The Bangladesh Development Studies
Vol. XXXI, March-June 2005, Nos.1 & 2

Demand for Money in Bangladesh: A Cointegration Analysis

by

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I. INTRODUCTION

The demand for money, complex but essential for the formulation and conduct of efficient monetary and fiscal policy, has geared considerable research (e.g. Friedman (1959), Adekunle (1968), Fry (1978), Gupta (1983), Johansen and Juselius (1990), Hafer and Jansen (1991), and Hendry and Ericsson (1991 a, b)) since last few decades. But the determination of various factors (e.g. income, wealth, and opportunity cost of holding real balances) that affect the long-run demand for money as well as short-run dynamic adjustment of actual money balances to the desired level still remains inconclusive because of continuous monetary innovation and financial market integration. In general, in a well-functioning and matured capitalist economy, there are three motives for holding money, namely, transactions, speculative, and precautionary motives (Keynes 1936, ch. 13) and these motives depend on interest rates of alternative assets (i.e. the rate on treasury bills, bonds or securities or some weighted average rates of return on these financial assets) and the level of income, at least theoretically. In addition, empirical findings demonstrate that the demand for money adjusts to changes in income level and interest rates with a lag (Dornbusch and Fischer 2001). However, in countries with high inflation and narrow based capital market, it is also possible that the return on non-financial assets (i.e. stocks of gold, silver, real estate, and capital machinery or consumer durables) can be even higher than that on financial assets, thereby inducing households or firms to substitute/prefer non-financial assets over financial assets.

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Till now, a number of studies (e.g. Ahmed (1977), Murty and Murty (1978), Rahim and Uddin (1978), Taslim (1983, 1984), Hossain (1988), Hassan (1992), and Islam (2000)) have been conducted in the search for the appropriate variables and functional forms of the demand for money in Bangladesh. But these studies suffer from flaws in terms of the: (i) econometric estimation techniques; (ii) choice of appropriate variables; and (iii) data coverage.[1] In particular, except Islam (2000), all of these have used ordinary least squares (OLS) without examining the time series properties of the concerned macroeconomic variables. Since it is highly plausible that some of the time series variables that these studies have used are non-stationary in their levels, and therefore the OLS results are questionable.[2] Besides, Ahmed (1977), Murty and Murty (1978), and Rahim and Uddin (1978) have followed the approach suitable for a well-functioning and matured capitalist economy to estimate the money demand functions for Bangladesh ignoring the fact that the nominal interest rates they have used in the absence of the rates of return on alternative assets were institutionally fixed, not market based (Taslim 1984).

Although Islam (2000) has used cointegration techniques and finds that the money demand function in the country is stable, the paper is open to several criticisms. First, the issue that the data contains a significant number of observations on weighted average nominal interest rates which were administratively set (i.e. rates before the 1990s); therefore, the possible existence of a structural break in the data has been ignored. Second, the use of the same weighted average nominal interest rates for broad and narrow money (i.e. M2 and M1) categories respectively. Finally, the incorporation of expected inflation and weighted average nominal interest rates together in the estimation process may bias some of the results. Therefore, the main objective of the paper is to empirically explore the long-run equilibrium money demand relationship as well as short-run dynamics (i.e. stability and the speed of adjustment to the long-run equilibrium) in Bangladesh for both broad money (M2) and narrow money (M1 and M0) categories while overcoming the criticisms of the past studies on the topic.

The paper is timely and important since there have been significant changes in the legal, institutional and policy frameworks of the financial system of Bangladesh, particularly interest rate liberalisation under the Financial Sector Reform

[1] For a good analytical discussion on these empirical studies, see Islam (2000).

[2] Engle and Granger (1987) pointed out that if the time series variables are non-stationary in their levels and not cointegrated, OLS regression results would be *spurious* and the usual test statistics (i.e., t and F) would not be econometrically meaningful.

