Monetary Targeting in Pakistan: A Skeptical Note

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Abstract

The objective of this study is to evaluate monetary targeting strategy in Pakistan by testing the Quantity Theory of Money and the income velocity of money stated by Monetarists and the endogenous money hypothesis postulated by the Post Keynesians. Our tests on the Pakistani data covering about thirty years reveal that the quantity theory is an inadequate explanation of inflation, income velocity of money is unstable, and money is endogenous. These results suggest rethinking on monetary targeting strategy in Pakistan.

Keywords: Monetary Targeting, QTM, Income Velocity of Money, Endogenous Money
JEL Codes: E12, E5

1. Introduction

Pakistan adopted monetary targeting strategy during the heydays of 'monetarism' when it was central to the conduct of monetary policy. Even in the mid 1990s, when the world around it was showing an obvious decline in the role of money in macro models, Pakistan continued with the very policy. The accepted wisdom in Pakistan *is* and *was* overwhelmed by monetarists' doctrines. Much of the empirical literature on inflation determinants in Pakistan also supports this dominance.

Few exploratory facts from Pakistan economy, however, suggest rethinking on the monetary doctrines and by corollary the monetary targeting strategy. This includes: transformation of Pakistan into a modern credit-based economy due to the reforms of 1980s and 1990s; the fact that monetary aggregate targets and their actual realization since mid 1970s leaves much to be desired; simple correlation analysis that suggest a rather weak relationship between inflation and various monetary aggregates; and the income velocity of money that shows an unstable pattern from 1975 to 2006.

These facts and the world wide decline in monetarists' paradigm motivate us to evaluate the optimality of monetary targeting in Pakistan. We do this by testing three hypotheses on Pakistani data. The first one relates to the testing of one-on-one money-inflation relationship in the long run, as predicted by the Quantity Theory of Money (QTM). The second being the test of the 'stable' assumption of the income velocity of money. The third relates to the identification of the endogenous money hypothesis; that is, money is a demand-driven phenomenon. Our findings support the absence of QTM and the presence of endogenous money hypothesis; and our tests reveal that the income velocity of money is not stable. All these results suggest rethinking on the monetary targeting policy in Pakistan.

We articulate our suggestion as follows. Section 2 reviews world-wide rise and demise of monetary targeting along with the endogenous money hypothesis. Section 3 gives some exploratory facts from the Pakistan economy. Section 4 outlines the methodology for testing the QTM, the stable income velocity of money assumption, and the presence of endogenous money hypothesis. Section 5 discusses results, followed by concluding remarks in Section 6.

2. The Rise and Demise of Monetary Targeting …

The roots of the monetary targeting monetary policy regime lie in the famous QTM, best described in Lucas' (1996, p. 665) words, "[T]he central predictions of the quantity theory are that, in the long run, money growth should be neutral in its effects on the growth rate of production and should affect the inflation rate on a one-for-one basis." The strategy, however, came into existence as a result of the influential writings in 1950s and 1960s of the "monetarism" school of thought. Led by Milton Friedman, it argued for a restatement of QTM as a steady, low growth rate of money supply rule over the long run for the eventual subjugation of inflation.

In fact, monetarism challenged the hugely influential monetary policy 'activism' of the 1950s and 1960s that sought an optimal point on the downward sloping Phillip's curve to stabilize either inflation or unemployment. Monetarists' 'counter-revolution' argued for the short run presence and long run absence of Phillip's curve; thereby, not only puncturing the 'activists' theories but also bringing them on the top of the mainstream economics. Their popularity peaked in the 1970s and early 1980s and since then motivated a considerable amount of empirical research on money growth and inflation.[1] Furthermore, monetarists' hypothesis also influenced the leading central banks of the world, Bundesbank, Federal Reserve Bank, Bank of Canada, Bank of England, among others, to adopt monetary targeting as their nominal anchor.

By late 1990s, however, virtually no major central bank in the world was a monetary targeter.[2] Two main reasons are forwarded for the demise of this strategy. First, the constant stream of financial deregulations and innovations of the 1970s, 1980s, and 1990s kept destabilizing the demand for money. In other words, velocity of money, supposed to be fixed for the smooth functioning of monetary targeting regime, turned out to be highly variable. Second, the money growth and inflation relationship did not turn out to as predicted by the aforementioned monetary hypothesis and empirical studies on QTM.[3] Some argued it was a lack of proper commitment on the part of the central banks in implementing the monetary targeting strategy. For example, Mishkin (2000) argues that the strategy's failure in some industrial countries was due to their central banks' indulgence in 'gameplaying': targeting of multiple monetary aggregates, inconsistent target announcements, overshooting of targets without reversing, and lack of effective communication. This, he notes, greatly undermined the credibility of this strategy and eventually led to its failure.

Apart from unstable velocity of money and absence of significant money-inflation correlation, literature on country experiences of monetary targeting policy reveals other dimensions of the demise of this strategy as well; including the aforementioned gameplaying hypothesis.[4] We nonetheless assume that the most compelling reasons for abandoning this strategy have remained the lack of significant relationship between money and inflation and the instability in the velocity of money.

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[1] See, De Grauwe and Polan (2005, p. 242) for a brief review of these studies.

[2] Exception to this was Germany and Switzerland; who by early 2000s were inflation targeters [Germany was in euro zone by 2000; the European Central bank does not regard its monetary stability objective as an inflation target]. Indeed, there has been a spectacular decline in the role of money in monetary policy around the world; as King (2003, p. 63) observes, "The decline and fall of money in policy formulation is confirmed by a fall in the number of references to money in the speeches of central bank governors. So much so that over the past two years, Governor Sir Edward George has made one reference to money in 29 speeches, Chairman Greenspan one in 17, Governor Hayami one in 11, and Wim Duisenberg three in 30."

[3] Quoting several studies, this is well described on three grounds by Moroney (2002, pp. 398-399): "[1] income velocity of (and thus the demand for) monetary aggregates is so unstable that money growth is an unreliable explanation [2] if money, the price level, and output are not cointegrated, then there is no stable long-run relationship among them [3] there is a class of policy rules with a unique solution that shows that the price level is independent of monetary policy but dependent strictly on fiscal policy. This 'fiscal theory of price level determination' *breaks any link between money growth and inflation*."

