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Velocity of Money Functions in Pakistan and Lessons for Monetary Policy

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***Abstract**: This paper is an attempt to contribute to the ongoing debate: should central bank of Pakistan adopt the inflation targeting or continue with the monetary targeting as a monetary policy strategy? A pre-requisite for monetary targeting strategy is a stable money demand function, which in turn requires stability in velocity. Instability in velocity on the other hand is believed to stem from the volatility of the interest rate. The paper estimates velocity of money functions and explores their stability in Pakistan. The results show that base and broad money velocities are independent of the interest rate fluctuations. It is also found that velocities of all the three monetary aggregates (i.e., M0, M1, and M2) have stable relationship with their determinants. These findings support the use of monetary aggregates as nominal anchor.*

***JEL Classification:** E12, E5*
***Keywords:** monetary targeting, income velocity of money, money demand function*

1. Introduction

The State Bank of Pakistan is among the few central banks which have been using monetary targeting strategy for the conduct of their monetary policy.[1] In such a strategy, monetary aggregates are used as a nominal anchor which indirectly serves the basic objective of price stability. The achievement of targeted inflation remains less binding with this regime; however, the deviation of realized inflation from the targeted one could still be used as a measure of performance of a central bank. Based on such measure adopted by Omer and Saqib (2009), the SBP's performance in achieving price stability remains weak, specifically in the post financial liberalization period.

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[1] For a last couple of years, however, the SBP monetary policy statements have been focusing more on movements in interest rates than on monetary aggregates.

Recent surge in inflation in Pakistan since FY08 and stories of successes with inflation targeting in various countries, renewed the debate on the monetary targeting strategy followed by the SBP. Number of authors have argued for and against the adoption of inflation targeting strategy like Moinuddin (2009), Felipe, (2009), Akbari and Rankaduwa (2006), Khalid (2006), Khan and Schimmelpfenning (2006), and Chaudhry and Choudhary (2006). Also, a great number of authors has assessed if quantity theory of money, the basis of monetary targeting, holds for Pakistan like Omer and Saqib (2009), Qayyum (2006), Kemal (2006) and Abbas and Husain (2006).

Besides the above two directions, a few authors have revisited the assumptions of quantity theory of money (QTM) that forms the building block of the monetary targeting strategy. Of these assumptions, two are critical, first income velocity of money or its growth rate is constant, and second since monetary shock does not has a long run real effect, a stable velocity implies a stable money demand function over the long run. A stable money demand function, on the other hand, makes monetary aggregates a favorable candidate for the intermediate target; otherwise, interest rate should be adopted as nominal anchor as argued by Mishkin (2004). In case of Pakistan, Omer and Saqib (2009), while testing the QTM explore the constant velocity assumption. They test the stationarity of the velocities related with all the three definitions of monetary aggregate (i.e., M0, M1, and M3) and report that velocities are not mean reverting and hence unstable. They conclude that the SBP has very limited ability to control the monetary aggregates or money supply; however, it has significant control over the interest rates due to money endogeniety. Therefore, the SBP should adopt interest rate as its nominal anchor. A similar conclusion has been drawn by Moinuddin (2009) who finds money demand function in Pakistan as unstable. However, both papers have been criticized on the basis of either specification or methodology adopted

For money demand function, interest rate is believed to be the major source of instability. Volatility in the interest rate makes the velocity of money volatile and hence the money demand. Alternatively, as indicated by the Bordo and Junong (2004) the changing definition of money and/or development of financial institutions could be a stronger source of instability.

The objective of this paper is therefore first to check if the interest rate is a significant determinant of velocity of money in Pakistan, as generally perceived; and second, if this relationship of velocity with its determinants is stable in the long run. Either an insignificant interest rate in the velocity function or a stable relationship of velocity with its determinants and/or both will lend necessary support to the monetary aggregates for their use as nominal anchor. An unstable velocity on the other hand, not only sets the premise of the unstable money demand function but may also support the view of Omer and Saqib (2009) that the SBP should revisit its monetary targeting strategy and consider inflation targeting.

The rest of the paper is structured as follows. The next section presents a review of the existing literature on the subject and section 3 synthesizes the money demand function using velocity of money and explains the methodology and the data sources. Section 4 discusses the result of the velocity function and the last section consists of concluding remarks.

2. Review of literature

In the literature money demand function has been studied using both 'velocity' and 'conventional' formulation. This section presents the detailed review of the literature on money demand function using both the formulations separately, to account for overall progress on this area.

Before the collapse of the Bretton Woods System, M1 money was considered stable in the industrialized economies. However, since 1974 the conventional M1 money demand function began to over predict the demand for money, which Goldfeld (1976) termed as the case of 'missing money'. The woes of conventional money demand function increased in the 1980s as it under-predicted the velocity of money, which rose faster than expected. Economists have since been concerned that the velocity of Ml and several other monetary aggregates from 1981 to at least 1986, declined to an unpredicted extent. They have questioned the continued pursuit by central banks of monetary targets. Unpredictability of velocity is the key reason policymakers in the United States and elsewhere have given for abandoning monetary targeting.

