tests. We have estimated SVAR of mm model in level form while rm model has been taken in difference form.

Table 3: Results of Unit Root Tests on Variables

	ADF		**PP**		**KPSS**	
Variables (in log level)	With intercept	With trend + intercept	With intercept	With trend + intercept	With intercept	With trend + intercept
mm	I(1)	I(0)	I(0)	I(0)	I(1)	I(0)
cd	I(1)	I(1)	I(0)	I(0)	I(1)	I(1)
rd	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)
ed	I(1)	I(1)	I(0)	I(0)	I(1)	I(0)
rm	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
g	I(1)	I(1)	I(1)	I(1)	I(1)	I(0)
sb	I(0)	I(0)	I(0)	I(1)	I(1)	I(1)
fa	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)

Notes: 1. All tests have been performed on the basis of 5 percent significance level using Econometric Views 4.1 Package.
2. Lag length for ADF tests have been decided on the basis of Schwartz's information criteria (SIC).
3. Maximum bandwidth for PP and KPSS tests has been decided on the basis of Newey-West (1994).
4. The ADF and PP tests are based on the null hypothesis of unit roots while the KPSS test assumes the null hypothesis of stationary.
5. I(1) means non-stationary and I(0) means stationary.

V. Analysis of Empirical Results

Impulse Response of mm

The estimated impulse response function of money multiplier (mm) is given in Figure 5. The individual's impulse (shocks) of C/D, R/D and E/D on changing money multiplier shows a significant negative response of mm at different time horizon. The shock of

C/D, R/D and E/D on mm has continued up to 3 quarters, 4 quarters and 5 quarters respectively. The combined impulse response shows that impact of C/D ratio is much higher than that of R/D and E/D. The R/D ratio which is controlled by BB shows less influence to mm but it depicts a systematic pattern.

