

The Money Supply Process in Bangladesh: An Error-Correction Approach

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Abstract

In this paper we examine both long-term and short-term dynamic relationships among money supply and its components for Bangladesh economy within an Engle-Granger error-correction framework. Using 24 years of annual data on money and its components, our results suggest that M1 and M2 money supply have very predictable long-run relationships with its components. Moreover, M1 money supply has short-run relationship with its components but no short-term relationships exist among M2 and its components indicating the absence of a developed money market operation in Bangladesh. Finally, the choice between monetary targeting and inflation targeting is also discussed.

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1. Introduction:

Money supply has become an important policy instrument and is being increasingly used since the financial deregulation in the late 1980s. There lies a consensus among policy-makers that controlling the growth rate of money stock is essential to achieve full employment and stable price level. However, two prerequisite must be accomplished in order to attain these targets (Zaki 1995): first, development of an effective procedure for controlling the rate of money stock growth and second, close identification of the linkage between the desired growth rate of money and the ultimate objectives. Money multiplier in this case plays a crucial role by exerting control over the reserve aggregate such as the monetary base (Johannes and Rasche 1979) although the monetary base, often called high-powered money¹, is independent in this case.

For effective control of monetary aggregates, it is pertinent that the monetary authorities predict the movement of money multiplier with some level of accuracy, which is not always an easy task. While predicting, policy makers should not only take account of the changes in reserve requirements, but the decisions of households, businesses, and financial institutions despite the fact that these parties operate and make decision independently (Zaki 1995). Therefore, error in forecasting money multiplier is not rare that consequently affects the desired growth rate of money stock.

A huge volume of studies on money multiplier behavior can be found for both developed and less developed countries, however, for Bangladesh it is quite nascent. Hossain (1993) offered a simple money multiplier model for Bangladesh to examine the behavior of each of the components of the money multiplier. However, the author faced limitations in predicting the movement of money multiplier due to inherent volatility of some of the components of money multiplier. Hossain finds that while currency-demand deposit ratio is stable, the time deposit-demand deposit ratio and excess reserve- demand deposit ratios are unstable. Moreover, both the narrow and broad money multiplier equations are unstable.

Our paper differs from existing studies of money multiplier and money supply in the following ways. First, we use a most recent data set over the 1972-1997 to examine the question of money supply and multiplier and its components. We argue that the monetary sector of Bangladesh economy has gone through a deep structural change since the government adopted

¹ Monetary base = currency in the hands of the public + commercial bank's total reserves. Since these net monetary liabilities of the central bank form the basis for banks to provide further credit, and thus may serve as a basis for multiple expansion of deposits, it is sometimes referred to as 'high-powered money (Zaki 1995).'

financial sector reform in early 1990s, and a most recent monetary data exercise will reveal this change.

Second, like the U.S., U.K., Canada, Japan and Germany, Bangladesh also conducts monetary policy by targeting the growth rate of broad money supply with a pre-determined target. Implicit in such monetary targeting approach is that money demand is stable and Bangladesh Bank can control money supply. We will examine whether the Bangladesh Bank can control money supply process.

Third, we study for the first time the stationarity properties of monetary variables in the context of Bangladesh. We employ Phillips-Perron and Augmented Dickey Fuller tests to examine time-series properties of money supply, currency-deposit ratio, excess reserve-deposit ratio and time deposit- demand deposit ratio.

Finally, we examine both long-term and short-term dynamic relationships among money supply and its components within an Engle-Granger error-correction framework. Within such framework, we examine the exogeneity and endogeneity of various components of money supply. In summary, this paper is an improvement over the existing literature on money supply and multiplier in Bangladesh both in terms of data used and techniques employed to examine components of money supply. We rely on both aggregate and component approach to examine the movement of money multiplier in Bangladesh.

This paper is divided into five parts. Following introduction, we present a literature review in section 2. We present the data and methodology in section 3. We present and discuss the results in section 4. We conclude the paper in section 5.