Inherent role of velocity in the stability of money demand prompted researchers to conduct a detailed study of money demand function using velocity. In fact velocity is another way in which money demand function can be expressed (Siklos, 1993). Bordo and Junong (1981, 1987, 1990, and 2004) using long term data study the behavior of velocity among a number of developed economies, and find that velocity declined in these economies in phase of monetization and then recovered with the financial innovations and deregulations. As a tool for empirical analysis, the authors used ordinary least square in most of their studies. Later on, Bordo et al. (1997) provide necessary methodological support to their 'institutional hypothesis' using co-integration and the error correction techniques.

In comparison to the relatively limited literature on the velocity, 'conventional' money demand attracted a large number of researchers, primarily because of its easy to understand formulation. Even if one starts with the post Bretton Woods period, Goldfeld (1973), Boughton (1981), Arango and Nadiri (1981), Butter and Fase (1981), Rose (1985), Hendry and Ericsson (1991), Mehra (1991), and Leventakis (1993), are a few among the vast pool of the authors who made a significant contribution on the conventional models of money demand. A brief summary of the recent literature has been given in the annexure that discusses conventional money demand function in terms of stability.

Among selected developed countries, except Germany, UK and Switzerland, the money was found to have a stable and long run relationship with its determinants. Similarly, among the selected group of the developing countries, except China and Nepal, the money demand was found to be stable. The instability in the Chinese money demand stems from the rapid financial developments started since 1980s. Lee and Chien (2008) find the structural breaks in 1980 and in 1993, which they linked with the critical financial and economic developments.

As mentioned above, Moinuddin (2009) finds an unstable money function for Pakistan. His results show a large negative intercept for the estimated broad money demand model. Surprisingly, no satisfactory explanation is provided for the relatively large negative intercept, which leads to suspicion of specification bias. For example, Bordo and Junong (1990) suggest that in an economy where interest rate is not free to respond to the market forces (regulated economy) the expected inflation should be included in the demand function. However, Moinuddin (2009) study ignores expected inflation despite including the period of financial repression (1975-1991) in the sample. On the other hand, the samples used by other studies like Brahmani-Oskooee and Rehman (2005) and Qayyum (2006) do not go beyond the year 2000. Therefore, their results should be viewed with caution as their samples do not fully encompass the effect of second generation of financial reforms initiated in 2000s. The result of another study on Pakistan by Abbas and Husain (2006) should also be viewed with caution as they do not explicitly undertake any stability test and rely on the 'significance' of regression as indication of the "long run and stable" M2 demand function.

While there are number of studies that test stability of conventional money demand function for Pakistan, there is hardly one that examines the stability of velocity of money except some brief reviews by Bilquees and Shehnaz (1994) and Omer and Saqib (2009). Bilquees and Shehnaz (1994) document a slowdown in velocity between 1974-75 and 1991-92. They used the number of bank branches as proxy for the financial development and conclude that financial development in Pakistan has significantly affected the velocity of money. Neither they attempted to investigate the long run relationship nor did they conduct any stability test of their findings. Omer and Saqib (2009), on the other hand used “instability” in the money velocity as one of the reasons for disapproving the monetary targeting strategy adopted by the SBP. They argued that quantity theory of money assumes a constant or stationary velocity while income velocities of M0, M1, and M2 are not ‘mean reverting’ or stationary in Pakistan. On the basis of their findings, they conclude that all three velocities are unstable. Their result of non-stationary velocities has been criticized also, of being non robust.

The above review of existing literature clearly shows that conventional formulation of money demand is more popular among the researchers precisely due to simple analytical formulation and interpretation. However, this study focuses on velocity formulation of money demand function. As indicated earlier, the objective of this study is to investigate the stability of velocity, which is not possible using conventional money demand function. Moreover, the velocity formulation is strongly based on economic theory of permanent income hypothesis propounded by Milton Friedman. On contrary, those who worked with conventional money demand function, a large number of them have followed Arango and Nadiri (1981) approach which has been severely criticized for being ad hoc and lacking theoretical foundation.

3. Data and methodology

A combination of conventional equation of exchange and Friedman (1956) demand function of real money balances gives us the following function for velocity of money through a simple algebraic manipulation:

$$\log V(m) = \beta_0 + \beta_1 \log Y^p + \beta_2 r + \beta_3 \log Y^t + \beta_4 \pi^e + \varepsilon \tag{1}$$

Where *V(m)* is income velocity of money measured as a ratio of nominal GDP to some monetary aggregate and *m* = 0, 1, 2 for the respective monetary aggregate, i.e., M0, M1 and M2; Y^p is the real permanent income per capita; *r* is real interest rate; Y^t represents the transitory income measured as the ratio of the per capita overall income and permanent income; and π^e is expected inflation. .

