Volume 6
Number 1 & 2
Year 2004
ISSN 1529-0905

Journal of BANGLADESH STUDIES

BDI
Bangladesh Development Initiative

TABLE OF CONTENTS

MONEY, OUTPUT AND PRICES IN BANGLADESH

Akhtar Hossain

ABSTRACT

This paper has examined the Granger-causal relationship between money supply growth and inflation in Bangladesh for the period 1974-2003 within the cointegral-error correction-modeling framework. Empirical results suggest that the consumer price index (CPI), the stock of narrow (M1) or broad money (M2) and real permanent output/income (y^p) have a cointegral relationship and that there exists a strong causal relationship running from money supply growth to inflation. The paper draws the conclusion that the Bangladesh Bank (central bank of Bangladesh) is in a position to conduct an independent monetary policy for price stability through a monetary or an inflation targeting strategy. Inflation targeting as a strategy of monetary policy however remains conditional on a set of stringent conditions and is considered not appropriate for Bangladesh at this juncture. Monetary targeting may therefore be considered an alternative option, given that under the present market-based exchange rate system, the Bangladesh Bank has gained an effective control over the monetary base and that there exists both a stable money demand function and a situation of monetary stability as envisaged by monetary economists for a monetary rule.

Introduction

The role of monetary policy in price stability[1], meaning low and steady inflation, has increased in Bangladesh since the beginning of financial reforms in the early 1980s. Although the pace of financial reforms has been slow, they have covered most aspects of banking and finance and have been associated with opening-up the economy. The global integration of the Bangladesh economy has created as many opportunities as challenges insofar macroeconomic management. The greater importance that the monetary authorities in Bangladesh have lately placed on monetary and financial policy for macroeconomic stability is reflected in the amendment of the Bangladesh Bank Order 1972 in 2003 that has provided the Bangladesh Bank (central bank of Bangladesh) considerable institutional autonomy to pursue its monetary policy goal of price and exchange rate stability.[2] Although some ambiguities have remained, the objective of monetary policy as per the amended Order appears to have been redirected from directly promoting production and employment *'towards fostering growth and development of the country's productive resources in the best national interest'* through price and exchange rate stability.[3]

Whilst this change of the focus of monetary policy has been in the lines of international best practices, the Bangladesh Bank is yet to design and implement a monetary policy framework that would achieve price and exchange rate stability on a sustained basis. In fact, until recently the choice of a monetary policy strategy did not get priority in Bangladesh. Apparently, under both a pegged exchange rate system[4] and capital controls, monetary policy was conducted passively in conjunction with fiscal policy and their common objective was to achieve and maintain an adequate level of foreign exchange reserves rather than price stability *per se*. This strategy was also adopted on an adhoc basis and did not have credibility insofar achieving and maintaining price stability. To begin, Bangladesh is not such an inflation-prone country in a historical sense [Hossain and Rashid 1996] that would have required the introduction of an exchange rate-based stabilization program *à la* IMF. As a strategy of monetary policy, exchange rate pegging was not appropriate[5] for this country, especially when its economy has a relatively large non-tradable goods sector and remains exposed to both demand and supply shocks. Facing sustained external imbalances, the monetary authorities abandoned exchange rate pegging on May 31, 2003 in favor of a market-based exchange rate system. This was a bold decision and has made monetary policy an independent instrument in achieving its goal of price stability.[6]

Having gained monetary policy independence by discarding exchange rate pegging, the Bangladesh Bank would be able to conduct monetary policy better for price stability through an alternative nominal anchor.[7] Monetary and inflation targeting[8] remain the two rule-based strategies of monetary policy that may achieve and maintain price stability [Blejer, Ize and Leone 2000; Mishkin 2000]. The prevailing view of high officials in the Bangladesh Bank is that inflation targeting is not appropriate for Bangladesh at this juncture. Monetary targeting is however considered an option, given that an adhoc form of 'monetary base targeting' has remained in place under the ongoing World Bank-IMF-supported *Poverty Reduction and Growth Facility* (PRGF) program.

Whether monetary targeting remains an appropriate strategy of monetary policy for Bangladesh depends on the presence of a stable money demand function. The reason is that a stable money demand function is a necessary condition for any causal relationship between money supply growth and inflation. Hossain [2003;2004] has investigated the money demand behavior in Bangladesh with recent data. His main finding is that the money demand function in Bangladesh has remained broadly stable since the 1980s despite ongoing financial reforms. To complement this finding, this paper examines whether there exists a Granger-causal relationship between money supply growth and inflation in Bangladesh.

The remainder of this paper is organized as follows. Section II reviews the behavior of money, output and prices in Bangladesh using historical data since the 1950s when Bangladesh was known as East Pakistan in erstwhile Pakistan.[9] Section III specifies the relationship between money supply growth and inflation within a monetarist framework. Section IV establishes a cointegral relationship among money, output and prices for two sample periods: 1973-2003 and 1983-2003. Section V tests for a Granger-causal relationship between money supply growth and inflation within the cointegral-error correction-modeling framework. Section VI validates the monetary model of inflation by establishing an empirical relationship between excess money supply and inflation. Section VII summarizes the findings and draws conclusion. The paper has an Appendix, which reports the sources of data and the time series properties of variables used in the regression analysis.

Money, Output and Prices in Bangladesh: 1951-2003

Table 1 reports 5-yearly average historical data for money growth, output growth and CPI-inflation for the period 1951-2003. Annual data for these variables are also reported for the period 1999-2003. It is revealed that for Bangladesh, the 1950s and 1960s were periods of low inflation of about 4 percent per annum. This was partly the outcome of the country's macroeconomic policies, whose main goal was to promote economic growth without generating high inflation on the understanding that price stability is essential for orderly economic growth [Papanek 1981]. Such policy stance was in contrast with the prevailing view in many developing countries that inflation, caused by structural rigidities, is a

Table 1
Money, Output and Prices in Bangladesh: 1951-2003
(Annual Average)

Period/ Fiscal Year	Economic Growth (%)	Narrow Money Supply Growth (%)[a]	Broad Money Supply Growth (%)	CPI-Inflation (%)
1951-1955	2.8	7.8	n.a[b]	-1.2
1956-1960	2.1	8.6	n.a	7.3
1961-1965	5.0	8.6	n.a	2.9
1966-1970	3.6	7.8	n.a	6.4
1971-1975	-8.6	23.1	42.1	42.8
1976-1980	5.2	19.7	22.4	7.3
1981-1985	3.8	18.6	23.7	10.8
1986-1990	4.2	7.5	15.5	8.7
1991-1995	4.2	15.7	13.5	5.6
1996-2000	5.6	10.2	13.3	5.5
1999-2003	5.4	9.5	12.7	4.7
FY1999[c]	5.2	12.8	15.6	8.9
FY2000	6.0	7.5	8.4	3.4
FY2001	5.3	12.4	16.6	1.6
FY2002	4.8	8.1	13.1	2.4
FY2003	5.5	6.8	9.8	7.0

Source: Author's estimation/compilation based on IMF, *International Financial Statistics; IMF, Public Information Notice*; Bangladesh Bank, *Economic Trends*; Alamgir and Barlage [1974]; Islam [1981] and Kabir [1980].