[4] See, Argy et al. (1989) for a review of international experiences of monetary targeting strategy; see, Gomme (1998) for a concise review on the experience of Bank of Canada; and see, Friedman (1988) for lessons from the U.S. economy. See, for a detailed scrutiny of monetarism, Desai (1981).

… and the Endogenous Money Hypothesis

Relatively distinct in their arguments, Post Keynesian economists, led by Nicholos Kaldor and Basil Moore [Kaldor (1982) and (1985) and Moore (1988)], have also criticized the monetarism, and by corollary the monetary targeting strategy. This school of thought rejects the sine qua non assumption of monetarists' that money is an exogenous phenomenon; that is, policy determined. They argue that in a modern 'credit-money-economy' a central bank is bound to accommodate the private sector credit demand not as a matter of 'political choice' but as a matter of 'structural necessity' [Cottrell (1994)]. Furthermore, as a guarantor of the financial system any attempt by a central bank to control the supply of money would actually undermine its credibility as a lender-of-last-resort [Kaldor (1985)].

Changes in the real economy, for example wages, employment, and inventory, determine the demand for bank loans that in turn determine the supply of money. In particular, the money supply completely depends on the loans demanded; since loans make deposits and the deposits generate the monetary aggregate(s), the loans demanded cause the money supply. A central bank can only exert influence on money indirectly through interest rate. In fact, Kaldor and Moore argue for a perfectly elastic horizontal money supply curve; to the extent that money supply is a function of money demand only.[5]

These dynamics lead the Post Keynesians to challenge one of the most fundamental monetarists' contentions that reduction in money growth actually reduces inflation. They instead argue that reduction in money growth is actually a side effect of achieving disinflation through invoking recession. For instance, monetarists argue that the famous disinflationary episodes of the late 1970s and early 1980s were due to the *reduction* in money growth *leading* to lower inflation. Post Keynesians argue that this causation is wrong. Because, strict monetary policy essentially implies rising interest rates that dampen aggregate demand through depressing investments (and exports) therefore invoking recession. As recession deepens and unemployment rises, growth in the money wages slow down; with deceleration in wage cost, inflation abates. In effect, growth in the demand for credit slows down that actually slows the money supply. Therefore, the deceleration in money supply is a side effect of recession and unemployment. Hence, monetarists' contention is a false rationalization. [Cottrell (1994)]

3. Some Exploratory Facts from Pakistan

Despite the aforementioned world-wide decline in monetary targeting strategy, the central bank, the State Bank of Pakistan's (SBP), core mode of monetary policy conduct remained the very strategy. In particular, the strategy has remained in vogue as follows: 'selective credit/credit ceilings' from the second quarter of Fiscal Year 1973 to August 1992; 'credit to deposit ratio'

[5] This is sometimes termed as 'too' horizontal a view. Therefore, the Post Keynesian literature has further refined the endogeneity of money hypothesis in three different, yet intertwined views: 'accomodationists', 'structuralists', and 'liquidity preference' [Palley (1996, 1994), Howells (1995), and Pollin (1991)]. All the three varieties fundamentally endorse the endogeneity hypothesis; they, however, differ in their fine interpretations.

from September 1992 to September 1995; and 'M2' target from September 1995 to date. Prior to 1990s SBP conducted its monetary policy with direct control instruments; bank-wise credit ceilings were used as active instrument of monetary control. This system was established after the adoption of "credit planning" through the National Credit Consultative Council (NCCC) set up under SBP in 1972.

The credit policy adopted under NCCCs Annual Credit Plan had a specific objective to support the public and some priority sectors. For this purpose, a number of credit schemes such as Locally Manufactured Machinery, Export Refinance Scheme, Commodity Operation Scheme, were launched at the subsidized rates. As public sector was enjoying virtually unlimited access to credit at subsidized rates, the magnitude of the flow of credit to the private sector, which was subject to selective credit, was set in residual to the global credit target. Furthermore, as the government relied heavily on bank borrowing for budgetary financing, the resulting debt structure in absence of a developed secondary market and administratively set yield structure, promoted financial repression. Besides, the higher operational cost provided banks little incentive to increase their deposit or lending base thus promoting financial disintermediation.

However, as of late 1980s, in particular from 1989 onwards, Pakistan embarked upon a reforms program aimed at instilling competition in the markets to achieve efficient allocation of financial resources. Therefore, financial markets were liberalized, measures were taken to strengthen institutions, banking laws went through changes, domestic debt management was improved, and foreign exchange and capital markets were reformed and liberalized. In 1991, as a major landmark development, the government of Pakistan for the first time auctioned short term (6-month) Market Treasury Bills (MTBs) and long term (3, 5, and 10 years) Federal Investment Bonds (FIBs). SBP (2002) gives a comprehensive review on the liberalization policies undertaken from late 1980s onwards.

These developments changed the character of Pakistan's economy, especially that of the financial sector. There were now more banks and other financial intermediaries, more innovations and therefore more financial products. In fact, there was a remarkable increase in financial intermediation. The currency to deposit ratio declined from 51.4 percent in 1990 to 34.3 percent in 2000 [SBP (2002)]; and the same ratio for 2007 further reduced to 26.1 percent. Indeed, the ingredients of a credit-based economy started to become apparent in the 1990s, continuing well into the 2000s.

On the other hand, SBP's performance in terms of actually realizing the monetary targets over 1975-2006 has remained subdued. A 'performance-analysis' of monetary targeting in Pakistan is summarized in Table 1. As presented, along with CPI Inflation both Credit and M2 have hardly met these targets. Allowing a ±1 percentage point margin of error in the whole sample (1975-2006), the Credit growth overshot its target 21 times and undershot 7 times. With this margin of error criterion, the Credit growth reached its target only 4 times in 1981, 1982, 1996, and 1997.