2. Review of the literature

The literature on the money multiplier forecasting is plenty and still growing. We present a tabular summary of the important papers in Table 6. There are two approaches to predict the money multiplier: “aggregate” and “component” approaches. Bomhoff’s (1977) first estimated a time-series forecasting model of money multiplier for the U.S. using monthly data. The author developed a Box-Jenkins type model for the U.S. multiplier and compared both the methodology and the results with the regressions of the Federal Reserve Bank of St. Louis. Bomhoff’s study considered the aggregate approach to money multiplier and finds that the Box-Jenkins model performs 30% better than those produced by St. Louis. Bomhoff then applied his model to three different money multipliers for the Netherlands. He finds that Box-Jenkins predictions outperform the St. Louis method for Netherlands. The author’s overall conclusion is that Box-

Jenkins technique can produce the prediction for multiplier with sufficient accuracy even when a complete model of the financial sector is absent.

Johannes and Rasche (1979) in their paper raised several shortcomings of the Bomhoff's study and developed a component model of the money multiplier. The idea is that instead of forecasting the multiplier with a univariate time-series model (e.g., aggregate approach), an innovative way to model and forecast the multiplier is the separate ratios that comprise the multiplier. The authors used ARIMA models for the various multiplier components for the U.S. using monthly data. Their overall finding is that time-series models of the individual money multiplier component yield more accurate forecast of the multiplier than those produced by other regression methods.

With these developments in the forecasting models of money multiplier, Hafer and Hein (1984) investigate the relative forecasting capabilities of component and aggregate time-series model of the money multiplier. Using monthly U.S. data, the authors' findings suggest that the aggregate approach does equally well as the component method.

Hossain (1993) developed a money multiplier model of the money supply for Bangladesh using quarterly data from 1972-1993. Using a component approach of the money multiplier, the author finds that only deposit-currency ratio equation is stable, but the narrow and broad money multiplier equations are found to be unstable. The author argues that the instability in the components of money multiplier makes it difficult for the monetary authority in Bangladesh to effectively conduct monetary policy through monetary targeting. He suggested that the central bank should make an effort to stabilize the value of the money multiplier for effective monetary conduct.

Recently Zaki (1995) used Egyptian monetary data and finds that the aggregate forecasting approach of the money multiplier provided satisfactory results while the component method did not. More recently, Arby (2002) developed time-series forecasting models of aggregate multiplier and component models using monthly data from Pakistan. The author finds that aggregate model is superior to the component model and produce better projected values.

With the recent advancements in time-series econometrics (integration and cointegration), many researchers have tested the long-run relationship between various monetary aggregates and money multiplier. Baghestani and Mott (1997) used monthly U.S. data (1983:01 to 1990:06) and found long-run equilibrium relation (cointegration) among M1, the monetary base, and the market-deposit interest rate. The authors argued that the deregulation of the bank deposit rates made the relation between the monetary base and M1 more predictable. However, when the sample was extended beyond June 1990, the cointegration among M1, the monetary

base, and the interest rate differentials no longer exists. The authors offer an explanation that the U.S. economic recession which begun on July 1990 was responsible for the breakdown in cointegration relationships.

Ford and Morris (1996) investigated a cointegrating relationship between various monetary aggregates and a high-powered money base for the UK using quarterly data from 1977-1994 periods. The authors' findings which also coincided with the Bank of England's results show that high-powered money (M0) has strong predictive power (through interest rate) in regard to inflation and output. The authors also constructed various Divisia monetary aggregates to allow for financial innovations (ATMs, electronic fund transfer) that have occurred in the UK banking system after 1980s. The results suggest that although no cointegration relation is found among the five Divisia aggregates, but the non-innovation variant of the Divisia index has a slight edge over the innovation-adjusted variants. Furthermore, the error-correction mechanism and causality are found inadequate in providing any causal relationship among the aggregates, output, and price level. Recently Agung and Ford (1999) carried out a similar exercise to test the relationship between monetary base and monetary aggregates in Taiwan. The authors find evidence of cointegration between the monetary base and the Divisia and one innovation variants. Causality results show that causality is either from the monetary base to the Divisia or is joint.

Darbha (2002) finds a stable but time-varying long-run relation between measure of money stock and reserve money for India. The author used the cointegration test developed by Gregory and Hansen and finds that the cointegration relation is a discrete one-time shift rather than a usual random walk process, which the author argues is a characterization of discrete changes in monetary policy in India.