Figure 5: Impulse Response of mm

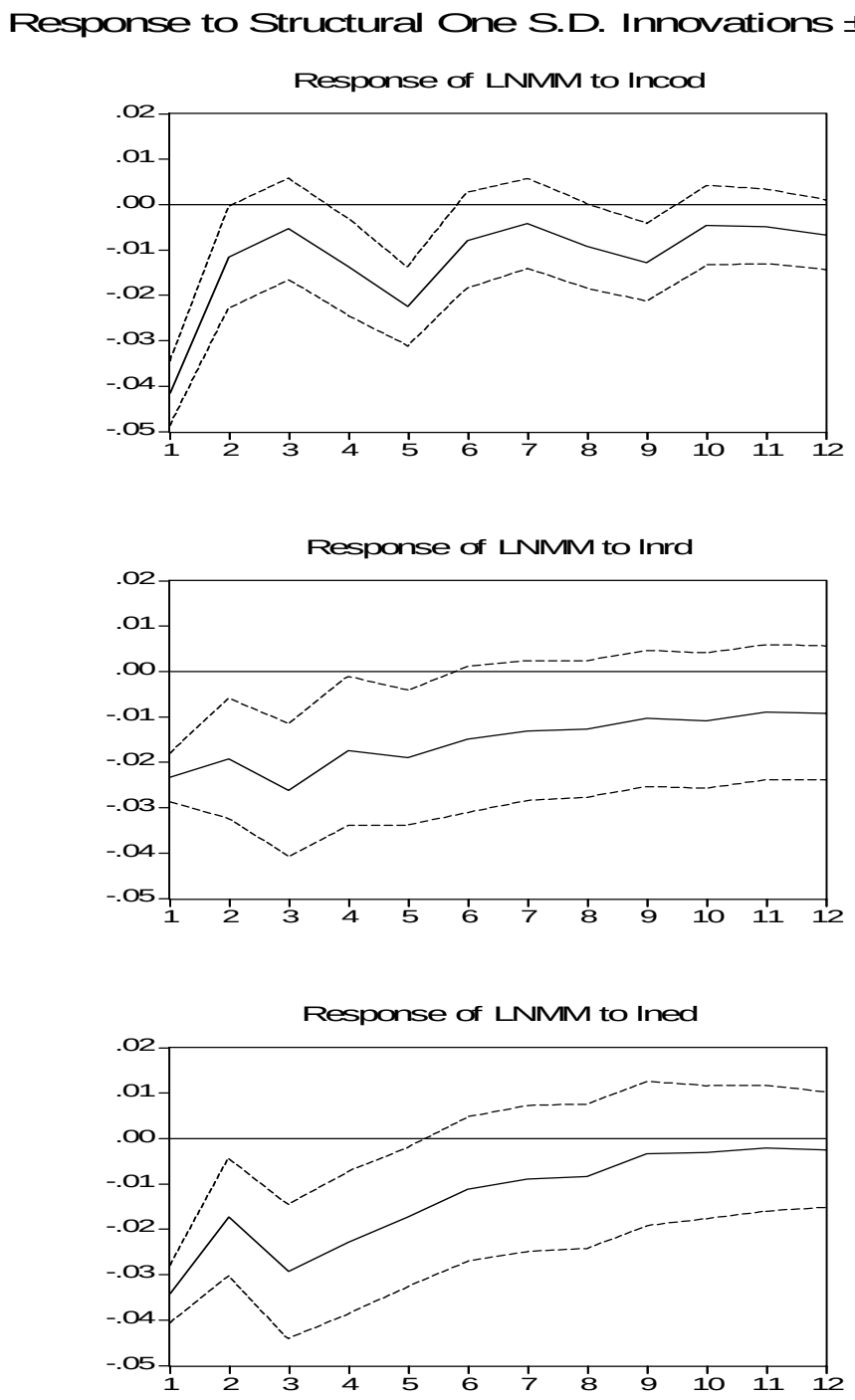
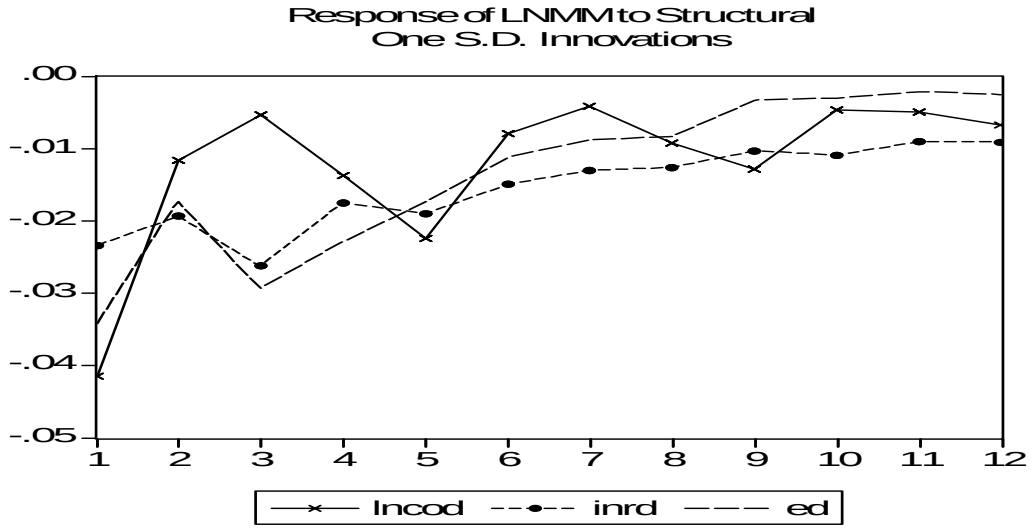


Figure 6: Combined Impulse Response of mm



Variance Decomposition of mm

Variance decomposition of mm presented in Table 4 at forecast horizons 1 quarter to 10 quarters, gives the share of fluctuations in a given variable that are caused by shocks in other relevant variables as well as itself. The columns give the percentage of forecast error variance due to each shock, with each row adding up to 100 percent. The results indicate that the innovation by the *C/D* exhibits the highest statistically significant explanatory power of predicting the movements in mm up to 10 quarter time horizon. More than 43 percent of the variance of the one-step forecast error is due to the innovation in C/D. The E/D shows the second highest variation nearly 30 percent, followed by 14 percent for R/D ratio.