Notes: a. The estimated data for the narrow money stock for Bangladesh are drawn from Kabir [1980]. As the estimates appear to have been made using crude assumptions, they need to be treated with caution.
b n.a. = not available.

necessary price that a developing country must pay for rapid economic growth [Corbo 1974; Agenor and Montiel 2000; Montiel 2003]. To the policy-makers in Pakistan, inflation was essentially a monetary phenomenon with some fiscal roots [Hossain and Rashid 1996]. This explains the moderate growth rate of the (estimated) narrow money supply in Bangladesh during 1951-1970, precisely about 8 percent per annum. The associated economic growth rates during the 1950s and 1960s were 2.5 and 4.3 percent per annum. Thus it appears that there was some balance between money growth, output growth and inflation in Bangladesh during the period 1951-1970.

Bangladesh gained independence from Pakistan on December 16, 1971. This was achieved after a prolonged autonomy movement and an independence war. The country went through a turbulent period of economic-political crisis during 1974-1975. This was in the midst of a historically high inflation rate of about 40 percent per annum during 1972-1975. Available studies suggest that the main source of this inflation was excessive money supply growth in a war-ravaged economy [Ahsan 1974; Alamgir 1980; Bose 1973; Rahim 1973; Siddique 1975; Hossain 1995;1996;2000]. The inflation rate fell sharply after the political change in August 15, 1975 and remained at an average level of about 10 percent per annum throughout the late 1970s and the 1980s. The inflation rate fell further in the 1990s and stabilized at a level of about 5 percent per annum since FY1999. The monetary data in Table 1 show that the money supply growth rate (narrow or broad) during 1972-2003 exhibited a pattern that was broadly similar to that of inflation. The associated economic growth rate since the early 1980s was about 5 percent per annum. Again, it appears that there was some balance between money growth, output growth and inflation in Bangladesh during the period 1972-2003.

On the basis of this brief review, it is possible to draw a testable hypothesis that a monetary model of inflation is appropriate for explaining the inflationary process in Bangladesh, especially since its Independence. Section III outlines such a model for investigation of the relationship among money, output and prices in Bangladesh.

Money Growth, Output Growth and Inflation

Consider the money market equilibrium condition:

$$m^s = m^d \qquad (1)$$

where $m^s = M/P$ (real money stock, M is the nominal money stock and P is the price level) and $m^d(y^p,i)$ is real money demand, which is an increasing function of real permanent income y^p and a decreasing function of the nominal interest rate i.[10] From this money market equilibrium condition, the following relationship can be derived in proportional growth form:

$$\pi = \lambda - (\eta_y g_y - \eta_i g_i) \qquad (2)$$

where π is the inflation rate, λ is the money supply growth rate, g_y is the permanent income/output growth rate, g_i is the percentage change in the nominal interest rate, and η_y (η_i) is the income (interest) elasticity of demand for money.

Equation (2) shows that the inflation rate equals the growth rate of the money supply less the growth rate of money demand, which measures the excess growth rate of the money supply. In general, an excess growth of the money supply can originate from both the demand and supply sides of the money market and should be considered the proximate cause of long-term inflation. This is the basis of the monetarist dictum that 'inflation is always and everywhere a monetary phenomenon' (Friedman 1963:17).[11]

Relationships Among Money, Output and Prices in Bangladesh

Underneath any causal relationship between money supply growth and inflation as specified in Section III, there are two basic conditions that need to be fulfilled: first, there exists a stable money demand function [Friedman 1956; Judd and Scadding 1982]; and, second, the monetary authorities have control over the money supply (that is, the money stock is an exogenous policy variable). In the literature, the question of stability of the money demand function is considered an empirical issue, while the monetary authorities can maintain an effective control over the monetary base under a floating exchange rate system.

Recent studies, such as Hossain [2003;2004], suggest that the money demand function in Bangladesh has remained broadly stable since the early 1980s. This satisfies the first condition for a causal relationship between money supply growth and inflation in Bangladesh. However the second condition for the causal relationship between money and inflation is not apparently satisfied for this country because it operated under a fixed or pegged exchange rate system throughout the sample period that made the money stock an endogenous variable. Nevertheless, the monetary authorities maintained short-to-medium term control over the money supply through policy measures, such as credit and capital controls and trade restrictions. Therefore the question whether there

existed a relationship among money, output and prices in Bangladesh can be considered an empirical issue. A relationship may indeed exist among these variables in Bangladesh that has a large non-tradable goods sector where the prices of non-tradable goods change in response to monetary conditions.

Cointegral Relationships Among Money, Output and Prices

Given that there exists a stable money demand function in Bangladesh and the monetary authorities maintained some control over the money stock through policy measures, it is hypothesized that the stock of the nominal money (M1 or M2), the consumer price index (CPI) and real permanent income/output (y^P) formed a long-term cointegral relationship during the period 1973-2003. The Appendix reports the time series properties of these variables, which suggest that they have a unit root and are eligible to form a cointegral relationship.[12]

The presence of a cointegral relationship can be examined within the cointegration-error correction modeling framework by estimating a regression equation of CPI as a dependent variable on real permanent income/output and the nominal money stock, and any misspecification bias that emerges in the cointegration regression as a result of omitted dynamics being forced into the error term can be removed by adding the first-difference terms of the explanatory variables, with or without lags. For the present purposes, the Engle-Granger two-step test is conducted.[13] The establishment of a cointegral relationship among money, output and prices is the first step that allows testing for a Granger-causality between money supply growth and inflation within the error-correction modeling framework. The test for cointegration among variables in the cointegrating set (ln CPI, ln M1 or ln M2, ln y^p) is essentially a test for a unit root in the residuals of the cointegrating regression. When the non-stationary variables form a cointegral relationship, the residuals should be stationary. This is commonly tested by the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests. One additional test for cointegration is the Cointegrating Regression Durbin-Watson (CRDW) statistic, proposed by Sargan and Bhargava [1983]. To complement these tests, the Phillips-Perron and the KPSS tests are conducted.

Table 2 reports the cointegration tests results, where adj-R^2 is the adjusted coefficient of determination and the sample period is adjusted for lagged terms. The unit root tests results for the residuals of the cointegration regression suggest that there exists a cointegral relationship among money, output and prices. Note that in the Engle-Granger cointegration regression, even though the OLS parameter estimates are super-consistent, the same is not true for the estimated standard errors of the regression. Thus it is not possible to test for significance of individual coefficients in the cointegrating equation. The variables that entered in the

Table 2
Cointegral Relationships Among Money, Prices and Output

Sample: 1973-2003

$\ln CPI_t = 3.19 + 0.80 \ln M1_t - 0.55 \ln y^p_t - 0.75 \Delta \ln M1_t + 1.13 \Delta \ln y^p_t$
Estimator: OLS Adj-R^2 =0.99 CRDW=1.13 ADF(2) =-3.37 Phillips-Perron (Bandwith:3) =-3.12 KPSS (Bandwith:2): 0.10

$\ln CPI_t = 4.30 + 0.62 \ln M2_t - 0.53 \ln y^p_t - 0.73 \Delta \ln M2_t + 0.88 \Delta \ln y^p_t$
Estimator: OLS Adj-R^2 =0.99 CRDW=1.88 ADF(1)=-4.44 Phillips-Perron (Bandwith:12)=-5.24 KPSS(Bandwith:11):0.16

Sample: 1983-2003

$\ln CPI_t = -5.26 + 0.38 \ln M1_t + 0.47 \ln y^p_t - 0.67 \Delta \ln M1_t - 3.89 \Delta \ln y^p_t$
Estimator: OLS Adj-R^2=0.96 CRDW = 0.38 DF = -1.61 Phillips-Perron (Bandwith:1) =-1.38 KPSS (Bandwith:3): 0.15

$\ln CPI_t = 3.95 + 0.63 \ln M2_t - 0.53 \ln y^p_t - 0.20 \Delta \ln M2_t + 1.67 \Delta \ln y^p_t$
Estimator: OLS Adj-R^2 = 0.99 CRDW=1.22 DF=-3.22 Phillips-Perron (Bandwith:1)=-3.31 KPSS (Bandwith:1): 0.06

above defined cointegral relationship have been made on both theoretical and statistical grounds. In the estimated equations, the first-difference terms are unimportant and are included only to lower the finite sample bias in estimates of coefficients of variables in the level form.