Table 1. Growth in Monetary Aggregates and CPI Inflation: Target and Actual

Fiscal Year	Credit (percent)			M2 (percent)			CPI Inflation (percent)		
	Target	Actual	Difference	Target	Actual	Difference	Target	Actual	Difference
1975	8.9	4.1	-4.8	11.2	6.0	-5.2		26.8	
1976	3.7	5.2	1.5	11.3	20.3	9.1		11.6	
1977	2.4	5.4	3.0	13.6	19.7	6.1		11.8	
1978	5.0	6.1	1.1	10.6	19.3	8.8		7.3	
1979	9.4	11.1	1.7	12.0	20.3	8.3		7.1	
1980	13.3	10.2	-3.1	13.7	15.7	2.0		10.7	
1981	11.3	10.7	-0.5	10.3	12.0	1.7		12.4	
1982	15.6	15.0	-0.6	13.8	10.4	-3.4		11.1	
1983	14.5	17.5	3.0	13.9	23.4	9.5		4.7	
1984	13.8	20.6	6.8	12.3	11.1	-1.2		7.3	
1985	13.2	14.7	1.5	10.4	11.9	1.5		5.7	
1986	12.9	18.3	5.4	9.4	14.1	4.7		4.4	
1987	9.3	16.7	7.4	11.3	13.1	1.8		3.6	
1988	9.5	15.5	6.0	11.7	11.8	0.1		6.3	
1989	7.7	10.4	2.7	11.2	7.5	-3.7		10.4	
1990	10.1	12.7	2.6	10.3	16.9	6.6		6.1	
1991	8.9	12.5	3.6	9.7	16.9	7.2	7.0	12.6	5.6
1992	9.3	13.8	4.5	11.1	25.6	14.5	8.5	10.6	2.1
1993	8.7	23.2	14.5	9.2	17.4	8.2	8.0	9.8	1.8
1994	11.5	13.8	2.3	13.1	17.9	4.7	8.0	11.3	3.3
1995	11.6	18.1	6.5	10.7	17.0	6.3	7.0	13.0	6.0
1996	14.6	14.1	-0.5	12.0	13.7	1.6	9.5	10.8	1.3
1997	12.9	13.8	0.9	12.2	12.1	-0.2	8.5	11.8	3.3
1998	16.1	15.0	-1.1	14.1	14.4	0.3	9.0	7.8	-1.2
1999	18.0	14.5	-3.6	13.5	6.1	-7.4	8.0	5.7	-2.3
2000	17.9	2.8	-15.2	9.4	9.3	-0.1	6.0	3.6	-2.4
2001	12.1	8.2	-3.9	10.4	8.9	-1.5	4.5	4.4	-0.1
2002	13.3	7.2	-6.1	9.5	15.3	5.8	5.0	3.5	-1.5
2003	12.0	21.2	9.2	10.7	17.9	7.2	4.0	3.1	-0.9
2004	8.9	34.0	25.1	11.0	19.5	8.5	3.9	4.6	0.7
2005	15.6	33.4	17.8	11.2	19.2	8.0	5.0	9.3	4.3
2006	19.3	23.5	4.2	12.8	14.8	2.0	8.0	7.9	-0.1

Source: *State Bank of Pakistan* and *Janjua (2004)*.

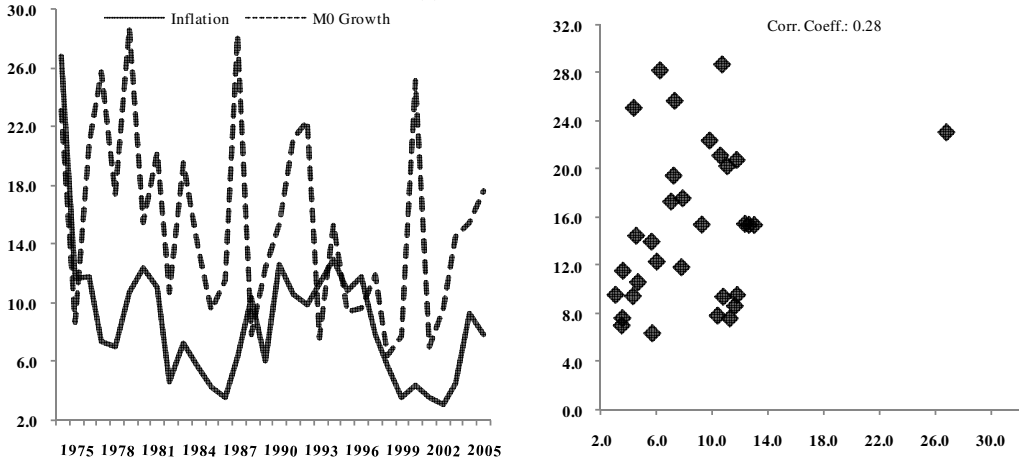
Note: Prior to 1991 there were no explicit targets for inflation rate; the emphasis has remained on the qualitative aspect of moderate prices as opposed to a quantitative inflation target. However, as a *means* credit and monetary growth have been used to achieve the *ends* of moderate price level

Similarly, M2 growth targets were undershot 5 times and were overshot 23 times in the sample. Its performance, allowing the aforementioned margin of error, is similar to that of the Credit one; that is, 4 times only. If we focus only on the sample from 1995-2006 during which operational monetary target was M2, it was only in 1997, 1998, and 2000 when M2's growth realization deviated from its target value by a difference of -0.2, 0.3, and -0.1 percentage point. As a whole, it overshot by 7 times and undershot by 2 times.