Programme (FSRP) initiated at the beginning of the 1990s.[3] These changes enable Bangladesh Bank (BB) to conduct monetary policy on the basis of market based instruments (e.g. *repo*, *reverse repo*, 28-day, 91-day, 182-day, 364-day, 2-year, and 5-year government Treasury bills (TBs)) along with direct instruments (e.g. bank rate, cash reserve requirement, and statutory liquidity ratio) in order to achieve price stability and smooth financial intermediation. Besides, in the face of fiscal dominance, BB on 21 September 2006 re-introduced its own 30-day and 91-day bills for open market operations. Therefore, knowing the long-run equilibrium money demand relationship as well as short-run dynamics for both the broad money and narrow money categories would guide the monetary authority in programming and conducting prudent monetary policy.[4]

The remainder of the paper is organised as follows: Section II discusses the theoretical model of the demand for money. Section III discusses the empirical framework and methodology used to obtain the empirical findings reported in the paper. Section IV provides data specification and estimated results on money demand in Bangladesh, and finally, section V presents a summary of the main conclusions and policy implications.

II. THE THEORETICAL MODEL

The task of modeling the money demand function for an economy (whether developed or developing) and to test that empirically involves the resolution of three contentious issues. These are: (i) which is the proper scale variable, measured

[3] Immediately after independence in 1971, BB adopted an administered interest rate policy which continued to the end of 1980s. In view of the shortcomings of the regime, a market oriented interest rate policy was introduced in January 1990 under the FSRP of the 1990s. The reform measures in general allowed scheduled banks of the country to freely set interest rate (both lending and deposit) as long as they remained within the bands determined by BB. Deposit rates were freed except that a floor and ceiling for savings and fixed deposit were established. In 1992, floors on savings and fixed deposit were continued but ceilings were removed. Finally, in 1997, the floor rates of deposits were removed. For further details, see Ahmed and Islam (2004a).

[4] The monetary programming exercise of BB involves the estimation of the *required limit* (also known as *safe limit*) of monetary expansion, i.e. broad money on the demand side. Previously, BB used income elasticity of demand for money approach to estimate the *safe limit* of monetary expansion. In recent years, the programming of the *safe limit* of monetary expansion is derived from the classical quantity equation of money demand, i.e., $\hat{M} = \hat{Y} + \hat{P} - \hat{V}$, where $\hat{M}$, $\hat{Y}$, $\hat{P}$, and $\hat{V}$ are the growth rates of money demand, anticipated real output, expected inflation rate and income velocity of money respectively (Ahmed and Islam 2004b).

current income, permanent income or wealth?; (ii) which is the appropriate measure of the opportunity cost of holding real balances, rate on treasury bills, bonds, securities, weighted average interest rate on deposits, or inflation (expected)?; and (iii) how does actual money balances adjust to the desired level? (Hafer and Jansen 1991). In the literature, measured current income and permanent income are the main competitors for scale variable (Hossain 1988). For developed countries, Friedman (1959) finds permanent income to be the superior scale variable over measured current income. Besides, permanent income is also found to be a better scale variable compared to measured current income even for developing countries (Fry 1978). However, Adekunle (1968), Mammen (1970), and Khan (1980) find that their elasticities are, more or less, close to each other for developing countries. Apart from the scale variable controversy, in a well-functioning developed and matured capitalist economy, it does not make significant difference whether the opportunity cost of holding real balances is measured by interest rates on alternative assets or inflation since interest rates reflect expectations of inflation (Dornbusch and Fischer 2001). Conversely, for a developing country with thin capital market and institutionally regulated interest rates, it has been argued that the use of inflation (expected) over interest rates as a measure of the alternative cost of holding money is more apposite (Taslim 1984).

In light of the above discussion, although Bangladesh is a developing country, to model its money demand function for both the broad money and narrow money categories and to test those empirically, the critical question that arises is should those models use data from or before 1990. This is vital because interest rates have been liberalised (market based) under the FSRP initiated at the beginning of the 1990s. As a result, to model the money demand functions using data before and since 1990, the choice of variable regarding the opportunity cost of holding money should be different. The reason is that since 1990, the country possesses some features of a developed economy due to interest rate liberalisation and the launching of market based instruments, especially various government TBs and some features of a developing economy (i.e. scale variable). Since the paper uses data since 1990, the money demand models for the country is specified to depend on: (i) real income (i.e. real GDP) and nominal TB (28-day) rates (as a measure of the opportunity cost of holding money) for broad money; (ii) real income and fixed deposit rates (nominal) for narrow money (M1); and (iii) real income and short-term deposit rates (nominal) for narrow money (M0).