Table 4: Variance Decomposition of Money Multiplier

Quarter	S.E.	Shock to ln cd	Shock to ln rd	Shock to lned	Shock to ln mm
1	0.06	43.40	13.74	29.47	13.38
2	0.07	37.23	18.36	29.45	14.94
3	0.08	27.61	23.45	34.04	14.88
4	0.08	26.41	24.28	36.26	13.04
5	0.09	28.15	24.79	34.41	12.63
6	0.09	27.55	26.02	34.18	12.23
7	0.09	26.92	26.98	33.98	12.10
8	0.10	26.92	27.72	33.61	11.73
9	0.10	27.73	27.98	32.77	11.51
10	0.10	27.53	28.69	32.39	11.36

Note: Structural factorization.

Impulse Response of RM

The impulse response of RM is given in Figure 7. It shows that one standard innovation shock by government borrowing (ln g) has impacted on RM (ln rm) in long time path of the system. It implies that the impact of net government borrowing from BB on RM persists for a longer time. Similarly, the impact of net foreign asset on RM also persists for a longer time. These two components are, however, beyond the control of BB. The innovation shock in ln sb exhibited a positive impact on reserve money up to two years which is under BB's control.

Variance Decomposition of RM

The variance decomposition of RM in Table 5 indicates that 37 percent of the variance of the one-step forecast error is due to innovation in net foreign asset (ln fa). In the longer step, both government borrowing (ln g) and banks borrowing (ln sb) from BB become important sources of RM (ln rm) variation. It implies that both net foreign asset and government borrowing which are beyond the control of BB influence RM. This is of interest for projection of RM as an operating target.