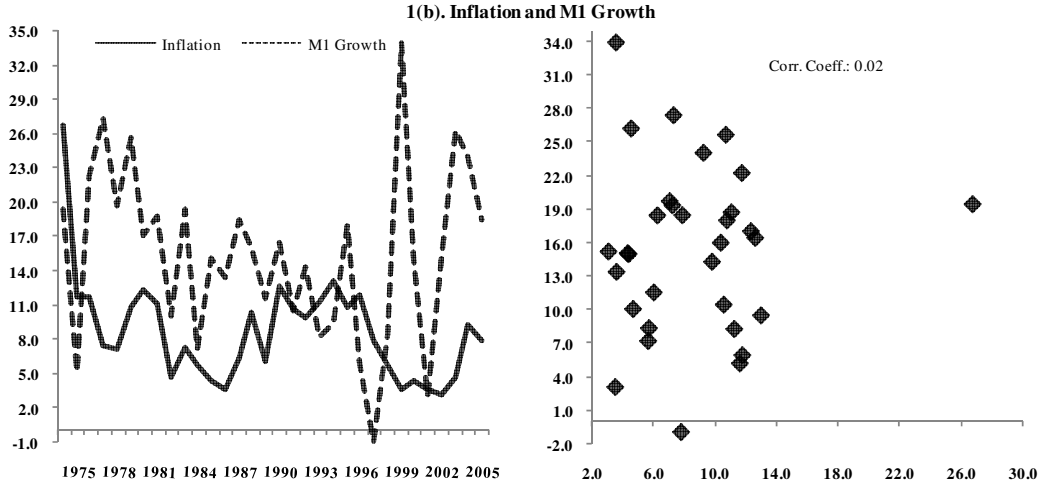
Performance on CPI Inflation is mixed. In fact, nothing consistent, such as increase in CPI Inflation to be consistent with a proportional increase in M2, comes out (Table 1). In the available sample (1991-2006) of CPI inflation target, the realization of inflation rates overshot the target values 8 times and undershot 4 times. Like credit and M2 growth, inflation hit the target range 4 times in the available sample, with best results in the years 2001 and 2006 when targets deviated by -0.1 percentage point. Based on this, therefore it is difficult to establish any consistent pattern between CPI Inflation and the monetary aggregates.

Figure 1. Inflation and Monetary Aggregates Growth, 1975-2006

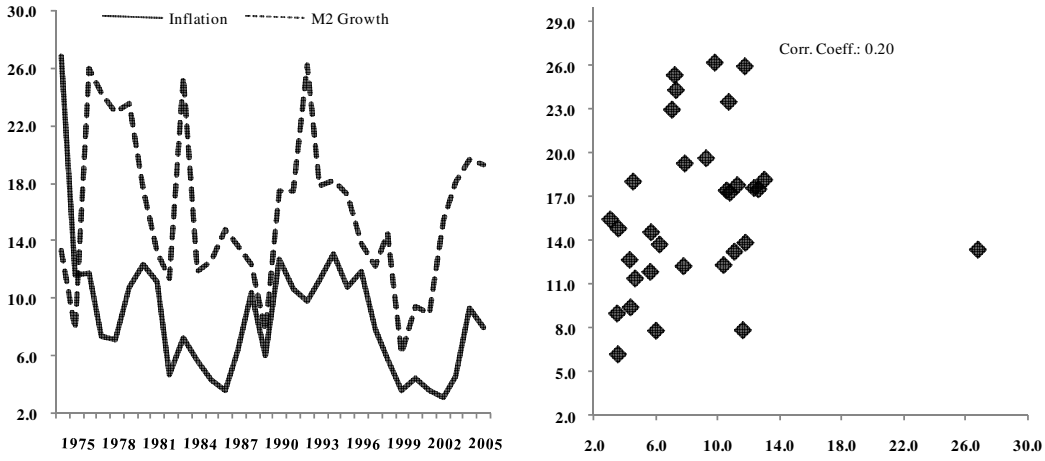
1(a). Inflation and M0 Growth



1(b). Inflation and M1 Growth



1(c). Inflation and M2 Growth



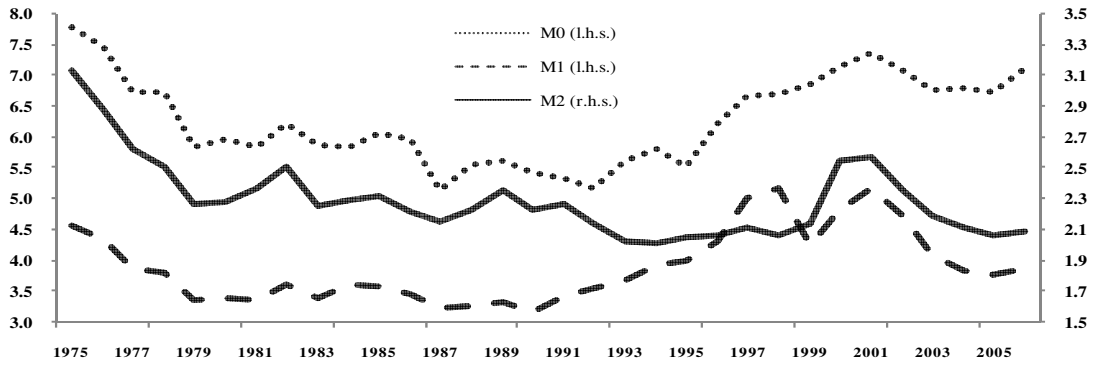
Source: *State Bank of Pakistan*
Note: All the monetary aggregates are with one lag

There could be two reasons behind this rather subdued performance. The first being the lack of significant relationship between inflation and monetary aggregates in Pakistan. Figure 1, covering a period of more than 30 years (1975-2006), summarizes this relationship through correlations. In particular, Figures 1(a), 1(b), and 1(c) present the correlations between CPI inflation and growth rates of M0, M1, and M2. Assuming that the growth rate of money is determined by the inflation rate, which also implies the exogeneity of money, all the monetary aggregates are taken with one lag. The correlation coefficient between Inflation and M0 is 0.28, between inflation and M1 is 0.02, and between inflation and M2 is 0.20. Even by removing the outlier in the sample (CPI inflation of 26.8 percent in 1975), the correlation coefficients in the case of M0 and M1 are reduced to 0.18 and -0.07. But, for M2 it improves to 0.38, which we assume is still not very convincing.