The choice of the scale variable, in this paper, current income as measured by real GDP is due to the empirical findings of Adekunle (1968), that is, income expectations are static in least developed countries. Therefore, it would not be inappropriate that the demand for real balances depend on current income in

Bangladesh (Taslim 1984).[5] Since the largest component of broad money in Bangladesh is time deposits, the use of TB (28-day) rate as the alternative rate for broad money would be reasonable. Similarly, demand deposits are the biggest item of narrow money (M1), and therefore, using fixed deposit rates would not be inappropriate.[6] An increase in time deposit rates (i.e., fixed deposit rates) increases the cost of holding narrow money (M1), and thereby likely to induce people to reduce their holdings of narrow money (M1). These suffice the use of short-term deposit rates, i.e. the rates on demand deposits as a measure of the opportunity cost of holding narrow money (M0). In practice, narrow money (M0) is the difference between narrow money (M1) and demand deposits in the economy.

Therefore, the general money demand function for Bangladesh underpinning the preceding arguments can be represented in the following form:

$$m_j^d = f(y, R_l) \tag{1}$$

where,

m^d = demand for real money balances;
y = scale variable (i.e., real income);
R = nominal interest rate as an opportunity cost of holding money;
j = 1 for broad money (M2), 2 for narrow money (M1), and 3 for narrow money (M0); and
l = 1 for TB rate (28-day), 2 for fixed deposit rate, and 3 for short-term deposit rate.

Using t as the time subscript and adding a random disturbance term w, equation (1) can be written in Cobb-Douglas form as:[7]

$$m_{tj}^d = a y_t^b R_{tl}^c e^{w_t} \quad ; \quad t = 1, 2, \ldots T \tag{2}$$

Now, taking natural log on both sides, equation (2) can be represented as the following log-linear form:

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[5] Khan (1982) also finds that the substitution of permanent income for measured current income does not improve the estimates of the money demand functions for developing countries.

[6] Besides, the exclusion of the nominal interest rate variable may also cause a specification bias problem in the money demand functions (Islam, 2000).

[7] Islam (2000) has also used a similar functional form.

$$ln\ m_{tj}^{d} = ln\ a + b\ ln\ y_t + c\ ln\ R_{tl} + w_t\ ;\ b>0;\ c<0 \qquad (3)$$

This form of money demand function originates from the classic quantity theory of money demand. Besides, equation (3) is the empirically testable version of the long run equilibrium money demand function for various monetary aggregates in Bangladesh. Finally, it is important to mention that the sign of the elasticity coefficients (i.e. b and c) of real income and nominal interest rate variables are expected to be positive and negative respectively in the empirical results.

III. THE EMPIRICAL FRAMEWORK AND METHODOLOGY

Before employing the appropriate econometric technique to arrive at empirical findings reported in the paper, time series properties of all concerned macroeconomic variables have been identified by four most popular unit root tests, namely, Dicky-Fuller (DF 1979), Augmented Dickey-Fuller (ADF 1981), Phillips-Perron (PP 1988) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS 1992) tests, respectively. Based on these tests, if the variables are found to be non-stationary in their levels, it necessitates the tests for cointegration (Engle and Granger 1987). In order to test cointegration, Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration approach (also known as *JJ approach*) has been applied in the empirical estimation. The basic features of this approach are illustrated below in brief.

Following Johansen (1988) and Johansen and Juselius (1990), a vector autoregression (VAR) system of k^{th} order formed by N-dimensional vector Y_t of non-stationary variables can be represented as:

$$Y_t = \Pi_1 Y_{t-1} + \ldots\ldots + \Pi_k Y_{t-k} + \eta + \varepsilon_t \quad (t = 1, 2, \ldots T) \qquad (4)$$

where ε_t is N-dimensional vector of innovations which are independently and identically distributed with zero mean and constant variance. Besides, η represents a vector of constant terms which can be decomposed into two parts: (i) intercept in the cointegrating equation; and (ii) the trend term. Since equation (3) contains three time series variables, the vector Y_t is of N = 3-dimensional. Using Δ as the first difference operator, the k^{th} order VAR system represented by equation (4) can be expressed in the following vector error-correction model (VECM) form:

$$\Delta Y_t = \Pi_1 Y_{t-1} + \sum_{i=1}^{k-1} \Gamma \Delta\ Y_t + \eta + \varepsilon_t \qquad (5)$$