3. Data, Hypotheses and Methodology

3.1. Data: The data used in this study is annual data of 24 years (1973-97), taken from Economic Trend (a Bangladesh Bank's monthly publication). Currency in circulation (CUR), reserves (RES), monetary base (MOBA), required reserve (RERE), excess reserve (EXRE), demand deposit (DEDE), time deposit (TIDE), currency deposit ratio (CUDE), excess reserve

ratio (EXDE), time deposit ratio (TIDERA), narrow money multiplier² (NARm1), and broad money multiplier³ (BROm2).are used in our empirical analysis.

3.2. Hypotheses: While the monetarists argue that price stability should be the sole objective of monetary policy, non-monetarists argue that monetary policy should aim at the twin dangers of inflation and unemployment. Following such an eclectic view, less developed country, especially the South Asian countries have aimed to achieve multiple objectives through monetary policy. Although price stability and economic growth remain the primary objectives of monetary policy, the objective of social and economic justice is pursued also but with different degrees of intensity. The main criticism of the argument for multiple objectives of monetary policy is that such objectives cannot be achieved simultaneously without creating conflicts of one form or the other. For instance, when expansionary monetary policy is used to promote economic growth (or lower unemployment), it may create macroeconomic instability, which, in turn, may retard economic growth.

In Bangladesh, frequent government intervention (both political and social reasons including Jute loan, loans to SOEs, financing budget deficit and others) into the central bank's monetary policy hampers the normal flow of money supply, thus make it impossible to predict the money multiplier. The government has embarked on a market economy and opened up the economy. We would expect that "with less govt. interference and greater reliance on the market system, one would expect both the predictability and the stability of the money multipliers to increase (Zaki, 1995) ."

Earlier works on money multiplier in context of Bangladesh seem inappropriate. Therefore, amelioration and incorporation of more rigorous techniques are required to predict money multiplier with a reasonable accuracy, as it was the case for Johannes and Rasche (1979). Where the authors indicate some shortcomings in the Bomhoff (1977) analysis as applied to the

$$2 \quad m1 = \frac{1 + (C / D)}{rD + (ER / D) + (C / D)}$$

$$3 \quad m2 = \frac{1 + (C / D) + (T / D)}{rD + (ER / D) + (C / D)}$$

Where,

m1 = narrow money multiplier

m2 = broad money multiplier

C = currency in circulation

D = checkable deposits

T = time deposits

ER = excess reserves

rD = required reserve, which is 5% for Bangladesh

United States data, and suggest an improved forecasting model using ARIMA models for the various multiplier components.

Money multiplier can be related to velocity of money. Lavoie (1992) paper examines that in particular to Le Bourva's belief that reverse causation, rather than the instability of the velocity function, is the key objection to the quantity theory of money and the mainstream theory of inflation. Scheide (1993) paper points out that the strategy of monetary targeting is based on the stability of the money multiplier and of the money velocity. It has been widely questioned whether this condition still holds, especially after the German unification. Scheide's paper investigates it by using ARIMA time series models and it is shown that the instability was limited to the year 1990, since then both variables can be predicted with the same precision as before. In addition, no change has found in the trend of velocity.

3.3. METHODOLOGY: Time series data usually shows a trend because estimation of this type of data often involves spurious regression. Thus regressing a time series variable against another one might be very appealing (i.e., high R^2 and t value), although there might be no meaningful pragmatic relationship between the two. Any time series data can be generated by a stochastic or random process, and a concrete set of data, such as ours, can be regarded as a realization of the underlying stochastic process (Gujarati, 1995). Empirical work based on time series data assumes that the underlying time series is stationary. Intuitively, by the stationary properties of a time series data we understand that its mean and variance do not vary systematically over time. In contrast, a time series data is said to be nonstationary if its mean and variance are variant with time. Besides, there may be serial correlation between time series variables if the data is nonstationary. Thus, OLS estimation providing biased and inconsistent estimation of the parameters decreases the credibility of the regression output.