The other reason can be the velocity of money, variability of which implies instability in money demand. Figure 2 shows the income velocity of money defined for M0, M1, and M2 from 1975 to 2006. As shown, all the three velocities trend downwards and start rising from early 1990s. The rise in M2 velocity is comparatively less pronounced than M0 and M1; it nonetheless is at a higher value in 2006 than its bottom value in 1994. In particular, two simple points emerge from this figure: variability in velocities is *noteworthy* and the velocities *reverse* their downward trend from early 1990s onwards, coinciding with the financial liberalization policies.

To make further sense of Figure 2, we analyze the 'constant' velocity assumption of the monetarists and track the trend behavior of velocity within the Bordo-Jonung's U-shaped hypothesis. Bordo-Jonung's U-shaped hypothesis is based on the stylized long run, with data spanning from 1870s to 1980s, trend behavior of velocity of money of several developed economies [Jounung (1978), Bordo and Jonung (1990) and (2003)]. The hypothesis argues that historically the trend behavior of velocity has remained influenced by two different regimes, with each regime characterized by different stage of development. The first regime is characterized by

Figure 2. Income Velocity of Money, 1975-2006



Source: *State Bank of Pakistan*

a shift from barter system to the cash and demand deposit ones, in which increased monetization takes place thus resulting in the secular fall in the income velocity of money. The second regime is a result of financial liberalization and technological progress that redefines the role of money through the introduction of a wide range of financial products and means of transferring funds. As a result, the income velocity of money either stabilizes or even follows a secular increase. That is how income velocity of money tracks a U-shaped pattern. Therefore, as one might guess, this pattern would cause instability in the demand for money.

The data span that we have for Pakistan is rather short for the application of Bordo-Jonung's framework of analysis; especially with the fact that a barter system is not a possibility for a 1970s or a 1980s Pakistan. Looking at Figure 2, we nonetheless find one important point conforming to Bordo-Jonung's U-shaped hypothesis. It is the rise in all the three varieties of velocity from early 1990s. While for M2 and M1 velocities we cannot claim a secular increase, they are nonetheless on the rise since the early 1990s. As mentioned before, this time period is identified with the implementation of the financial liberalization programs in Pakistan. Therefore, based on the U-shaped velocity hypothesis analysis, we can argue that income velocity of money demand might not be a 'constant' phenomenon in Pakistan.

4. Testing Monetarists' Doctrines

The aforementioned exploratory facts and the world wide decline in monetarism paradigm motivate us to evaluate the optimality of monetary targeting strategy in Pakistan. We do this by testing for the presence of three hypotheses on Pakistani data. The first one, as predicted by the QTM, relates to the testing of one-on-one money-inflation relationship in the long run. The second test focuses on the 'constant' assumption of the income velocity of money. The third, as postulated by the Post Keynesians, relates to the identification of the endogenous money hypothesis. In what follows, therefore, we present the methodologies to test the QTM, 'constant' assumption of income velocity money, and the endogenous money hypothesis.

4.1. Testing the QTM

In the empirical literature on Pakistan, the evidence on money as a determinant of inflation is considerable. Table 2 summarizes some of the recent empirical research on inflation and money relationship in Pakistan. With the exception of Chaudhry and Choudhary (2006) and Akbari and Rankaduwa (2006), who find M2 in their estimates of inflation as insignificant and inelastic, all of other studies find money as a significant determinant of inflation. Furthermore, five out of eight studies attempt to 'model' inflation in Pakistan and do not address the one-on-one money-inflation relationship in particular.

While Abbas and Hussain (2006) investigate the cointegrating relationship between GNP deflator and M2, Qayyum (2006) and Kemal (2006) are the only studies that attempt to model the QTM. The former estimates a behavioral equation, whereas the latter relies on the cointegration and

Table 2. Some Recent Studies on the Money-Inflation Relationship in Pakistan

Study	Sample	Variables	Findings
Qayyum (2006)	1960-2005 (quarterly)	Dependent: *CPI inflation*. Independent: money, *GDP growth, income velocity of money*	Money is significant
Chaudhry and Choudhary (2006)	1972-2004	Dependent: *GDP deflator*. Independent: *M2, real GDP, import price*	M2 is insignificant
Akbari and Rankaduwa (2006)	1982-2004	Dependent: *CPI, WPI*. Independent: *exchange rate, foreign price, M2, large scale manufacturing index*	M2 is inelastic
Khan and Schimmelpfennig (2006)	1998-2005 (monthly)	Dependent: *CPI inflation*. Independent: *M2, interest rate, private sector credit, large scale manufacturing index, nominal effective exchange rate, wheat support price*	M2 is significant
Kemal (2006)	1975-2003	*CPI inflation, M2, GDP*	All variables are cointegrated
Abbas and Husain (2006)	1960-2004	*GDP deflator, GNP, M2*	Long run relationship between GDP deflator and M2
Bokil and Schimmelpfennig (2005)	1975-2004 (annual & quarterly)	Dependent: *CPI inflation*. Independent: *M2, GDP, large scale manufacturing index*	M2 is significant
Khan and Schimmelpfennig (2005)	1998-2005 (annual & monthly)	Dependent: *CPI inflation*. Independent: *M2, interest rate, private sector credit, GDP, large scale manufacturing index, wheat support price*	M2 is significant

error correction approach. Their findings conform to the one-on-one relationship between money and inflation. These studies use an approximation for the 'quarterly' GDP growth rate series. As the use of an approximation to the quarterly GDP series for Pakistan has yet to establish itself, we view these results with caution.

We attempt to model QTM in this study, as opposed to modeling inflation, and particularly look for one-on-one relationship between money and inflation. Therefore, following DeGrauwe and Polan's (2005) representation, we begin by the roots of the QTM that lie in the famous identity:

$$MV = PY \qquad (1)$$

The relationship simply dictates that for a given velocity of money (V) and given quantity of output (Y), controlling for some monetary aggregate (M) would yield the desired level of price (P). More specifically, the aforementioned identity is transformed into a theory by first moving to growth rates and then solving the P :

$$m + v = y + p \qquad (2), \text{ and}$$

$$p = m - y + v \qquad (3)$$

In Equations (2) and (3), lower case denotes growth. In Equation (3), the growth rate of price (p) – that is, inflation – is expressed as a function of growth rates of money (m), output (y), and velocity (v).