In equation (5), Π is the parameter matrix and the rank r of this matrix $r(\Pi)$ determines the number of cointegrating vectors that exists in the k^{th} order VAR system. If $0<r<N$, parameter matrix Π can be expressed as $\Pi = \alpha\beta'$ where α is the speed of adjustment vector (also known as weights or loadings) and β is the cointegrating vector and, in this case, the dimension of α and β are $N \times r$. Conversely, if $r = N$, the vector Y_t is stationary (i.e. I (0)). In the other extreme, when $r = 0$ then the parameter matrix Π is null and the vector Y_t is a non stationary process. Here, it is important to mention that the sign and magnitude of the coefficients of estimated α vector provides information regarding short-run dynamics of the k^{th} order VAR system, i.e. its stability, direction, and the speed of adjustment towards the long-run equilibrium path. Therefore, for the money demand function for Bangladesh, estimated in the paper, a coefficient value of less than unity implies that the short-run money demand function is stable and any deviation of short-run money demand from its long-run equilibrium will be corrected within a reasonable time, thus, the long-run equilibrium will be reinstated (Islam 2000).

Johansen (1988) and Johansen and Juselius (1990) develop two test statistics for identifying the number of cointegrating vectors (if any exists), namely, the trace (λ_{Trace}) statistic and the maximum eigenvalue ($\lambda_{\max}$) statistic. These test statistics can be written as:

$$\lambda_{Trace} = -T \sum_{i=r+1}^{N} \ln\left(1 - \hat{\lambda}_i\right) \tag{6}$$

$$\lambda_{\max} = -T \ln\left(1 - \hat{\lambda}_{r+1}\right) \tag{7}$$

where $\hat{\lambda}_i$ is the estimated value of the i^{th} characteristics root obtained from the estimated parameter matrix Π and T is the number of usable observations. The $\lambda_{\max}$ statistic tests the null hypothesis that there are at least r cointergrating vectors as against the alternative of $(r + 1)$ cointergrating vectors. On the other hand, the λ_{Trace} statistic tests the null hypothesis that the number of distinct characteristic roots is less than or equal to r as against a general alternative.[8] Like standard t of F tests, the null hypotheses under these two likelihood ratio (LR) tests are not rejected if the estimated values are less than the critical values at the appropriate level of significance and the degrees of freedom.

[8] Johansen and Juselius (1990) pointed that the power of the trace test is lower.

Finally, "weak exogeneity" tests have been performed by imposing zero restriction on the speed of adjustment coefficients of the estimated α vector to identify whether each respective time series variable can be treated as exogenous or not, i.e. whether each variable of concern adjusts towards its long-run equilibrium path. In a cointegrated system, if a time series variable does not respond to the deviation from the long-run equilibrium relationship, it is regarded as weakly exogenous. Therefore, if the estimated speed of adjustment coefficient α_i equals zero, the variable in question is weakly exogenous and it does not experience the required type of feedback that necessitates the use of an k^{th} order VAR system (Enders 2003).

IV. DATA AND EMPIRICAL EVIDENCE

IV.1 Data Specification

The empirical estimation in the paper has used quarterly data on: (i) real GDP at producer prices (base year: 1995-96);[9] (ii) broad money (M2); (iii) narrow money (M1); (iv) narrow money (M0); (v) TB (28-day) rate (nominal);[10] (vii) fixed deposit rate (nominal); and (viii) short-term deposit rate (nominal) for the period of January-March 1990 to April-June 2006.[11] These data have been retrieved from various publications of Bangladesh Bureau of Statistics (BBS) and BB. Data on broad money, narrow money (M1), and narrow money (M0) have been transformed in real terms by using quarterly GDP deflator (base year: 1995-96) and these variables along with real GDP have also been adjusted for seasonality.

Finally, in the estimation process, the money demand model regarding: (i) broad money has used quarterly data on real broad money (*RM*2), real GDP (*RGDP*), and nominal TB (28-day) rate (*TBR*); (ii) narrow money (M1) has used real narrow money (*RM*1), *RGDP*, and nominal fixed deposit rate (*FDR*); and (iii) narrow money (M0) has used real narrow money (*RM*0), *RGDP*, and nominal short-term deposit rate (*SHDR*). Hence, *RM*2, *RM*1, *RM*0, *RGDP*, *TBR*, *FDR*, and *SHDR* denote the relevant time series macroeconomic variables in the log form.

IV.2 Empirical Evidence

The results of the unit root tests on the relevant time series macroeconomic variables have been reported in Table I. Based on these results, it can be concluded

[9] For an elaboration, see Ahmed and Islam (2004a).

[10] Data on TB (28-day) rate before January-Mach 1995 has been proxied by government TB rates (ad hoc).