An Error-Correction Model of Inflation

Having established the cointegral relationship, it is possible to specify and estimate an error-correction model for inflation. For the present purposes, an error-correction model for inflation of the following general form is specified and used for estimation:

$$\Delta \ln CPI_t = \alpha_0 + \alpha_1 EC_{t-1} + \sum \alpha_i Z_{t-j} \; (i = 2,3,\ldots; j = 0,1,2\ldots) + \varepsilon_t$$

where EC_{t-1} is the one-period lagged residual of the cointegrating regression of ln CPI on ln y^p, ln M1 or ln M2 and the difference terms of these variables, Z is a vector of stationary variables that are thought to explain the behavior of inflation, such as $\sum \Delta \ln CPI_{t-j-1}$, $\sum \Delta \ln M1_{t-j}$ or $\sum \Delta \ln M2_{t-j}$ and $\sum \Delta \ln y^p_{t-j}$ and ε_t is a randomly distributed error term.

Given that the error-correction model contains only stationary variables, the usual stationary regression theory applies. In this specification, the error correction term plays the crucial role. The coefficient of one period lagged error-correction term measures the speed of adjustment to the cointegration relationship if the actual relationship deviates from the long-term relationship due to disturbances or shocks [Engle and Granger 1987]. Unlike the estimation of a cointegral regression, the estimation of an error-correction model is, however, untidy. Beginning with a generalized form, a preferred equation is usually chosen through experimentation following, say, a general-to-specific modeling strategy that uses a range of diagnostic tests for model selection. The diagnostic tests normally include the Lagrange multiplier test for the i^{th} order autocorrelation in the residuals and the Ramsey RESET Lagrange multiplier test for incorrect functional form. When the error correction model fails the diagnostic tests, it may indicate problems with specification of the model. The error-correction model may then be respecified until the diagnostic tests indicate that the model is theoretically consistent and statistically adequate. Sometimes theoretical considerations are given precedence over minor statistical inadequacies.

Table 3 reports the preferred error-correction models of inflation for Bangladesh for two sample periods that fitted the data best. These models are selected after experimentation with the general form of the specification. As expected, the coefficient of the error-correction term with one period lag bears a negative sign. This coefficient remained statistically significant irrespective of whichever combinations of other variables were used in the regression model. The explanatory power of the model is high for the sample period 1974-2003. However the model suffers from some statistical problems perhaps because it is estimated with data for the 1970s that were the period of economic shocks and uncertainties. The model estimated for the shorter sample period 1984-2003 that covers the period of financial reforms is superior statistically, although the explanatory power of the model is somewhat lower. The diagnostic tests statistics show that this model does not suffer from any functional form misspecification, serial correlation and heteroskedasticity.

The Granger-Causality Between Money Growth and Inflation

One theoretical implication of cointegration is that if two variables, say, consumer price index and the nominal money stock, are integrated of order one and cointegrated, there must be a Granger-causality between inflation and money supply growth in at least one direction as one variable can help determine the other. The cointegration test results [Table 2] suggest that the consumer price index, the stock of nominal money, and real permanent output/income form a long-run relationship in Bangladesh. In the error-correction model, the coefficient of one-period lagged error-correction term suggests that there are forces within the economic system that bring money, output and prices together if they drift apart temporarily. Given these findings, a Granger-causality model of the following form[14] can be specified for testing causality between money supply growth and inflation:

$$\Delta \ln CPI_t = \text{constant} + \rho 1 \, EC_{t-1} + \Sigma \alpha i \, \Delta \ln Mj_{t-i} + \Sigma \delta i \, \Delta \ln CPI_{t-i} + \text{error term}$$

$$\Delta \ln Mj_t = \text{constant} + \rho 2 \, EC_{t-1} + \Sigma \beta i \, \Delta \ln CPI_{t-i} + \Sigma \gamma i \, \Delta \ln Mj_{t-i} + \text{error term}$$

where EC_{t-1} is one period lagged error-correction term in the cointegral relationship among money, output and prices, Mj(j = 1,2) is the narrow or broad money stock, and as per the Granger representation theorem at least one of $\rho 1$ and $\rho 2$ is nonzero. In the specification, i can take an infinite value, but in practice, it takes a finite value. The definition of Granger-causality in the limited sense (or

Table 3
The Error-Correction Model of Δln CPI

Sample: 1974-2003

$\Delta \ln CPI_t = 0.19 + 0.22\ \Delta \ln CPI_{t-1} - 2.90\ \Delta \ln y^p_t - 0.44\ EC_{t-1}$
(t-ratio) (9.81) (2.99) (8.92) (4.23)

Estimator: OLS Sample: 1974-2003 Adj-R^2 = 0.83 A: Serial Correlation: F(1,25) = 4.97; B: Functional Form: F(1,25) = 0.23; C: Normality: $\chi^2_{(2)}$ = 20.94; D: Heteroskedasticity: F(1,28) = 10.12

$\Delta \ln CPI_t = -0.06 + 0.27\ \Delta \ln CPI_{t-1} + 0.75\ \Delta \ln M2_{t-1} - 1.12\ EC_{t-1}$
(t-ratio) (3.71) (3.53) (8.32) (5.74)

Estimator: OLS Sample: 1974-2003 Adj-R^2 = 0.84 A: Serial Correlation: F(1,25) = 4.23; B: Functional form: F(1,25) = 20.67; C: Normality: $\chi^2_{(2)}$ = 0.17; D: Heteroskedasticity: F(1,28) = 1.46

Sample 1984-2003

$\Delta \ln CPI_t = 0.14 - 1.77\ \Delta \ln y^p_t - 0.27\ EC_{t-1}$
(t-ratio) (4.24) (2.37) (3.06)

Estimator: OLS Sample: 1984-2003 Adj-R^2 = 0.41 A: Serial Correlation: F(1,16) = 0.02; B: Functional form: F(1,16) = 0.26; C: Normality: $\chi^2_{(2)}$ = 1.03; D: Heteroskedasticity: F(1,18) = 0.55

$\Delta \ln CPI_t = 0.02 + 0.38\ \Delta \ln CPI_{t-1} + 0.10\ \Delta \ln M2_{t-1} - 0.64\ EC_{t-1}$
(t-ratio) (1.80) (2.28) (1.20) (3.87)

Estimator: OLS Sample: 1984-2003 Adj-R^2 = 0.53 A: Serial Correlation: F(1,16)= 2.25; B: Functional form: F(1,16) = 0.56; C: Normality: $\chi^2_{(2)}$ = 1.14; D: Heteroskedasticity: F(1,19) = 0.04

'precedence" *à la* Leamer 1985) money supply growth is causing inflation provided that in the regression of inflation on lagged inflation and lagged money growth rates, the sum of the coefficients of money growth rates (that is, $\Sigma\alpha i$) is not statistically zero. Similarly, inflation is causing money supply growth provided that in the regression of money supply growth on lagged money growth and inflation rates, the sum of the coefficients of inflation (that is, $\Sigma\beta i$) is not statistically zero. If both of these events occur, there is said to be a feedback relationship between inflation and money supply growth.