What follows from this transformation is one important proposition that in the long run, there is a proportional relation between inflation and growth rate of money: a permanent increase in money growth would lead to an equal increase in inflation. This proposition is tested using a simple OLS estimation on Pakistani data. Specifically, the study estimates the following equation:

$$p_t = \alpha_0 + \alpha_1 m_t - \alpha_2 y_t + \mu_t \qquad (4)$$

Where, p_t, m_t, and y_t are the rates of inflation, money growth, and output growth respectively; and error term, μ_t, is assumed as velocity. Our assumption of velocity as a random variable is justified on the basis of 'non-constant' income velocity of money discussion in the preceding section. Hence, the QTM in its one-on-one prediction would hold if the estimate of α_1 in Equation (4) equals 1. Or, any estimate of α_1 (very) close to 1, would validate the QTM theory.

4.2. Testing the 'Stable' Velocity Assumption

To understand the underlying concept of 'stable' velocity of money, we follow Friedman (1956; p. 16), "The quantity theorist accepts the empirical hypothesis that the demand for money is highly stable … This hypothesis needs to be hedged … [that] the quantity theorist need not, and generally does not, mean that the real quantity of money demanded per unit of output, or the velocity of circulation of money, is to be regarded as *numerically constant* over time …" [emphasis added]. Therefore, for our analysis we assume that income velocity of money is stable if it is 'mean reverting' over a period of time.

To test this assumption, we follow the guidelines offered to us by one of the most fundamental concepts of time series econometrics: the properties of a stationary stochastic process. Loosely speaking, a stationary stochastic process does not depend on time; if a time series is stationary it will fluctuate around a constant level. Formally, "a series is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two periods and not on the actual time at which the covariance is computed." [Gujarati (1995; p. 713)]

Sometimes, even a visual inspection of a time series may indicate its stationarity status, especially when it follows a secular upward (or downward) trend. This however might not be the case if the series does not exhibit any trend; this is especially the case if the sample size is small (as in Figure 2 here). In any case, standard Augmented Dickey-Fuller (ADF) test can be applied to determine the stationarity status of a time series.

Therefore, assuming Y_t to be a time series, the ADF test amounts to running the following regression:

$$\Delta Y_t = \beta_0 + \beta_1 t + \rho Y_{t-1} + \sum_{i=1}^{k} \phi_i \Delta Y_{t-i} + \varepsilon_t \; ; \qquad t = 1,2,3,... \qquad (5)$$

Equation (5) is self explanatory except for t which is a time or trend variable and (for example) ΔY_{t-1} would equal $(Y_{t-1} - Y_{t-2})$. After running the regression, the t-statistics of the coefficient ρ is compared with the Mackinnon's critical values. If they exceed the critical values then the null of non-stationarity is rejected. The estimation of Equation (5) is done, in the first place, in levels when the dependant variable is not differenced. If the null is not rejected in levels then the dependant variable is differenced once. If, still the null hypothesis is not rejected then the dependant variable is differenced twice.

Note that if stationarity is confirmed through the estimation of Equation (5) in levels then we conclude that the series is stationary or an integrated process of order zero, I (0). In other words, the series is a mean reverting process, or as we would call it here as a 'stable' series. In other cases, if the series is either an integrated process of order one or two, I (1) or I (2), then we conclude that it is not a mean reverting process or as we would call it here as an 'unstable' series.

4.3. Testing the Endogenous Money Hypothesis

Empirical investigations stemming from the predictions of Post Keynesian school of thought models are nearly non-existent in Pakistan. In fact, there is only one study, Ahmad and Ahmed (2006), which investigates the endogenous money hypothesis. Using Granger Causality tests on Pakistani data, the study finds the hypothesis valid in the short run and argues for weak evidence in the long run. Highlighting some of the shortcomings of standard Granger Causality test, our test of the endogenous money hypothesis would make use of a relatively improved methodology of Auto Regressive Distributed Lag (ARDL) procedure popularized by Pesaran and Pesaran (1997) and Pesaran and Shin (1999).

There are several advantages of applying this approach.[6] The main being the fact that it can be applied on a time series data irrespective of whether the variables are I(0) or I(1) [Pesaran and Pesaran (1997)]. Second, it takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework [Laurenceson and Chai (2003)]. Third, a dynamic

[6] The empirical literature investigating the endogenous money hypothesis has generally applied the standard Granger Causality test [Shanmugam et al. (2003) and Vera (2001)]. Conceptually, this test examines the dynamic linkage between the two time series only when the series are stationary. Furthermore, the test detects the current changes in one variable due to the past changes of another variable, but sometimes fails to detect the causality due to the current changes. Therefore, a cointegrating model that can capture long run as well as short run causality is a better choice. For this, various methods have been prescribed including Engle and Granger (1987), Johansen (1988) and (1991), and Johansen and Juselius (1990). The performance of these models, however, is restricted when the sample size is small or when the order of the cointegrating variables is not the same.

Error Correction Model (ECM) can be derived from ARDL through a simple linear transformation [Banerjee et al. (1993)]. The ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information.

The ARDL approach is described in two steps. In the first step, bound testing is conducted to detect the *presence* of cointegrating relationship, irrespective of the stationarity status of the variables, using the model:

$$\Delta y_t = \gamma_0 + \sum_{i=1}^{p} \gamma_{1i} \Delta y_{t-i} + \sum_{i=1}^{p} \gamma_{2i} \Delta x_{t-i} + \gamma_3 y_{t-1} + \gamma_4 \; x_{t-1} + \zeta_t \qquad (6)$$

In the first part of Equation (6), γ_1 and γ_2 represent the short run dynamics of the model. The null hypothesis is of the non-existence of the long run relationship; that is, $\gamma_3 = \gamma_4 = 0$. The estimated F-stat from Equation (6) has non standard distribution; therefore, Pesaran and Pesaran (1997) have tabulated the upper and lower bound of critical values. An estimated F-stat above the upper bound assumes the variables to be I (1) stationary and below the lower bound indicates that the relationship is non-stationary.