[11] All nominal interest rates (i.e. TB, fixed, and short-term deposit rates) are weighted average rates.

that all of the variables, i.e. *RM*2, *RM*1, *RM*0, *RGDP*, *TBR*, *FDR*, and *SHDR* are non-stationary in their levels and contain unit roots I(1). The non-stationarity of these variables in levels suffice the use of Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration approach to explore the long-run equilibrium money demand relationship as well as short-run dynamics for both the broad money and narrow money categories in Bangladesh.

Table II presents the results on Johansen (1988) and Johansen and Juselius (1990) maximum likelihood (ML) test for cointegration. For broad money category in the country, both the trace (λ_{Trace}) and the maximum eigenvalue ($\lambda_{\max}$) test statistics indicate the presence of a single cointergrating vector (i.e., $r = 1$) among *RM*2, *RGDP*, and *TBR* variables at 5-per cent level of significance. Again, for narrow money (M1), a single cointegrating vector exists among *RM*1, *RGDP*, and *FDR* variables suggested both by the trace (λ_{Trace}) and the maximum eigenvalue ($\lambda_{\max}$) test statistics at 5-per cent level of significance. Finally, for narrow money (M0) category, the trace (λ_{Trace}) and the maximum eigenvalue ($\lambda_{\max}$) test statistics indicate a single cointegrating vector among *RM*0, *RGDP*, and *SHDR* variables at 5 per cent level of significance. Therefore, it can be concluded that there exists a long-run equilibrium relationship among real money balances of various types, real income and respective nominal interest rates in the economy.

Based on the conclusion regarding the existence of a single cointegrating vector for all types of monetary aggregates (i.e. M2, M1, and M0), ML estimates of the respective cointegrating vectors (normalised on *RM*2, *RM*1, and *RM*0 respectively) have been reported in Table III. It is observable that for broad money demand, both *RGDP* and *TBR* variables are significant even at the 1-per cent level, i.e. the null hypothesis of long-run zero restrictions is rejected for these variables at 1-per cent level of significance. Besides, the coefficients (i.e. the elasticity coefficients) of these variables have the expected positive and negative signs, respectively. For narrow money (M1) demand, the variables, *RGDP* and *FDR*, are significant at 1-per cent level and their coefficients have also the expected positive and negative signs respectively. Lastly, for narrow money (M0) demand, *RGDP* variable is significant at 1-per cent level while *SHDR* variable is significant at 10 per cent level with the expected coefficient signs, and in this case, positive on *RGDP* variable and negative on *SHDR* variable. Thus, real income is the most important factor that influences the long-run demand for all types of real balances in the economy. Besides, TB (28-day) rate, fixed deposit rate, and short-term deposit rates are also important in determining the long-run demands for broad money, narrow money (M1), and narrow money (M0) respectively.

TABLE I
UNIT ROOT TESTS ON THE VARIABLES

Variables (in log levels)	DF		ADF		PP		KPSS		Decision
	Without trend	With trend	Without trend	With trend	Without trend	With trend	Without trend	With trend	
RM2	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
RM1	I(1)***	I(1)	I(1)	I(1)	I(1)	I(1)***	I(1)	I(1)**	I(1)
RM0	I(1)	I(1)	I(1)	I(0)	I(1)	I(0)	I(1)	I(1)**	I(1)
RGDP	I(1)	I(1)	I(1)	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)
TBR	I(0)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
FDR	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)**	I(1)	I(1)
SHDR	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)**	I(1)	I(1)

Notes: 1. All tests have been performed on the basis of 5 per cent significance level using Econometric Views 4 Package.

2. *** and ** mean significant at 1 per cent and 10 per cent levels, respectively.

3. Lag length for DF tests has been decided on the basis of Schwartz's Information Criteria (SIC).

4. Lag length for ADF tests has been decided on the basis of Akaike's Information Criteria (AIC).

5. Maximum Bandwidth for PP and KPSS tests has been decided on the basis of Newey-West (1994).

6. The DF, ADF and PP tests are based on the null hypothesis of unit roots while the KPSS test assumes the null hypothesis of stationarity.