Figure 7: Impulse Response of RM

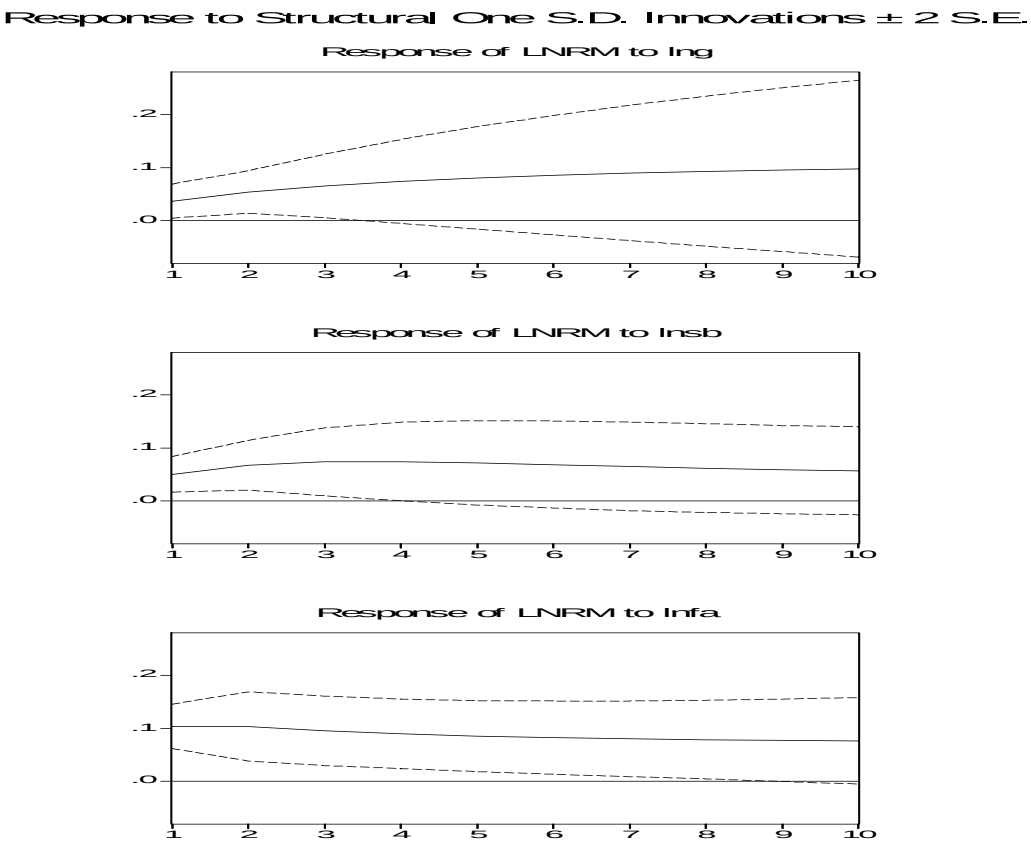


Figure 8: Combined Impulse Response of RM

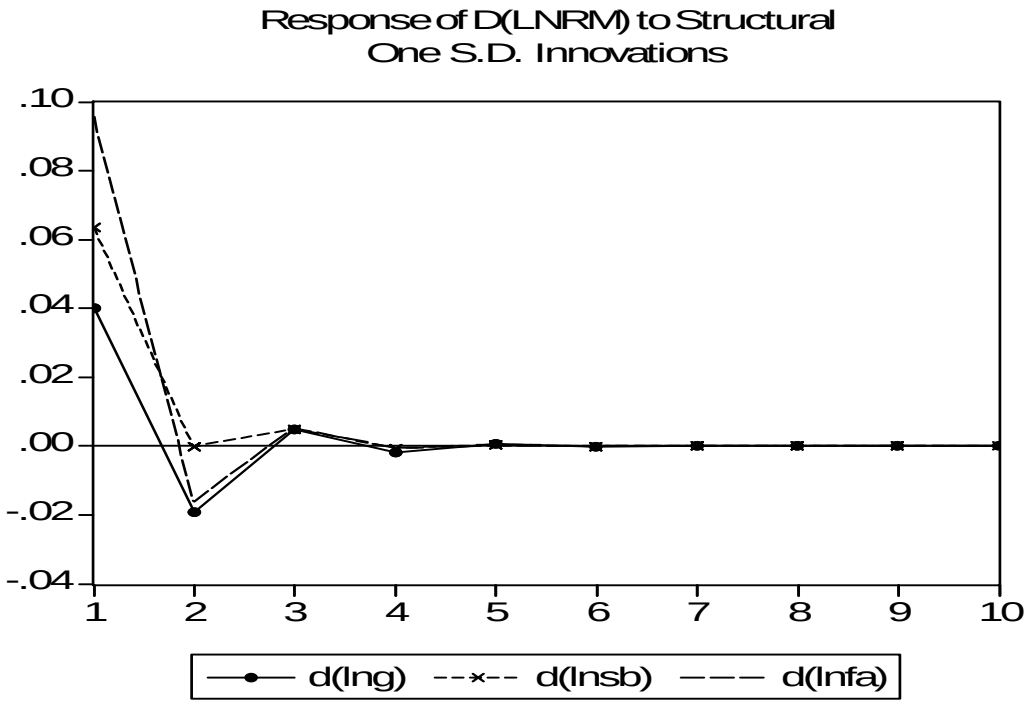


Table 5 : Variance decomposition of ln rm

Year	S.E.	Shock to d(ln g)	Shock to d(ln sb)	Shock to d(ln fa)	Shock to d(ln rm)
1	0.32	6.54	16.51	37.49	39.45
2	0.37	7.60	15.58	36.36	40.44
3	0.37	7.64	15.57	36.24	40.53
4	0.37	7.65	15.56	36.22	40.54
5	0.37	7.66	15.56	36.22	40.54
6	0.37	7.66	15.56	36.22	40.54
7	0.37	7.66	15.56	36.22	40.54
8	0.37	7.66	15.56	36.22	40.54
9	0.37	7.66	15.56	36.22	40.54
10	0.37	7.66	15.56	36.22	40.54

Note: Structural factorization.