The second step consists of estimating long run and short run relationship. At first, the long run relationship is estimated using the following cointegrating equation:

$$y_t = \delta_0 + \delta_1 x_t + e_t \qquad (7)$$

Where, y_t and x_t are two different time series; e_t is a vector of stochastic error terms; and δ_0 and δ_1 are the parameters. When there is a long run relationship, there exists an error correction representation. Then, therefore, an error correction model is estimated:

$$\Delta y_t = \lambda_0 + \sum_{i=1}^{r} \lambda_{1\,yi} \Delta y_{t-i} + \sum_{i=0}^{s} \lambda_{2\,xi} \Delta x_{t-i} + \lambda_3 \zeta_{t-1} + \upsilon_t \qquad (8)$$

ζ_{t-1} is the error correction term obtained from the residual of Equation (7). The error correction model result indicates the speed of adjustment back to the long run equilibrium after a short run shock. ζ_{t-1} in Equation (8) provides a useful alternative to the Granger causality test. The test is based on *past changes* in one variable explaining *current change* in the other. If, however, variables share a common trend then *current* adjustments in y towards its long-run equilibrium value are partly the result of *current* changes in x. Such causality can be detected if the error correction term in Equation (8) is statistically significant.[7] Therefore, if the relevant variables are

[7] In particular, if lagged values of x in a model with dependent variable y are jointly significant then null hypothesis (x does not Granger-causes y) is rejected and *vice versa*. Furthermore, if the relevant variables are cointegrated and

Table 4. QTM Estimate based on Equation (4) (Dependant Variable: p_t)

	coefficient	t-stat	Probability	Adj. R^2	DW-stat	F-stat
Intercept	5.643	2.263	0.031			
y_t	-0.854	-2.067	0.048	0.226	1.126	5.526 (Prob.: 0.009)
m_{t-2}	0.469	3.248	0.003			

cointegrated, then causality must exist in at least one direction which is not always detectable if the results are only based on the standard Granger causality procedure.

5. The Results

Based on the methodologies outlined in the preceding section, we now present the results on the QTM theory, stability of the income velocity of money, and the presence of the endogenous money hypothesis.

5.1. The QTM Estimates

We estimate Equation (4) using a sample of more than 30 years from 1975 to 2006. We assume that a sample of this size is sufficient to fulfill the 'long-run' condition of QTM to hold. The data is from SBP on M2 (m_t), real GDP (y_t), and CPI inflation (p_t), converted into growth rates. As mentioned earlier, we do not use any independent estimates of velocity and assume it to be in the error term. This assumption is reasonable, as reflected in the results of the test in the next section.

We estimate Equation (4) using Ordinary Least Squares method. To run the regression in the original specification of the QTM, we used nominal GDP growth rates; however, no meaningful relationship was detected. Therefore, we estimate Equation (4) with p_t as dependent variable and m_t and y_t growth rates as independent variables and report the results in Table 4.

As evident, the estimate might not be reflecting very robust statistics of Adj. R^2, DW-stat, and F-stat, but the residual tests suggests no serial correlation. Therefore, it is technically an acceptable specification. Plot of estimated and actual p_t, not shown here, indicate that the estimated values track the actual ones rather well. Furthermore, the individual contribution of the explanatory variables is statistically significant and consistent with the a priori signs.

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the error correction term is significant then causality must exist at least in one direction; that is, current changes in y are caused by the current changes in x .

Table 5. ADF Test Results on the Income Velocities of Money based on Equation (5)

Y_t	Absolute t-statistics of ρ		Remarks
	Level	First Difference	
M0	1.57	4.24	I (1)*
M1	2.09	5.00	I (1)*
M2	2.90	5.09	I (1)*

* 95 percent absolute critical value for ADF statistics: 2.96

GDP growth rate enters the estimate with correct sign and is statistically significant. Similarly, M2 growth, the variable of our prime concern, is positive and statistically significant. Its coefficient, 0.469, however is far below than 1 and therefore does not conform to the QTM prediction of one-on-one relationship with CPI inflation. Moreover, the Wald tests for the null hypothesis that $\alpha_1 = 1$ is rejected at 5 percent level of significance. This further negates the presence of QTM in the above estimate.

Note however that a very low Adj. R^2 of only 0.226 suggests that not only QTM is an inadequate explanation; there could potentially be more determinants of inflation in Pakistan other than M2 and GDP growth. This also highlights the need to model inflation in Pakistan. Apart from the fact that M2 growth only marginally explains inflation in Pakistan, its significance with two lags, that is 24 months, is also debatable. In fact, it defies the conventional wisdom of monetary policy, variations in monetary aggregates, affecting prices with 6 to 12 months lag in developing countries. Nonetheless, we report this result as it is the best fit among the other estimates with M0 and M1 and with level and one lag specifications.

5.2. Stability of the Income Velocity of Money

To implement the ADF test methodology, we run the regression as in Equation (5) on all the three velocities of M0, M1, and M2. The data we use is from SBP covering a time period from 1975 to 2006. The results are presented in Table 5. The given results are obtained considering the deterministic trend; that is, estimation of Equation (5) with intercept term. Even after considering the stochastic trend, estimation of Equation (5) with trend variable as well, the results in Table 5 remain unchanged.

The test clearly reveals that all three velocities are integrated processes of order one, I (1); that is, the income velocities of money in Pakistan are non-stationary process. This implies that the income velocities of M0, M1, and M2 are not mean reverting processes. Therefore, we conclude that income velocity of money in Pakistan is an 'unstable' phenomenon.

Recall Friedman's explanation from Section 4.2. on the meaning of stable velocity of money. He further elaborates that increase in velocity during unusual episodes of hyperinflations is still

consistent with stable velocity assumption. This argument, however, might not hold in the present day Pakistan as it has never experienced hyperinflation. Indeed, the source of this instability stems from the liberalization policies that Pakistan implemented in late 1980s and 1990s.