3.3.1. Cointegration Test and Error Correction Model

A time-series is integrated of order d, denoted by I(d), if the series can achieve stationarity after differencing d times. An I(0) series is thus by definition stationary, while I(1) series is random walk, which contains a unit root and non-stationary. Non-stationary series may drift apart from each other in the short-run but a linear combination of the series may be stationary which share a long-run equilibrium relationship. This property is referred to as cointegration [Engle and Granger, 1987]. If two series, X_t and Y_t , are both I(1), their linear combination

$$Z_t = X_t - \alpha Y_t \quad (1)$$

is generally also I(1). However, if there exists an α such that Z_t is stationary or I(0), then X_t and Y_t are said to be cointegrated. The cointegrating relationship $X_t - \alpha Y_t = 0$ represents a long-run equilibrium relationship between two variables, and Z_t measures the deviation from this long-run relationship in some time-period t .

The notion of cointegration allows us to model both the short-run and long-run relationships simultaneously. If X_t and Y_t are cointegrated, then according to Granger representation theorem [Engle and Granger, 1987], there exists an error correction representation of the following form:

$$\Delta X_t = \beta_1 Z_{t-1} + \sum_{i=1}^k \pi_i \Delta X_{t-i} + \sum_{j=1}^k \tau_j \Delta Y_{t-j} + U_{1t} \quad (2)$$

$$\Delta Y_t = \beta_2 Z_{t-1} + \sum_{i=1}^k \phi_i \Delta X_{t-i} + \sum_{j=1}^k \delta_j \Delta Y_{t-j} + U_{2t} \quad (3)$$

where $Z_t = X_t - \alpha Y_t$, as defined earlier, and u_{1t} and u_{2t} are white noise error terms. In these two equations, the series X_t and Y_t are cointegrated when at least one of the coefficients β_1 or β_2 is not zero. In that case, two series will display long-run relationship. If $\beta_1 \neq 0$ and $\beta_2 = 0$, then series Y_t will lead X_t in the long-run. The opposite will occur if $\beta_2 \neq 0$ and $\beta_1 = 0$. If both β_1 and β_2 are nonzero, then a feedback relationship exists between the two series, which will adjust to one another in the long-run.

In addition to long-run relationships, short-run relationships between the two series, X_t and Y_t , are characterized by the coefficients τ_j 's and ϕ_i 's. If τ_j 's are not all zero, movements in the Y_t will lead X_t in the short-run. If ϕ_i 's are not all zero, movements in the X_t will lead (cause) Y_t in the short-run. According to Engle and Granger (1987), if α can be obtained so that Z_t can be constructed, the remaining parameters in equation (2) and (3) can easily be estimated. Engle and Granger (1987) propose a two-step procedure. The first step involves ordinary least squares (OLS) regression of X_t on Y_t and yields a consistent estimate for α . The next step involves OLS estimation of equations (2) and (3) with Z_t replaced by $Z_t = X_t - \alpha Y_t$.

Both short-run and long-run dynamic linkages between the two series X_t and Y_t can be examined by forming hypotheses and testing them on the estimated coefficients in the equations (2) and (3). In general, six possible testable hypotheses concerning the short-run and long-run

influence of X_t on Y_t ($X_t \rightarrow Y_t$) and Y_t on X_t ($Y_t \rightarrow X_t$) can be formulated. These can be described in the following ways:

$$(1) \quad H_{Y_t \rightarrow X_t}^{ST} (\text{No ST linkage}): \tau_j = 0 \quad (j = 1, \dots, k);$$

$$(2) \quad H_{Y_t \rightarrow X_t}^{LT} (\text{No LT linkage}): \beta_1 = 0;$$

$$(3) \quad H_{Y_t \rightarrow X_t}^{NO} (\text{No ST or LT linkages}): \beta_1 = 0 \text{ and } \tau_j = 0 \quad (j = 1, \dots, k)$$

$$(4) \quad H_{X_t \rightarrow Y_t}^{ST} (\text{No ST linkage}): \phi_i = 0 \quad (i = 1, \dots, k);$$

$$(5) \quad H_{X_t \rightarrow Y_t}^{LT} (\text{No LT linkage}): \beta_2 = 0;$$

$$(6) \quad H_{X_t \rightarrow Y_t}^{NO} (\text{No ST or LT impact}): \beta_2 = 0 \text{ and } \phi_i = 0 \quad (i = 1, \dots, k)$$

These individual hypotheses can be tested using standard F-tests on the estimated coefficients of the error-correction model. The hypotheses deal with both short-term and long-term relationships among M1, M2, CD, ERD and TD.