V. Conclusion and Policy Implication

The Bangladesh Bank conducts monetary policy by taking M2 as an intermediate target and RM as an operating target. For influencing RM, indirect market based instruments are mostly used viz. SLR, CRR, repo, reverse repo, open market operation, and moral suasion. The success of monetary policy in achieving its goals depends on the degree of controllability of BB on RM and M2. This paper investigates the dynamic relationships among money multiplier and reserve money components in the money supply process in Bangladesh using structural vector autoregression (SVAR) with quarterly data for 1979:Q3 to 2007:Q2.

The estimated impulse response and variance decomposition of money multiplier shows that currency-deposit ratio has a significance influence on money multiplier. It is determined by the public's preference for currency versus demand deposits, which in turn depends on interest rate and income. The elasticity of currency holding with respect to nominal income and interest rate indicates that nominal income is more powerful than the interest rate in determining the currency-deposit ratio. In recent years, several other elements such as financial deepening (as measured by M2/GDP ratio and private sector credit/GDP ratio), interest rate liberalization, availability of innovative financial products, improvement in non-performing loans, changes in legal, institutional, and policy framework in the financial sector have also affected the currency-deposit ratio. Although the ratio is not controlled directly by BB, its stability has significant implications in determining money supply.

The analysis of impulse response and variance decomposition indicates that reserve-deposit (rd) has a persistent impact on mm as compared to cd. BB can influence it by changing cash reserve requirement ratio (CRR). The excess reserve deposits ratio (ed) for the banks shows also significant persistent impact on mm in the path of reserve money. The volatility trend in the ratio was observed throughout the sample period. The stability of this ratio depends on sound financial system and money market condition.

The dynamic relationship based on impulse response and variance decomposition among the components of reserve money shows that net foreign asset and net government borrowing have a greater influence in changing the reserve money. These determinants are, however, beyond the control of BB and hence should be appropriately considered in designing the monetary program of BB. The movement of net foreign asset depends on the overall performance of the country's external sector. A wide variation in the share of net foreign asset to reserve money can be observed which indicates the relative unpredictability of net foreign asset component. The BB, however, can influence net foreign asset indirectly by intervening in the foreign exchange market. The government borrowing from BB, on the other hand, originates from the budget deficit and remains a major factor in determining the movement of reserve money. The analysis shows that both net foreign asset and government borrowing loosens the degree of controllability of BB over reserve money.

The estimated impulse response and the variance decomposition of reserve money show that the borrowings of commercial banks have a systematic impact on reserve money. The BB has power to influence such borrowings by changing the bank rate or discount rate. The components analysis of both money multiplier and reserve money indicates that public the behavior of the public as captured by the cash-deposit ratio, net government borrowing, and movement of net foreign asset put some limits on BB's controllability over money supply with implications for conducting prudent monetary policy.

In order to ensure effective management of reserve money and contain budget deficit within its targeted level, the adoption of a prudent government borrowing strategy could be useful. In this context, several options may be considered for managing the government's deficit financing in an efficient manner, such as: (i) ensure progressively retirement of the borrowing from the BB, (ii) adopt and adhere to quarterly ceiling on borrowing from BB, and (iii) gradually move toward a more balanced domestic debt strategy such that the budget deficit is financed through long term borrowing sources (security and bond market). These steps will empower BB to control reserve money more effectively.

The movement of net foreign asset is influenced by complex interactions between export and import growth, inflow of remittances, and borrowing from external sources by the government and other entities. This brings out the relatively unpredictable nature of net foreign asset which is a part of the common characteristics of less developed countries like Bangladesh. By nature, monetary policy is likely to be less effective under floating exchange rate with a closed capital account. However, in view of the unpredictability of movement of net foreign asset stemming from changes in the external sector, especially the current account balance and the financial account of the balance of payments, BB can use sterilization tools along with interventions in foreign exchange market when necessary. In addition, a prudent combination of expenditure switching and expenditure reducing policies is required for maintaining the predetermined growth in the reserve money.

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