In applying the test for Bangladesh, the lag length is sequentially set at 1, 2 and 3 years because causal inference is usually found sensitive to the choice of lag length. The maximum lag length of 3 years is considered long enough for the explanatory variables to have their impact realized on the dependent variable. In general, a premature truncation of the lag length may ignore the significant connection that exists in the relationship.[15]

Table 4 reports the causality test results in a summary form. They show that there is a strong causality running from money supply growth to inflation. This result remains robust irrespective of whether a narrow or a broad definition of money is used in the regression model. Any causality running from inflation to money supply growth is not significant. This later finding is consistent with the idea that only high inflation has a pronounced impact on money supply growth. This impact is usually mild when inflation rate is low because the government attempts to extract resources from the private sector by printing money (and spending it) at a faster rate than the rate of inflation to cover rapid loss of real revenue. When the inflation rate is low, the impact of inflation on fiscal deficit is not so pronounced; hence, any causality running from inflation to money supply growth may not be strong enough to be detected by statistical tests. As the rate of inflation in Bangladesh has not been very high since the late-1970s, the impact of inflation on money supply growth was not statistically significant.

Table 4
The Granger-Causality Between Money Supply Growth and Inflation

Regression Model		
$\Delta \ln CPI_t$ = constant + $\rho 1\ EC_{t-1}$ + $\Sigma \alpha i\ \Delta \ln Mj_{t-i}$ + $\Sigma \delta i\ \Delta \ln CPI_{t-i}$ + error term (i = 1,2,3)		
With Broad Money Supply Growth (Δln M2)		
Lag-Adjusted Sample Period	Lag Length	F(degrees of freedom)[a]
1974-2003	1	F(1,26) = 69.2[b]
1975-2003	2	F(2,23) = 20.69[b]
1976-2003	3	F(3,20) = 4.21[b]
With Narrow Money Supply Growth (Δln M1)		
1974-2003	1	F(1,26) = 22.6[b]
1975-2003	2	F(2,24) = 10.50[b]
1976-2003	3	F(3,22) = 18.93[b]
Regression Model		
$\Delta \ln Mj_t$ = constant + $\rho 2\ EC_{t-1}$ + $\Sigma \beta i\ \Delta \ln CPI_{t-i}$ + $\Sigma \gamma i\ \Delta \ln Mj_{t-i}$ + error term		
With Broad Money Supply Growth (Δln M2)		
1974-2003	1	F(1,26) = 0.2
1975-2003	2	F(2,23) = 0.37
1976-2003	3	F(3,20) = 1.15
With Narrow Money Supply Growth (Δln M1)		
1974-2003	1	F(1,26) = 1.08
1975-2003	2	F(2,24) = 0.37
1996-2003	3	F(3,22) = 0.99

Notes:

a. F-statistic value is obtained by the variable deletion test. The figures in parentheses are the degrees of freedom
b. significant at the 5 percent level, implying a *causality* running from money supply growth to inflation.

Validation of the Monetary Model of Inflation for Bangladesh

As indicated earlier, the classical monetary theory suggests that inflation occurs in response to an excess money supply, which, for a country like Bangladesh, may originate from both the demand and supply sides of the money market.[16] This viewpoint of inflation can be examined empirically using the model specified in Section II: Inflation rate (π) = money supply growth rate (λ) – income elasticity of demand for real balances (η_y) times the permanent output/income growth rate (g_y). This specification can be used to define an *optimum growth rate of money*[17] as the growth rate of money that would result approximately a zero rate of inflation ($\pi \approx 0$): $\lambda_0 = \eta_y \bullet g_y$. This condition shows that if $\lambda > \lambda_0$, inflation would be positive ($\pi > 0$) and if $\lambda < \lambda_0$, inflation would be negative ($\pi < 0$).[18]

Table 5 reports the estimated values for excess money supply in Bangladesh over the period 1951-2003. It also reports the summary data used for computational purposes. A visual inspection of the data [Table 5] shows that there is a linkage between excess money supply and inflation. This is confirmed in plotted charts, not reported here. Further, to establish statistically the linkage between inflation and excess broad money supply, a Granger causality-type lag distributed model has been estimated for 1975-2003. The model with 2 lagged terms for excess money supply has been found to fit the data best.

Table 6 reports the results in a summary form. They show that there existed a Granger-causal linkage between the excess broad money supply and inflation in Bangladesh for the sample period 1975-2003. The model explains about 76 percent of inflation over this sample period. However these results are only an indication of the implied relationship and can be improved with a respecified model and for a longer sample period.

Summary and Conclusion

This paper has examined the Granger-causal relationship between money supply growth and inflation in Bangladesh for the period 1974-2003 within the cointegral-error correction-modeling framework. Empirical results suggest that the consumer price index,

Table 5
Excess Money Supply and Inflation

Period	Money Supply Growth (%)		Estimated Permanent Income Elasticity of Demand for Real Money Balances		Permanent Real GDP Growth Rate (%)	Optimum Growth Rate of Money (%)		Excess Money Supply Growth (%)		Inflation Rate (%)
	M1	M2	(M1/GDPD)	(M2/GDPD)		M1	M2	M1	M2	
1951-1955	7.8	n.a.	1.2000	n.a.	2.73	3.28	n.a.	5.05	n.a	-1.25
1956-1960	8.6	n.a	1.2000	n.a.	0.93	1.11	n.a.	7.52	n.a	7.26
1961-1965	8.6	n.a	1.2000	n.a.	5.35	6.42	n.a.	2.21	n.a	2.95
1966-1970	7.8	n.a	1.2000	n.a.	3.76	4.51	n.a.	3.33	n.a	6.44
1971-1975	23.1	42.1	1.0161	2.4000	-9.81	-9.79	-25.78	32.86	61.97	42.82
1976-1980	19.7	22.4	0.9701	2.3800	5.62	5.45	13.42	14.27	8.59	7.26
1981-1985	18.6	23.7	0.9701	2.2879	3.59	3.48	8.21	15.17	19.34	10.80
1986-1990	7.5	15.5	0.9734	2.2826	3.97	3.87	9.06	3.63	6.46	8.73
1991-1995	15.7	13.5	0.9145	2.1553	4.30	3.93	9.26	11.73	4.25	5.55
1996-2000	8.0	11.1	1.1571	2.0108	5.43	6.29	10.91	1.74	0.23	5.70
2001-2003	10.4	15.1	1.1513	1.8905	5.30	6.10	10.02	4.30	5.08	3.65

Source: Author's compilation/computation based on data in Table 1 and Hossain [2004].

the stock of narrow or broad money and real permanent output/income have a cointegral relationship and that there exists a strong causal relationship running from money supply growth to inflation. These findings have important policy implications. For example, under a floating exchange rate system, monetary policy can be conducted to achieve price stability through monetary targeting, which is equivalent to inflation targeting if money growth is considered the primary, if not the sole determinant, of long-term inflation. Inflation targeting as a strategy of monetary policy, however, remains conditional on a set of stringent conditions[19] and is not considered appropriate for Bangladesh at this juncture. Monetary targeting may therefore be considered an option at least for a transitional period, given that under the present market-based exchange rate system, the Bangladesh Bank has gained an effective control over the monetary base and that there exists both a stable money demand function [Hossain 2003,2004] and a situation of monetary stability as envisaged by monetary economists for a monetary rule [Friedman 1960; Laidler 1986].