3.3.2. Empirical Methodology

Testing for cointegration and performing six causality tests involve four steps. First, determine if the level of series are non-stationary and their differences are stationary by employing either Dickey-Fuller (DF) or the augmented Dickey-Fuller (ADF) unit root tests [Dickey and Fuller, 1979, 1981]. The ADF test is performed in the following way:

$$\Delta X_t = \beta_0 + \beta_1 X_{t-1} + \sum_{i=1}^n \alpha_i \Delta X_{t-i} + \varepsilon_t \quad (4)$$

The null hypothesis of a unit root implies that the coefficient of X_{t-1} is zero. If the null hypothesis is rejected, then the series is stationary and no differencing in the series is necessary to induce stationarity. Otherwise, differencing of data is necessary and the resulting series is tested until the null hypothesis of a unit root is rejected.

The second step involves estimating the following cointegrating regression by OLS:

$$Y_t = \alpha_0 + \alpha X_t + u_t \quad (5)$$

The null hypothesis of no cointegration is tested against the alternative hypothesis of cointegration. The cointegration test involves examining whether the estimated time series of the residuals from the cointegrating regression has a unit root. This cointegration test can either be based on the standard Durbin-Watson (DW) statistic or augmented Dickey-Fuller (ADF) test. The calculated value of DW is obtained from the OLS regression estimate of equation (5). Based on simulation, Engle and Yoo (1987) provide critical values for cointegration tests. If DW test statistic is greater than its critical value, then the null hypothesis of no cointegration is rejected. But a statistically more powerful ADF test can be performed by estimating the following regression:

$$\Delta \hat{U}_t = a \hat{U}_{t-1} + \sum_{i=1}^m b_i \Delta \hat{U}_{t-i} + g_t \quad (6)$$

where U_t 's are estimated residuals from equation (5). The optimal lag length can be determined by examining at what lag length the error term g_t becomes a white noise. The ADF test statistic is a pseudo t-value associated with to test the null hypothesis of no cointegration. The null hypothesis is rejected if the calculated ADF test statistic is greater than its critical value provided by Engle and Yoo (1987).

The third step involves the estimation of error correction model by following the two-step procedure prescribed by Engle and Granger (1987). Finally, the six hypotheses regarding lead-lag and feedback relationships among time series are tested using standard F-tests.

4. Analysis of Results

4.1. Empirical Findings: We present unit root tests of M1, M2, CD, ERD, and TD by employing three tests namely ADF test, Phillips-Peron test and KPPS test. Unit root test identifies whether the variables have unit roots or are nonstationary. We present these tests in Table 1.

According to Phillips-Perron test, we find all series are non-stationary at the levels or have unit roots. We rely on Phillips-Perron tests as this is the most powerful test out of the three. However, the first differencing of these variables reveal that each series is $I(1)$ is stationary. It is thus now useful to determine cointegration among the variables. Empirical results for cointegration among money supply, CD, ERD and TD are appropriate.⁴

In Table 2, we will present two models that we will estimate. The Johansen multivariate cointegration test is used to establish the number of cointegrating vectors. We present the Johansen and Juselius cointegration with appropriate lags in Table 3. This Table 3 reports the maximum eigen-value and trace tests of Johansen (1988) and Johansen and Juselius (1991). These are complementary versions of the same test to determine the cointegration rank, r . Both tests suggest that there is certainly one cointegrating vector among M1, CD and ERD, but there are two cointegrating relationships among M2, CD, TD and ERD in the sample.

We present the error-correction results in tables 4 and 5. We test a number of hypotheses regarding the relationships among the money supply, CD, ERD and TD. We find both short-run and long-term relationships exist among M1 and its components such as CD and ERD. There are, however, no short-term but only long-term relationships among M2 and its components. Bangladesh still does not have a developed money market, which makes the public hold only money and real assets, rather than money-substitutes which can earn interest.