5.3. The Endogenous Money Results

To implement the methodology as outlined in Section 4.3., the log linear variables we use are LCPS and LM0 and LM2 over the period 1973-2006. Our objective is to check the causality between LCPS and LM0 and LM2; that is, LCPS $\Rightarrow$ LM0 and LCPS $\Rightarrow$ LM2. To differentiate the market structure that existed before 1991, prior to the landmark auctions of MTBs and PIBs, we introduce a dummy variable (DUM) assuming a value of 1 from 1991 to 2006, 0 otherwise.

The results in Table 6 are based on bound test as given in Equation (6). All the specifications include an intercept, a linear trend, and a dummy variable. As obvious, the F-Stat for specifications (i) and (iii) crosses the upper limits of the bound; implying that there is a cointegrating relationship between "LM0 and LCPS" and "LM2 and LCPS". In other words, in the long run LCPS causes LM0 and it is not the LM0 that causes the LCPS, as envisaged by the monetarists. Similarly, it is LCPS that determines the LM2; therefore, credit determines the deposits that lead to the creation of money supply process. Having confirmed the presence of cointegrating relationship and establishing the direction of causality, we now further strengthen our result by calculating the long run coefficients and checking the significance of the error term in the ECM specification.

The results of the estimates based on Equations (7) and (8) are reported in Table 7. The results are based on AIC criterion of lag selection procedure. A significant DUM in both cases shows that the market liberalization and the creation of secondary market have further strengthened the impact of credit on the monetary aggregates.

The coefficients for LCPS, and the error term in both specifications, with LM0 and LM2 as dependent variables, are significant, thus validating the causality and long run relationship between "LCPS and LM0" and "LCPS and LM2". The first result, with LM0 as dependent

Table 6. Cointegration Results based on Equation (6)

Specification	Dependent Variable	Independent Variable	F-Stat†	Intercept	Trend	DUM2	Order of Cointegration
(i)	LM0	LCPS	13.53	Yes	Yes	Yes	I(1)*
(ii)	LCPS	LM0	4.42	Yes	Yes	Yes	-
(iii)	LM2	LCPS	6.36	Yes	Yes	Yes	I(1)**
(iv)	LCPS	LM2	2.87	Yes	Yes	Yes	-

* 1 % level of significance; † 99 % critical values: lower: 6.52 – upper: 7.58
**5% level of significance; ; † 95 % critical values: lower: 4.90 – upper: 5.87

Table 7. Results based on Equations (7) and (8)

Dependent Variable	Order of Lags (AIC)	LCPS	Intercept	DUM	Trend	Error Term	Joint Significance (ChiSq)
LM0	1,0	0.28*	0.22*	0.06*	0.044*	-0.72*	-
LM2	3,1	0.17**	0.36*	0.10*	0.032*	-0.50*	10.41*

* 1 % level of significance; **5% Level of Significance

variable, shows that 1 percent increase in the LCPS results in 0.28 percent increase in LM0. Long run cointegration relationship from LCPS to LM0 and the significant error term leads us to the conclusion that in the long run LCPS determines the LM0.

The second result, with LM2 as dependent variable, shows that 1 percent increase in LCPS causes LM2 to rise by 0.17 percent. Furthermore the lag term of the LCPS is found jointly significant, forcing the rejection of the null hypothesis that the LCPS does not cause LM2. The significant error term in the presence of the cointegrating relation between LCPS and LM2 at the same time also confirms that the causality exists from credit to money supply. Both the test results support the endogenous money hypothesis in Pakistan.

6. Concluding Remarks

This study finds that the QTM does not hold in its one-on-one money-inflation relationship, that income velocity of money is unstable, and that the money is endogenous. But, does this imply that 'money' is irrelevant? Paul Volcker once observed, "[T]here is a kind of commonsense view that inflation is too much money chasing too few goods. You could oversimplify it and say that inflation is just a monetary phenomenon. There are decades, hundreds of years, of economic thinking relating the money supply to inflation, and people to some extent have that in their bones."[8] Therefore, it would take some deal of audacity on our part as well to negate a theory that has remained rather dominant.[9] Nonetheless, two multi-country investigations of the QTM do support our findings.

In one of various tests of the QTM, Moroney (2002) separates countries into 'high-money-growth and high-inflation' and 'low-money-growth and low-inflation' categories. The former category is characterized by money growth exceeding real GDP growth by at least 15 percent and for the latter category exceeding by less than 6 percent. He finds that QTM in its nearly one-on-one prediction is strongly supported in the former category and does not carry the same support in the

[8] As quoted in Barnett and Samuelson (2007, p. 178).

[9] Many, such as the Governor of Bank of England Mervyn King, still believe that ignoring money might turn out to be costly and that sooner or later it would make a comeback in standard models. Quoting Hilaire Belloc he concludes an interesting article on the role of money in the economy as, "I'm tired of Love: I'm still more tired of Rhyme/But Money gives me pleasure all the time." [King (2003); p. 86]

latter category. Similarly, De Grauwe and Polan (2005) confirm this result by separating countries into four categories characterized by annual average money (M1 and M2) growth rates of less than 15, 20, 30, and 100 percents. The QTM holds in its one-to-one prediction in the last two categories, and the coefficients for less than 20 percent category are 0.79 and 0.88 for M1 and M2. For the first category, however, the coefficients are rather low at 0.22 (M1) and 0.25 (M2). Furthermore, low inflation countries in these studies are typically OECD countries where average inflation has remained at single-digit level in the last thirty years.

In Pakistan average annual inflation and money growth (M2 growth) remained 8.7 percent and 16 percent during 1975-2006. M2 growth to real GDP growth over the same time has remained at 3.5 percent. Therefore, if we take aforementioned studies' line of argument Pakistan can be categorized into 'low-money-growth and low-inflation' countries. This brings our result of the absence of QTM in Pakistan in line with the international evidence.

Furthermore, our finding of the income velocity of money as unstable is a widely accepted phenomenon in quite a few countries of the world. Similarly, our confirmation of the presence of endogenous money in Pakistan is also in line with the established Post Keynesian hypothesis. These results point to the fact that we might need to rethink on monetary targeting monetary policy strategy in Pakistan.

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