Appendix

Sources of the Data and their Time Series Properties

The data for this study have been compiled/computed from a number of sources, such as the *International Financial Statistics* of the IMF and the *Economic Trends* of the Bangladesh Bank. The data for the period 1950-1971 have been drawn from various published and unpublished sources and are not strictly comparable to those for the period 1972-2003.

Table 6
Excess Broad Money Supply and Inflation
(Dependent variable: Percentage Change in CPI)

Regressor	Coefficient	Absolute t-ratio
Intercept	5.55	3.00
Excess Broad Money Supply Growth Rate(-1)	0.41	2.91
Excess Broad Money Supply Growth Rate(-2)	0.46	3.44
Percentage Change in CPI (-1)	-0.49	3.17
Percentage Change in CPI (-2)	0.13	1.21
Percentage Change in CPI (-3)	0.07	0.81
Estimator: OLS Lag-Adjusted Sample: 1975-2003 Adj-R^2 = 0.76		
A: Serial Correlation: F(1,22)= 1.52; B: Functional Form: F(1,22) = 16.1; C: Normality $\chi^2(2)$ = 3.13 C: Heteroskedasticity: F(1,27) = 3.46		
Comment: The null hypothesis that the sum of the coefficients of two excess broad money supply growth terms is zero is rejected at the one percent level [F(2,23) = 35.57]		

As part of the regression analysis, the following variables have been tested for unit roots:

ln M1 = natural log of the narrow money stock, Millions of Taka.

ln M2 = natural log of the broad money stock, Millions of Taka.

ln $RGDP^p$ = natural log of real permanent output/income, Millions of Taka at 1995 prices, estimated as $RGDP^p$ = 0.5•RGDP + 0.3•RGDP(-1) + 0.2 •RGDP(-2) where RGDP is real GDP at constant prices. The weights used have been found to generate an income series that performs better than other sets of weights. (In the text this variable is denoted by y^p.)

ln CPI = natural log of the consumer price index (CPI) (1995=100).

π = [ln CPI - ln CPI (-1)] multiplied by 100.

The Unit Root Tests Results

Table A1 reports the unit root tests results for the above defined time series. Four tests for the unit roots — the Augmented Dickey-Fuller (ADF), the GLS-detrended Dickey-Fuller (DF-GLS), the Phillips-Perron (PP), and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) — have been conducted for two sample periods: 1951-2003 and 1972-2003 (adjusted for lagged terms). Note that the first three tests treat the series under consideration non-stationary as a null-hypothesis, while the last test treats the series stationary as a null hypothesis.

The ADF and PP test results for ln M1 and ln M2 are in conflict with those obtained by the DF-GLS and KPSS tests. The latter tests suggest that the log series of M1, M2, $RGDP^p$ and CPI have a unit root. As the unit root tests are generally known to have low power when the sample size is small, some subjective judgement can be made to interpret the results. This requires a visual inspection of the data set and the autocorrelation function for each of the series. The plotted series in their log-level and first-order logarithmic difference forms [not reported here] show that all the series have a trend. The autocorrelation function of each of these variables [not reported here] also dies out slowly, implying that they are non-stationary. However the first-order logarithmic difference of each of these series does not have a trend and appear stationary. Without further tests, the variables under consideration are assumed to be difference-stationary. This implies that these variables are eligible to form a cointegral relation, which can be estimated within the cointegral-error correction-modeling framework.

Notes

*The author is grateful to two anonymous referees for their comments and constructive suggestions on earlier drafts. He, however, remains responsible for any shortcomings of the paper.

1. Price stability as the sole or overriding objective of monetary policy reflects the emerging consensus on four basic propositions: (a) monetary expansion has a lasting effect only on the price level, not on real output or employment; (b) inflation is costly in terms of resource allocation (efficiency costs) or in terms of long-term output growth (breakdown of super-neutrality of money) or both; (c) monetary policy has transitory effects on a number of real variables, but there is imperfect understanding of the nature and the size of these effects, and (d) monetary policy affects the inflation rate with lags of uncertain duration and with variable strength, which undermines the central bank's ability to control inflation on a period-by-period basis. For a discussion on these and related propositions, see Friedman [1960;1963;1968;1969] and Masson, Savastano and Sharma [1997]. For a critique of the above propositions from a neo-Keynesian perspective, see Akerlof and Yellin [1985] and Akerlof, Dickens and Perry [1996].

2. The *BANGLADESH BANK ORDER 1972* provides the following rationale for the establishment of a central bank in Bangladesh:

   [Original 1972] Whereas, it is necessary to establish a central bank in Bangladesh to regulate the issue of currency and the keeping of reserves and manage the monetary and credit system of Bangladesh with a view to establishing domestic monetary value; preserving the par value of Bangladesh Taka; promoting and maintaining a high level of production, employment and real income in Bangladesh; and fostering growth and development of country's resources in the best national interest. [p.1]

   [Amended in 2003] Whereas, it is necessary to establish a central bank in Bangladesh to manage the monetary and credit system of Bangladesh with a view to stabilising domestic

monetary value and maintaining a competitive external par value of the Bangladesh Taka towards fostering growth and development of country's productive resources in the best national interest. [p.1]

As an addition, the Bangladesh Bank (amendment) Act 2003 (Chapter II, 7A:p.4] has also codified the main functions of the Bank, such that its main functions shall be: '(a) to formulate and implement monetary policy; (b) to formulate and implement intervention in the foreign exchange market; …'.

3. Although such amendments have provided the Bank some autonomy to conduct an independent monetary policy, the monetary policy goal of '*price and exchange rate stability*' is somewhat vague. This is because the achievement and maintenance of price stability, meaning zero or at most a low inflation rate of, say, 2-3 percent per annum, would be consistent with exchange rate volatility under a market-based exchange rate system that makes the money stock an exogenous policy variable. To the extent that the rate of depreciation of the exchange rate reflects inflation differential between domestic and foreign countries as per the Purchasing Power Parity proposition, the goal of price stability would be synonymous with stability of the exchange rate provided that the foreign inflation rate remains stable. If the exchange rate stability is considered an independent objective of monetary policy, it may conflict with the goal of price stability, as exchange rate stability may require central bank's frequent intervention in the foreign exchange market. This would be somewhat odd with the idea of a floating exchange rate system that makes the money stock an exogenous policy variable. In fact, Friedman [1992:262] emphasizes this point by quoting Keynes [1923:126]: 'monetary authorities cannot serve two masters: as he [Keynes] put it, 'we cannot keep *both* our own price level *and* our exchange rate stable. And we are compelled to choose.'

4. Until May 31, 2003 Bangladesh maintained a pegged exchange rate system and occasionally adjusted the exchange rate of the Taka in order to maintain export competitiveness, with reference to the trend of the *Real Effective Exchange Rate Index,* computed on the basis of a trade-weighted basket of currencies of major trading partners. The Bangladesh Bank, in its US$ purchase-and sale transactions with the commercial banks, maintained a pre-announced one Taka wide band, while the banks were free to set their own rates for interbank and customer transactions. Since May 31, 2003, the market forces of demand and supply in the foreign exchange market have determined the exchange rate of the Taka. Although the Bangladesh Bank no longer has a pre-announced rate band for transactions with commercial banks, it remains ready to intervene in the foreign exchange market if and when it is needed to maintain orderly market conditions. Also, the Bank uses its indirect monetary policy instruments, such as repo and reverse repo auctions on a regular basis to bring required changes in the money market liquidity to maintain exchange rate stability [Bangladesh Bank: Annual Report 2002-2003, Ch.9].