4.2. Discussion of Results: The money supply process has two parts. First, actions by the Bangladesh Bank largely determine the monetary base. Then the money multiplier measures the amount by which the money supply changes in response to a change in the monetary base. The participants in the money supply process are the Bangladesh Bank, banking institutions, non-bank public and the government. The Bangladesh Bank can add to reserves in the banking system by buying government notes and securities or making discount loans. The increase in reserve allows banks to make additional loans, which lead to additional deposits in banks, and as a result, the money supply increases.

The money multiplier represents the link between the monetary base and the money supply. If the multiplier is constant or predictable, the change in money supply equals the multiplier times the change in the monetary base. The percentage change in money is approximately equal to the sum of percentage change in the money multiplier and the percentage change in monetary base. Monetary base can further be decomposed into non-borrowed reserves (affected directed by the open market operations of Bangladesh Bank) and borrowed reserves or discount loans (largely affected by the government, banking system and the Bangladesh Bank). If we have a constant or

⁴ *ibid*

predictable money multiplier, careful forecasting of changes in discount loans and the non-borrowed reserves will produce a good prediction of the growth of the money supply.

However, we can neither predict the change of borrowed reserves (discount loans) as these discount loans are largely determined by the government borrowing from the banking sector and monetization of these government borrowing by the Bangladesh Bank, nor the change in money multiplier.

As a number of players endogenously determine the money multiplier and the money supply, the Bangladesh Bank cannot control the money supply completely. The portfolio allocation decisions by the nonbank public and banks are determined by the principal factors governing asset demand: wealth, expected returns, risk, liquidity, and information. Portfolio allocation decisions by banks and non-bank public affect the monetary base and the money multiplier. The non-bank public decides how to allocate its holdings between checkable deposits, time deposits and currency. An increase in the non-bank public's demand for currency to demand deposit increases the currency-deposit ratio, reducing the money supply multiplier. As Hassan, Khan and Haque (1993) found that the level of financial development proxied by demand deposit to time deposit ratio affects velocity of money (which is reciprocal of money multiplier) negatively, we can argue that the financial development in Bangladesh remains at an early stage and has not reached the stage when velocity of money and financial development becomes positive.

Banks must decide what proportion of checkable deposits to hold as excess reserve, which in turn increases the ratio of effective reserves to demand deposits and reduce the money multiplier. The Bangladesh Bank does not also control the discount lending. The discount lending of the Bangladesh is largely determined by the government directives to channel funds to various sectors and its own borrowing needs. The Bangladesh Bank sets the discount rate (in conjunction with the Ministry of Finance), but the decision to borrow is made by the banks.

5. Summary and Conclusions:

While Hossain (1993) dissects the various components of money multiplier, we examine the short-run and long-run dynamic relationships among these variables. We have found the M1 and M2 money supply have very predictable long-run relationships with its components. Moreover, M1 money supply has short-run relationship with its components.

What should the Bangladesh Bank do in light of our empirical results on money supply process within an error-correction framework? While the ultimate goal of monetary policy is to achieve price stability with high employment, the Bangladesh Bank achieves this goal by employing tools (such as open market operations, discount loans and reserve requirements) and reaching operating (such as monetary base) and intermediate targets (monetary aggregates such as

M1 and M2, and interest rates: short-term and long-term). The choice of intermediate targets depends on whether it is measurable, controllable by the Bangladesh Bank and has predictable impact on employment and GDP growth. The current monetary targeting approach of the Bangladesh Bank suffers from its inability of pursuing its targeting strategy seriously due to government intervention. The Bangladesh Bank is still an arm of the Government, so it cannot make independent decisions regarding the control of money supply. As an intermediate target, monetary aggregate is preferable to interest rate as the latter is not determined by the market forces of demand and supply in the context of Bangladesh (it is largely determined administratively by the Bangladesh Bank).