TABLE II
JOHANSEN TEST FOR COINTEGRATION

Null Hypothesis	Alternative Hypothesis	Test Statistics	5 per cent Critical Value	1 per cent Critical Value	Conclusion
M2 Money Demand[1]					
			Trace Test		
$r = 0$	$r > 0$	36.18	29.68	35.65	
$r \leq 1$	$r > 1$	15.19	15.41	20.04	One Cointegrating Relationship
$r \leq 2$	$r = 3$	4.41	3.76	6.65	
			Maximum Eigenvalue Test		
$r = 0$	$r = 1$	20.99	20.97	25.52	
$r = 1$	$r = 2$	10.78	14.07	18.63	One Cointegrating Relationship
$r = 2$	$r = 3$	4.41	3.76	6.65	
M1 Money Demand[2]					
			Trace Test		
$r = 0$	$r > 0$	38.87	29.68	35.65	
$r \leq 1$	$r > 1$	14.46	15.41	20.04	One Cointegrating Relationship
$r \leq 2$	$r = 3$	4.37	3.76	6.65	
			Maximum Eigenvalue Test		
$r = 0$	$r = 1$	24.40	20.97	25.52	
$r = 1$	$r = 2$	10.09	14.07	18.63	One Cointegrating Relationship
$r = 2$	$r = 3$	4.37	3.76	6.65	

(Contd. Table II)

(Contd. Table 11)

M0 Money Demand[3]

Null Hypothesis	Alternative Hypothesis	Test Statistics	5-per cent Critical Value	1-per cent Critical Value	Conclusion
			Trace Test		
r = 0	r > 0	56.56	34.91	41.07	
r ≤ 1	r > 1	9.24	19.96	24.60	One Cointegrating Relationship
r ≤ 2	r = 3	3.47	9.24	12.97	
			Maximum Eigenvalue Test		
r = 0	r = 1	47.35	22.00	26.81	
r = 1	r = 2	5.77	15.67	20.20	One Cointegrating Relationship
r = 2	r = 3	3.47	9.24	12.97	

Notes: 1. The results are based on the assumptions of a linear deterministic trend in the data and an intercept in the cointegrating equation with optimal lag length 4. AIC and SIC have been used in the VAR system to determine the optimal lag length that makes the residuals white noise, i.e. zero mean, constant variances, and individually serially uncorrelated.

2. The results are based on the assumptions of a linear deterministic trend in the data and an intercept in the cointegrating equation with optimal lag length 4. AIC and SIC have been used in the VAR system to determine the optimal lag length that makes the residuals white noise.

3. The results are based on the assumptions of no deterministic trend in the data and an intercept in the cointegrating equation with optimal lag length 3. AIC and SIC have been used in the VAR system to determine the optimal lag length that makes the residuals white noise.

TABLE III
COINTEGRATING EQUATIONS

Normalised Cointegrating Coefficients: M2 Money Demand		
RM2	*RGDP*	*TBR*
1.00	-1.89*	0.12*
	(0.03)	(0.02)
Normalised Cointegrating Coefficients: M1 Money Demand		
RM1	*RGDP*	*FDR*
1.00	-1.42*	0.41*
	(0.03)	(0.04)

Normalised Cointegrating Coefficients: M0 Money Demand			
RM0	*RGDP*	*SHDR*	*CONSTANT*
1.00	-1.88*	0.29**	12.09*
	(0.16)	(0.19)	(2.24)

Notes: 1. * and ** mean significant at 1 per cent and 10 per cent levels respectively.
2. Figures in the parentheses are standard errors.

In the above, the elasticity coefficient of real income variable is greater than unity for all categories of monetary aggregates, therefore, it can be concluded that money is deemed a luxury good in Bangladesh. For instance, a 1-per cent increase in real income (i.e. *RGDP*) raises the demand for real broad money (i.e. *RM2*) by 1.89 percent. The results regarding the income elasticity of money demand in equations (8) and (9) are consistent with those of Islam (2000). Besides, the magnitude is less for narrow money (M1) than broad money and narrow money (M0). On the other hand, the magnitude of the elasticity coefficient of nominal fixed deposit rate (i.e. *FDR*) and nominal short-term deposit rate (i.e. *SHDR*) variables indicates that alternative money demand in the financial system of the country is in effect. That is, time deposits and demand deposits act as alternative demands for narrow money (M1) and narrow money (M0) respectively in the absence of a bond market and the existence of a narrow based capital market in the economy. Surprisingly, most of the earlier empirical studies on money demand have failed to capture this phenomenon in Bangladesh. This is very important in view of policy stances since monetary policy in the current regime is based on market based instruments (along with direct instruments) initiated under the FSRP of the 1990s. Finally, the magnitude of the elasticity coefficient of real income variable for all categories of monetary aggregates is way higher than the magnitude of the elasticity coefficient of relevant nominal interest rate variables. Thus, the demand for real balances in the economy is strongly dominated by the transactions motive for holding money.