5. Note that the exchange rate pegging may help a high inflationary country to bring its inflation rate closer to the inflation rate in the anchor country by linking the prices of domestic goods to those of internationally traded goods. The more open the economy the greater is the convergence of domestic inflation to inflation in the anchor country. However the inflation rate in a large economy with a dominant non-tradable goods sector can deviate significantly from inflation in the anchor country. This was the case for Bangladesh, which has a large non-tradable goods sector that contributes about 50 percent of GDP. Under a pegged exchange rate system, the real exchange rate in Bangladesh showed a tendency to appreciate since the late 1980s due to foreign capital inflows of about 10 percent of GDP. This put the tradable goods sector in a disadvantageous position. The result was low production efficiency and slow technological progress [Hossain 2000].

6. Monetary policy independence should be seen in a broad context and in the sense that it has gained its ability to maintain price stability provided that it is designed and implemented to achieve this objective. As pointed out above, price stability is yet to be stated as the main objective of monetary policy. Under the amended Order, the Bank's monetary and financial policies must remain consistent with the macroeconomic framework that includes fiscal, monetary and exchange rate strategies and policies as defined by a co-ordination council, consisting of Minister for Finance, Minister for Commerce, Governor, Bangladesh Bank, Secretary, Finance Division, Secretary, Internal Resources Division and Member (programming),

Planning Commission.

7. In general, a nominal anchor is defined as a policy rule that sets a limit on the growth rate of a nominal variable, such as the nominal money stock (the monetary base or a broader monetary aggregate), the price level, the nominal GDP and the nominal exchange rate. A market-based exchange rate system remains compatible with both price stability (zero inflation) and hyperinflation and therefore a nominal anchor is needed to keep inflation under control. Under monetary (or more precisely, monetary base growth) targeting, the monetary base growth rate can act as a nominal anchor to inflation.

8. Following the convention in the literature [Cobham 1992], monetary targeting refers to the strategy of monetary policy that uses the growth rate of a monetary aggregate as an intermediate target to achieve a pre-announced rate of inflation. Inflation targeting is formally defined as the public declaration by the government or an independent central bank or both of a quantitative inflation target for the medium term, as well as the implementation of a procedure for monitoring how well the monetary authorities achieve the target path [Mishkin 2001]. Although a stable money demand function is crucial for monetary targeting, inflation targeting does not require such stability because a short-term interest rate, rather than a monetary aggregate, is used as a policy instrument to bring changes in aggregate demand and aggregate supply to maintain a pre-announced target rate of inflation.

9. Hereafter the name Bangladesh is used to represent East Pakistan for the period 1947-1971.

10. This specification is based on the simplified version of Milton Friedman's money demand function that includes permanent income, differential between the return on bond and money (i_b-i_m) and so on [Mishkin 2003]. Assuming that capital gain/loss in holding a bond is zero, the return on bond is synonymous with the interest rate on bond i_b. Assuming that the return on money (i_m) is zero, this gives the simplified money demand function as specified.

11. This is a long-term proposition, based on a number of assumptions. First, under a floating exchange rate system, the monetary authorities can control the growth rate of a monetary aggregate (say, monetary base). Secondly, the super-neutrality of money proposition suggests that the money supply growth rate does not affect the long-term economic growth rate and thus the money demand growth rate. This makes inflation a policy variable, which equals the money supply growth rate less the growth rate of the economy times the income elasticity of demand for money. The effect of the nominal interest rate on money demand is zero in the steady state, given that i_b-$i_m \approx$ constant under a competitive banking system.

12. Such a regression has often been pejoratively called a spurious regression but has now regained its status as the first step regression of a two-step technique for estimating of cointegration-and error correction models. The correspondence between cointegration and error-correction models is formalized in the *Granger Representation Theorem*, which states that if two or more variables form a cointegral relationship, they can be represented by a dynamic model as an error correction specification [Granger and Newbold 1974; Engle and Granger 1987].

13. In Hossain [2004], the cointegral relationship among money, output and prices has been established by the Johansen method [Johansen 1998; Johansen and Juselius 1990].

14. This specification is different from the conventional Granger-causality specification [Granger 1969]. In this specification, at least one parameter of the error-correction term is not zero. Given that there is a cointegral relationship among money, output and prices, the inclusion of an error-correction term would avoid the loss of power in the Granger-causality test [Roca 2000].

15. It is possible to determine the optimal lag length by using a statistical criterion, such as the *Akaike Information Criterion*. This strategy is not adopted here to determine the lag length because the main objective of the causality test has been to examine whether the model's explanatory power increases in a general sense with the addition of any lagged terms of the variable in interest. Anyway, the lag length is not crucial in the present case because, given the small sample size, the results remain robust irrespective of the number of lag terms used in the specification.

16. See Hossain [2000] for an illustration of this view in the context of high-inflationary episode in Bangladesh during the early 1970s.

17. The optimum money growth rate is defined so for only illustrative purposes. Note that the

optimum growth rate of the money supply depends on the optimal rate of inflation. However, there is no unanimous view on what should be considered the optimal rate of inflation. Feldstein [1976] argues for a long-run rate of inflation equal zero that is optimal from the viewpoint of taxation. However, in Friedman's [1960] view, the optimal rate of inflation is actually negative to the size of the real interest rate because only then the nominal interest rate becomes zero and at that rate of interest economic agents maximize their real money holdings up to the point of satiety. Assuming a zero economic growth rate, this would imply a negative growth rate of the money supply at a level that would generate a rate of deflation equal to the real interest rate. (See Marty [1961] for an elaboration of Friedman's argument and Woodford [1990] for an updated review of the literature.)

18. Given that there is no consensus on the optimal rate of inflation, it should be considered a policy variable, such that $\pi_T \geq 0$. From this viewpoint, the money growth target would mean the target of the money supply growth rate at a level that would yield $\pi = \pi_T$. Symbolically, $\lambda_T = \eta_y \bullet g_y + \pi_T$. For developing countries, if inflation is considered a contributing factor to economic growth, policymakers may choose the rate of inflation that is growth maximizing. Khan and Senhadji [2000] have shown that the output-maximizing rate of inflation for industrial countries is in the range of 1 to 3 percent. The output-maximizing rate of inflation is higher for developing countries, in the range of 7 to 11 percent per annum.

19. The key requirements of inflation targeting include: a political mandate to achieve and maintain price stability, central bank independence (instrument independence), developed money and capital markets, flexibility in wages, interest and exchange rates, absence of fiscal dominance (that is, monetary policy is not dictated by fiscal needs of the government), central bank's technical ability to forecast inflation, a well-defined and understood analytical framework of monetary policy that includes the transmission channels between policy instruments and inflation, macroeconomic stability, meaning low and stable inflation, and above all, policy credibility and accountability [Debelle 1997; Debelle, Masson, Savastano and Sharma 1997].

References

Agenor, P.R. and P.J. Montiel [2000]. *Development Macroeconomics*. Princeton, New Jersy: Princeton University Press.

Ahsan, A.S.M.F. [1974]. 'A Supplementary Scheme for Controlling Inflation in Bangladesh'. *Bangladesh Bank Bulletin* 12(June):1-9.