Ideally, the central bank of a country can control the open market operation if the money market is deep. However, it is not the case in the context of Bangladesh. As an operating target, the Bangladesh Bank should focus more on discount lending than open market operation because the money market is still in its developmental stage in Bangladesh. In Bangladesh, interest rate is mostly set by the Bangladesh Bank and the banking system is allowed to change it within a band. The nationalized commercial banks (NCBs) dominate the banking system and are controlled indirectly by the directives of the Ministry of Finance. The short-term money market is still in its infancy. Moreover, the recent breakdown in the relationship between monetary aggregates and goal variables such as nominal GDP and inflation in many developed countries have raised doubt about the effectiveness of monetary targeting approach.

The Government of Bangladesh can pursue a rather new but not tested policy of inflation targeting, which sets an inflation target for the Bangladesh bank, and makes the central bank relatively independent in its policy pursuit. Central banks need a nominal anchor that will promote price stability. Foreign exchange can be a nominal anchor in the context of having a currency board (ties the value of its currency to the currency of a country with a good inflation record) or dollarization (adopting dollar as its currency). However, the problem with this strategy is that a country no longer exercises control over its own monetary policy and cannot use monetary policy to respond to domestic needs. Inflation targeting, however, has not been able to produce a decline in inflation without a substantial decline in output and a rise in unemployment (examples of New Zealand, Canada and United Kingdom). However, inflation targeting has one advantage: it keeps the goal of price stability in the public's eye, thus making the central bank more accountable for keeping inflation low, which helps reduce political pressure on the central bank to pursue inflationary monetary policy.

A large sector of Bangladesh economy is not monetized. The government should implement policies so that the non-monetized sector can be brought into monetized sector so that

it can be measured, which in turn will exert less variability in the measurement of multiplier and velocity.

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Table 1: Unit Root Tests (1973-97)

Variable	ADF Test	Phillips-Perron Test	KPPS Test
M1	-2.2527 (4)	-4.2105 (4)	0.1418 (1)
M2	-1.2028 (4)	-3.2534 (4)	0.2826 (1)
CD	-3.5868 (4)	-3.2756 (4)	0.7182 (2)
ERD	0.34503 (4)	-3.3144 (4)	0.9111 (4)
TD	-2.4787 (4)	-1.0310 (4)	0.1107 (4)
.M1	-2.7901 (4)	-14.912 (4)	0.0783 (2)
.M2	-2.7080 (4)	-15.881 (4)	0.0609 (2)
.CD	-4.5436 (4)	-23.831 (4)	0.0881 (2)
.ERD	-3.4582 (4)	-10.939 (4)	0.0792 (2)
.TD	-2.192 (4)	-15.765 (2)	0.0876 (4)

Note 1 : M1 = Narrow money multiplier; M2 = Broad money multiplier; CD = Currency deposit ratio; ERD = Excess reserve deposit ratio; TD = Time deposit ratio.

Notes : ADF regressions include a constant and a time trend. Lags in Parentheses. For ADF and Phillips-Perron tests, the 5% and 10% critical levels are -3.50 and -3.18, respectively [See Fuller (1996)]. For KPPS test, lag window size, $l=4$ and the 1%, 5% and 10% critical values, n , are 0.216, 0.146, and 0.119 respectively.

Source : Bangladesh Bank Bulletin

Table 2: Specification of Model

Model 1 : $M1 = f(CD, ERD)$
 Model 2 : $M2 = f(CD, ERD, TD)$

Table 3: Johansen and Juselius Test of Cointegration

Data Vector	Lag	Hypothesis	λ Max	λ Trace
M1, CD, ERD	3	$\gamma \leq 0$	29.322*	43.871*
		$\gamma \leq 1$	12.192	14.849
		$\gamma \leq 2$	2.2365	2.356
M2, CD, ERD, TRD	3	$\gamma \leq 0$	34.567*	83.151*
		$\gamma \leq 1$	24.280*	48.583*
		$\gamma \leq 2$	12.458	24.302
		$\gamma \leq 3$	5.8492	5.8492

Notes: We have experimented with a number of lags and found the 2 to be the optimal lag length. The null hypothesis states that there does not exist at most r cointegrating relationships among these variables (M1, CD and ERD) or (M2, CD, TD and ERD). The 10% critical values for eigenvalue statistics are: 20.90, 17.15 and 13.39 respectively. The 10% critical values for trace statistics are 64.74, 43.84 and 26.70 respectively.