TABLE IV
SHORT-RUN DYNAMICS AND SPEED OF ADJUSTMENT COEFFICIENTS

	M2 Money Demand		
	$\Delta RM2$	$\Delta RGDP$	ΔTBR
	-0.32**	-0.16**	-2.21*
	(0.16)	(0.07)	(0.80)
	Weak Exogeneity Test		
	$\Delta RM2$	$\Delta RGDP$	ΔTBR
Chi-square (1)	3.58	4.22	4.93
Probability	0.05	0.04	0.02
	M1 Money Demand		
	$\Delta RM1$	$\Delta RGDP$	ΔFDR
	-0.56*	-0.18*	-0.19**
	(0.19)	(0.06)	(0.09)
	Weak Exogeneity Test		
	$\Delta RM1$	$\Delta RGDP$	ΔFDR
Chi-square (1)	6.57	7.75	2.83
Probability	0.01	0.00	0.09
	M0 Money Demand		
	$\Delta RM0$	$\Delta RGDP$	$\Delta SHDR$
	-0.05*	-0.05*	-0.02
	(0.02)	(0.01)	(0.04)
	Weak Exogeneity Test		
	$\Delta RM0$	$\Delta RGDP$	$\Delta SHDR$
Chi-square (1)	3.05	3.35	0.69
Probability	0.08	0.06	0.40

Notes: 1. * and ** means significant at 1-per cent and 5-per cent levels, respectively.
2. Figures in parentheses are standard errors.

The empirical results on short-run dynamics for all types of monetary aggregates have been reported in Table IV. All the speed of adjustment coefficients regarding broad money and narrow money (M1 and M0) demands have negative sign and significant either at 1-per cent or at 5-per cent level except the speed of adjustment coefficient of nominal short-term deposit rate (i.e. *SHDR*) variable is insignificant (although has negative sign) at any conventional level of significance. The estimated speed of adjustment coefficients for broad money, narrow money (M1), and narrow money (M0) demands is -0.32, -0.56, and -0.05 respectively. Besides, weak exogeneity of the variables, *RM*2, *RM*1, *RM*0, *RGDP*, *TBR*, and *FDR*, can be rejected either at 5-per cent or 10 per cent level of significance and cannot be rejected for nominal short-term deposit rate variable at any conventional level of significance. These results suggest stability of the short-run money demand

function for all types of monetary aggregates in Bangladesh. It can be concluded that 32 per cent of any deviation of broad money demand from its long-run equilibrium path is corrected in each quarter which is quite reasonable. The speed of adjustment for narrow money (M1) and narrow money (M0) demands are 56 per cent and 5-per cent in each quarter respectively.

V. CONCLUSION

The paper empirically explores the long-run equilibrium money demand relationship as well as short-run dynamics, i.e. stability and the speed of adjustment to the long-run equilibrium in the context of Bangladesh for both the broad money and the narrow money categories. An assessment of the empirical evidence has been made through Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration techniques using quarterly data on relevant macroeconomic variables. The empirical evidence demonstrates that a single cointegrating vector describes the long-run equilibrium money demand relationship for both the broad money and narrow money (M1 and M0) categories in the country. Besides, there exists a statistically significant long-run equilibrium demand relationship among real money balances of various types, real income and respective nominal interest rates. In other words, the long-run demands for broad money, narrow money (M1), and narrow money (M0) depend positively on real income and negatively on TB, fixed deposit, and short-term deposit rates respectively. It is also observable that the demand for real balances in the economy is strongly dominated by the transactions motive for holding money, reflected by the magnitude of the elasticity coefficient of real income variable for all categories of monetary aggregates.

Finally, the results on short-run dynamics suggest stability of the short-run money demand function for all categories of monetary aggregates and the speed of adjustment to the respective long-run equilibrium path is quite reasonable. For instance, in each quarter, 32 per cent of any deviation of broad money demand from its long-run equilibrium path is corrected. These results have important implications for the efficacy of the monetary policy in Bangladesh under the current regime, i.e. floating exchange rate and market based monetary policy instruments.

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