Alamgir, M. [1980]. *Famine in South Asia: Political Economy of Mass Starvation in Bangladesh*. Cambridge, Mass. Oelgeschlager, Gunn and Hain.

Alamgir, M. and L. Barlage [1974]. 'Bangladesh National Income and Expenditure 1949/50-1969/70'. *Research Monograph No.1*. Dhaka: Bangladesh Institute of Development Studies.

Akerlof, G.A. and J. Yellin [1985]. 'A Near-Rational Model of the Business Cycle with Wage and Price Inertia'. *Quarterly Journal of Economics* 100 (Supplement): 823-38.

Akerlof, G.A., W. Dickens and G. Perry [1996]. 'The Macroeconomics of Low Inflation.' *Brookings Papers on Economic Activity* (No.1):1-59.

Bangladesh Bank [1989]. *Bangladesh Bank Order, 1972 (President's Order No.127 of 1972), Incorporating all amendments upto March 31, 1989*. Department of Public Relations and Publications, Head Office, Dhaka.

Bangladesh Bank [2003]. *Bangladesh Bank Order, 1972 (President's Order No.127 of 1972), Incorporating all amendments upto March 10, 2003*. Department of Public Relations and Publications, Head Office, Dhaka.

Bangladesh Bank *Annual Report 2002-2003***.** Department of Public Relations and Publications, Head Office, Dhaka.

Bangladesh Bank [monthly issues]. *Economic Trends.* Dhaka: Bangladesh Bank.

Blejer, M.I., A. Ize and A.M. Leone (eds.) [2000]. *Inflation Targeting in Practice: Strategic and Operational Issues and Applications to Emerging Market Economies.* Washington, D.C.: IMF.

Bose, S.R. [1973]. 'The Price Situation in Bangladesh – A Preliminary Analysis'. *Bangladesh Economic Review* 1(3): 243-68.

Cobham, D. [1992]. 'Monetary Targeting'. In Newman, P., M. Milgate and J. Eatwell (eds.) *The New Palgrave Dictionary of Money and Finance* (Volume 2) London: Macmillan Press Limited.

Corbo, V.L. [1974]. *Inflation in Developing Countries: An Econometric Study of Chilean Inflation*. Amsterdam: North-Holland Publishing Company.

Debelle, G., Masson, P.R., M.A. Savastano and S. Sharma [1997]. 'The Scope for Inflation Targeting in Developing Countries'. *IMF Working Paper WP/97/130*, Washington, D.C.: IMF.

Engle, R. and C.W.J. Granger [1987]. 'Cointegration and Error Correction: Representation, Estimation and Testing'. *Econometrica* 55:251-76.

Feldstein, M. [1976]. 'Inflation, Income Taxes and the Rate of Interest: A Theoretical Analysis'. *American Economic Review* (December).

Friedman, M. [1956]. 'The Quantity Theory of Money: A Restatement'. In *Studies in the Quantity Theory of Money*. Chicago: University of Chicago Press.

Friedman, M. [1960]. *A Program for Monetary Stability*. New York: Fordham University Press.

Friedman, M. [1963]. *Inflation: Causes and Consequences.* New York: Asia Publishing House.

Friedman, M. [1968]. 'The Role of Monetary Policy'. *American Economic Review* (March): 1-17.

Friedman, M. [1969]. *The Optimum Quantity of Money and Other Essays*. Chicago: Aldine Publishing Company.

Friedman, F. [1992]. 'Quantity Theory of Money'. In Newman, P., M. Milgate and J. Eatwell (eds.) *The New Palgrave Dictionary of Money and Finance* (Volume 3) London: Macmillan Press Limited.

Granger, C.W.J. [1969]. 'Investigating Causal Relations by Econometric Models and Cross-Spectral Methods'. *Econometrica* 37: 424-38.

Granger, C.W.J. and P. Newbold [1974]. 'Spurious Regressions in Econometrics'. *Journal of Econometrics* 2: 111-20.

Hossain, A. [1995]. *Inflation, Economic Growth and the Balance of Payments in Bangladesh: A Macroeconomic Study*. Delhi: Oxford University Press.

Hossain, A. [1996]. *Macroeconomic Issues and Policies: The Case of Bangladesh.* New Delhi: Sage Publications.

Hossain, A. [2000]. *Exchange Rates, Capital Flows and International Trade*. Dhaka: University Press Limited.

Hossain, A. [2003]. 'An Examination of Some Key Issues in the Conduct of Monetary Policy in Bangladesh'. In Ali, A., Kuddus, R. and Andaleeb, S.S. (eds.) *Development Issues of Bangladesh-II.* Dhaka: University Press Limited.

Hossain, A. [2004]. 'The Money Demand Behavior in Bangladesh'. Unpublished Research Paper, University of Newcastle, Australia.

Hossain, A. and S. Rashid [1996]. *In Quest of Development: The Political Economy of South Asia.* Dhaka: University Press Limited.

IMF [various issues]. *International Financial Statistics*. Washington, D.C.: IMF.

Islam, N. [1981]. *Foreign Trade and Economic Controls in Development: The Case of United Pakistan.* New Haven: Yale University Press.

Johansen, S. [1988]. 'Statistical Analysis of Cointegration Vectors'. *Journal of Economic Dynamics and Control* 12 (June-September): 231-54.

Johansen, S. and K. Juselius [1990]. 'Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money'. *Oxford Bulletin of Economics and Statistics* 52 (May): 169-210.

Judd, J.P. and J.L. Scadding [1982]. 'The Search of a Stable Money Demand Function: A Survey of the Post-1973 Literature'. *Journal of Economic Literature* 20:993-1023.

Kabir, M. [1980]. *A Disaggregated Econometric Model of Price Behaviour in Bangladesh*. Unpublished PhD Thesis, McMaster University, Canada.

Keynes, J.M. [1923]. *A Tract on Monetary Reform*. Reprinted in the *Collected Writings of John Maynard Keynes*, Volume IV, London: Macmillan for the Royal Economic Society [1971].

Khan, M.S. and A.S. Senhadji [2000]. 'Threshold

Effects in the Relationship Between Inflation and Growth'. *IMF Working Paper WP/00/110*. Washington, D.C.: IMF.

Laidler, D. [1986]. 'What Do We Really Know About Monetary Policy?'. Australian Economic Papers 25: 1-16.

Leamer, E.E. [1985]. 'Vector Autoregressions for Causal Inference'. In K. Brunner and A. Meltzer (eds.) *Understanding Monetary Regimes* (Supplement to Journal of Monetary Economics): 255-304.

Marty, A. [1961]. 'Gurley and Shaw on Money in a Theory of Finance'. *Journal of Political Economy* 69 (February):56-62.

Masson, P.R., M.A. Savastano and S. Sharma [1997]. 'The Scope for Inflation Targeting in Developing Countries'. *IMF Working Paper WP/97/130*. Washington, D.C.: IMF.

Mishkin, F.S. [2000]. 'From Monetary Targeting to Inflation Targeting: Lessons from the Industrialized Countries'. Paper presented at the Bank of Mexico Conference, 'Stabilization and Monetary Policy: The International Experience', Mexico City, November 14-15.

Mishkin, F.S. [2001]. 'Inflation Targeting'. Graduate School of Business, Columbia University, New York.

Mishkin, F.S. [2003]. *The Economics of Money, Banking, and Financial Markets*, New York: Addison-Wesley.