Table 4 : Estimation of Error Correction Model
Causality tests : Model 1
Dependent Variable : Narrow Money Multiplier (M1)
Independent Variable : Currency Deposit Ratio (CD) and Excess Reserve Ratio (ERD)

Constant	Z_{t-1}	$\Delta M1_{t-1}$	$\Delta M1_{t-2}$	ΔCD_{t-1}	ΔCD_{t-2}	ΔERD_{t-1}	ΔERD_{t-2}
.10809 (.2769)	-1.06921 (-2.5353)	1.90255 (-2.08166)	1.29092 (1.54176)	1.0348 (1.28281)	1.14248 (1.4187)	1.11543 (1.14720)	2.22527 (2.31045)

Direction of Causality	F-Test	t-statistics
CD does not cause M1	0.26671	
ERD does not cause M1	2.8739**	
CD, ERD and Z_{t-1} do not cause M1	2.51746**	
CD and ERD do not cause M1 (Long-term)		-2.5353*

Notes F-test: ** significant at 10% level and t-statistics: * significant at 5% level.

Table 5 : Estimation of Error Correction Model
Causality tests : Model 2
Dependent Variable : Broad Money Multiplier (M2)
Independent Variable : CD, ERD, and Time Deposit Ratio (TD)

Constant	Z_{t-1}	$\Delta M2_{t-1}$	$\Delta M2_{t-2}$	ΔCD_{t-1}	ΔCD_{t-2}	ΔERD_{t-1}	ΔERD_{t-2}	ΔTD_{t-1}	ΔTD_{t-2}
-0.02679 (-0.14721)	-0.4635 (-0.894)	1.0427 (0.7418)	0.81078 (0.6466)	2.3798 (0.45495)	0.66373 (0.18148)	1.40963 (0.2824)	4.30353 (1.03431)	-0.35997 (-0.27092)	-0.439418 (-0.43258)

Direction of Causality	F-Test	t-statistics
CD does not cause M2	0.10851	
ERD does not cause M2	0.56783	
CD, ERD, TD and Z_{t-1} do not cause M2	0.12234	
CD, ERD and TD do not cause M2 (Long-term)		-2.89476

Notes F-test: ** significant at 10% level and t-statistics: * significant at 5% level.

Table 6: Selected Literature Review on Money Multiplier

Author(s)	Journal (Year)	Remarks
Bomhoff	JME (1977)	Developed a Box-Jenkins aggregate model to predict the US money Supply. Bomhoff's models perform 30% better than those produced by St. Louis.
Johannes and Rasche	JME (1979)	Argued that component approach of money multiplier yields better forecast than regressions or other time-series models.
Hafer and Hein	JME (1984)	Suggested that aggregate model does equally well as the component method.
Hossain	BDS (1993)	Found that the narrow and broad money multiplier equations are unstable and hence makes it difficult for the monetary authority to conduct money supply effectively.
Zaki	JDS (1995)	Concluded that aggregate rather than component forecasting approach of money multiplier provides better results for Egyptian money supply.
Arby	PDR (2000)	Developed a aggregate and component money multiplier model for Pakistan. Results suggest that aggregate method produce better forecast than component method.
Baghestani and Mott	JM (1997)	Found cointegration among the money supply, the monetary base, interest rate for US M1 money supply. A long-run equilibrium relationship was observed between the movement in interest rate differential and money supply using error correction method (ECM).
Ford and Morris	AP (1996)	Found evidence of cointegration between the monetary base and monetary aggregates.
Agung and Ford	IREB (1999)	Found evidence of cointegration between the monetary base and the divisia and one innovation variants.
Darba	AEL (2002)	Found a stable but time-varying long-run relation between measure of money stock and reserve money for India.
Lavoie	RPE (1992)	Argued that reverse causation rather than the instability of the velocity is the key objection to the quantity theory of money.
Scheide	K (1993)	Pointed the strategy of monetary targeting based on the stability of the money and multiplier and velocity of money.

Note: see reference for complete citation.