Montiel, P.J. [2003]. *Macroeconomics in Emerging Markets*. Cambridge: Cambridge University Press.

Papanek, G. [1981]. 'Comment on Stabilization Policies in Pakistan:1970-77 Experience by Guisinger'. In Cline, W. and S. Weintraub (eds.) *Economic Stabilization in Developing Countries*. Washington, D.C.:Brookings Institution.

Rahim, A.M.A. [1973]. 'Some Aspects of Inflation Theories in the Context of Bangladesh'. *Bangladesh Bank Bulletin* (September): 1-15.

Roca, E. [2000]. *Price Independence Among Equity Markets in the Asia-Pacific Region: Focus on Australia and ASEAN*. Aldershot, England: Ashgate.

Sargan, J.D. and A. Bhargava [1983]. 'Testing Residuals from Least Squares Regression for Being Generated by the Gaussian Random Walk'. *Econometrica* 51: 153-74.

Siddique, A.K.M. [1975]. 'Money and Inflation in Bangladesh'. *Bangladesh Development Studies* 3(1): 27-42.

Woodford, M. [1990]. 'The Optimum Quantity of Money'. In Friedman, B.M. and F. Hahn (eds.) *Handbook of Monetary Economics*, Volume II. New York: North-Holland.

Table A1
The Unit Root Test Results

Variable	Lag-Adjusted Sample Period (Number of observations)	The ADF Test Statistic	Lag Length (automatic based on Schwarz Information Criterion)	Null Hypothesis: The log (or first difference log) of the time series has a unit root
ln M1	1954-2003 (N=50)	0.25	0, constant included	Not rejected
ln M1	1973-2003 (N=31)	-4.94	4, constant included	Rejected
ln M2	1973-2003 (N=31)	-4.16	0, constant included	Rejected
ln $RGDP^p$	1957-2003 (N=47)	-0.07	4, constant included	Not rejected
ln $RGDP^p$	1973-2003 (N=31)	0.13	4, constant included	Not rejected
ln CPI	1952-2003 (N =52)	-0.40	1, constant included	Not rejected
ln CPI	1973-2003 (N =31)	-5.10	4, constant included	Rejected
Δln CPI	1952-2003 (N=52)	-4.09	0, constant included	Rejected
Δln CPI	1973-2003 (N=31)	-3.27	0, constant included	Rejected
Δln M1	1955-2003 (N=49)	-5.75	0, constant included	Rejected
Δln M1	1973-2003 (N=31)	-4.97	0, constant included	Rejected
Δln M2	1974-2003 (N=30)	-5.28	0, constant included	Rejected
Δln $RGDP^p$	1957-2003 (N=47)	-2.50	3, constant included	Rejected
Δln $RGDP^p$	1973-2003 (N=31)	-2.75	3, constant included	Rejected

Variable	Lag-Adjusted Sample Period (Number of observations)	The DF-GLS Test Statistic	Lag Length (automatic based on Schwarz Information Criterion)	Null Hypothesis: The log (or first difference log) of the time series has a unit root
ln M1	1955-2003 (N=49)	1.14	1, constant included	Not rejected
ln M1	1973-2003 (N=31)	-0.03	1, constant included	Not rejected
ln M2	1976-2003 (N=28)	0.33	3, constant included	Not rejected
ln $RGDP^p$	1957-2003 (N=47)	0.26	4, constant included	Not rejected
ln $RGDP^p$	1973-2003 (N=31)	-0.79	4, constant included	Not rejected
ln CPI	1952-2003 (N =52)	0.44	1, constant included	Not rejected
ln CPI	1973-2003 (N =31)	0.01	1, constant included	Not rejected
Δln CPI	1952-2003 (N=52)	-3.84	0, constant included	Rejected
Δln CPI	1973-2003 (N=31)	-2.38	0, constant included	Rejected
Δln M1	1955-2003 (N=49)	-5.65	0, constant included	Rejected
Δln M1	1973-2003 (N=31)	-4.58	0, constant included	Rejected
Δln M2	1983-2003 (N=21)	1.04	9, constant included	Not Rejected
Δln $RGDP^p$	1957-2003 (N=47)	-2.55	3, constant included	Rejected
Δln $RGDP^p$	1973-2003 (N=31)	-2.96	3, constant included	Rejected
Variable	Lag-Adjusted Period (Number of observations)	Phillips-Perron Test Statistic	Bandwidth: (Newey-West using Bartlett kernel)	Null Hypothesis: The log (or first difference log) of the time series has a unit root
ln M1	1954-2003 (N=50)	0.23	3, constant included	Not rejected
ln M1	1973-2003 (N=31)	-6.28	30, constant included	Rejected
ln M2	1973-2003 (N=31)	-6.14	9, constant included	Rejected
ln $RGDP^p$	1953-2003 (N=51)	0.35	3, constant included	Not rejected
ln $RGDP^p$	1973-2003 (N=31)	1.18	1, constant included	Not rejected
ln CPI	1951-2003 (N =53)	-0.16	4, constant included	Not rejected
ln CPI	1973-2003 (N =31)	-4.83	1, constant included	Rejected
Δln CPI	1952-2003 (N=52)	-4.10	2, constant included	Rejected
Δln CPI	1973-2003 (N=31)	-3.13	8, constant included	Rejected
Δln M1	1955-2003 (N=49)	-5.65	5, constant included	Rejected
Δln M1	1973-2003 (N=31)	-4.97	7, constant included	Rejected
Δln M2	1974-2003 (N=30)	-5.47	0, constant included	Rejected
Δln $RGDP^p$	1954-2003 (N=50)	-2.60	6, constant included	Rejected
Δln $RGDP^p$	1973-2003 (N=31)	-6.12	24, constant included	Rejected
Variable	Lag-Adjusted Sample Period (Number of observations)	KPSS Test Statistic	Bandwidth: (Newey-West using Bartlett kernel)	Null Hypothesis: The log (or first difference log) of the time series is stationary
ln M1	1953-2003 (N=51)	0.95	5, constant included	Rejected
ln M1	1973-2003 (N=31)	0.73	4, constant included	Rejected
ln M2	1972-2003 (N=32)	0.75	4, constant included	Rejected
ln $RGDP^p$	1952-2003 (N=52)	0.80	5, constant included	Rejected
ln $RGDP^p$	1973-2003 (N=31)	0.73	4, constant included	Rejected
ln CPI	1950-2003 (N =53)	0.85	6, constant included	Rejected
ln CPI	1973-2003 (N =31)	0.73	4, constant included	Rejected
Δln CPI	1951-2003 (N=53)	0.16	4, constant included	Not Rejected

Δln CPI	1973-2003 (N=52)	0.56	2, constant included	Not Rejected
Δln M1	1954-2003 (N=50)	0.16	3, constant included	Not rejected
Δln M1	1973-2003 (N=31)	0.50	5, constant included	Not Rejected
Δln M2	1973-2003 (N=31)	0.70	2, constant included	Rejected
Δln RGDP^p	1953-2003 (N=51)	0.20	3, constant included	Not Rejected
Δln RGDP^p	1973-2003 (N=31)	0.46	1, constant included	Not Rejected

Note: The tests are conducted using *Eviews-4*, Quantitative Micro Software. *Eviews* displays critical values when a unit root test is conducted.

Revised: November 19, 2004

Akhtar Hossain
University of Newcastle, Australia
E-mail: Akhtar.Hossain@newcastle.edu.au