We expect a positive sign for permanent income in the above equation as any increase in it will increase the number of transactions in the economy thereby affecting the velocity positively. Transitory income, on the other hand should have a unity coefficient in the regression. A coefficient that is positive but less than one would indicate that the velocity moves pro-cyclically and would be consistent with the Friedman’s permanent income hypothesis. Over the cycle, the transitory income would increase the demand for money, because cash balances serve as a buffer stock. In the long run these transitory balances would then be worked off, returning to the coefficient to unity (Bordo and Junong, 1990).

The real interest rate is also expected to have a positive sign as an increase in it would decrease the demand of real money balances and thus a rise in the velocity with a given level of income. The impact of the inflation on velocity is ambiguous and the coefficient could take either positive or negative sign depending upon its relative influence on money balances and income growth.

In order to estimate the relationship between the velocity of money and its determinants as mentioned above, we have used autoregressive distributed lag (ARDL) model suggested by Pesaran and Shin (1999) and Pesaran et al (2001). The advantages of using ARDL are (a) it can be applied on a time series data irrespective of whether the variables are integrated of order zero or one, (b) it can take sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson and Chai, 2003); and (c) a dynamic 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.

Although the aim is to estimate the long-run relationship and examine their stability, the ARDL approach also incorporates the short run dynamics as only relying upon long run estimates will not be sufficient. Indeed, Laidler (1993) argues that only relying on long-run money demand function is inappropriate, as some of the problems of instability in the money demand function could stem from inadequate modeling of the short-run dynamics characterizing departures from the long-run relationship.

We estimate the following ARDL model for examining the stability of velocity of money function.

$$\Delta \log V(m) = \gamma_0 + \sum_{1}^{l} \gamma_{1_i} \Delta \log V(m)_{t-i} + \sum_{0}^{m} \gamma_{2_i} \Delta \log Y^p + \sum_{0}^{n} \gamma_{3_i} \Delta r + \sum_{0}^{o} \gamma_{4_i} \Delta \pi + \sum_{0}^{p} \gamma_{5_i} \Delta Y^t + \gamma_6 \log V(m)_{t-1} + \gamma_7 \log Y^p{}_{t-1} + \gamma_8 r_{t-1} + \gamma_9 \pi_{t-1} + \gamma_{10} Y^t{}_{t-1} + \zeta_t \quad (2)$$

Where $\gamma_6, \gamma_7, \gamma_8, \gamma_9, \gamma_{10}$ are the long run coefficients while $\gamma_{1_i}, \gamma_{2_i}, \gamma_{3_i}, \gamma_{4_i}, \gamma_{5_i}$ and ζ_t represents the short run dynamics and random disturbance term respectively.

The null hypothesis that the long run relationship does not exist, i.e.,

$\gamma_6 = \gamma_7 = \gamma_8 = \gamma_9 = \gamma_{10} = 0$ is tested against the alternative hypothesis $\gamma_6 \neq \gamma_7 \neq \gamma_8 \neq \gamma_9 \neq \gamma_{10} \neq 0$ by means of familiar F-test. However, the asymptotic distribution of this F-statistic is non-standard irrespective of whether the variables are I(0) or I(1). Pesaran et al. (2001) have tabulated two sets of appropriate critical values. One set assumes all variables are I(1) and another assumes that they are all I(0). This provides a band covering all possible classifications of the variables into I(1) and I(0) or even fractionally integrated. If the calculated F-statistic lies above the upper level of the band, the null is rejected indicating cointegration.

Next step in ARDL estimation, as outlined by the Pesaran and Pesaran (1997), is estimation of the long run relationship based on the appropriate lag selection criterion such as Adjusted R^2, Akaike Information Criterion (AIC), or Schwarz Bayesian Criterion (SBC). The choice of lag selection criteria is important and only an appropriate lag selection criterion will help in identifying the true dynamics of the model. Once determined, the ARDL model gives the long run cointegrating coefficients of the model.

Based on these long run coefficients, the estimation of dynamic error correction is carried out using formulation of equation (3). The coefficients $\delta_{1_i}, \delta_{2_i}, \delta_{3_i}, \delta_{4_i}$ and δ_{5i} show the short run dynamics of the model and δ_6 indicates the divergence/convergence towards the long run equilibrium. A positive coefficient indicates a divergence, while a negative coefficient indicates convergence.

$$\Delta \log V(m) = \delta_0 + \sum_{1}^{l} \delta_{1_i} \Delta \log V(m)_{t-i} + \sum_{0}^{m} \delta_{2_i} \Delta \log Y^p + \sum_{0}^{n} \delta_{3_i} \Delta r + \sum_{0}^{o} \delta_{4_i} \Delta \pi + \quad (3)$$

$$\sum_{0}^{p} \delta_{5_i} \Delta Y^t + \delta_6 ECM_{t-1} + \vartheta_t$$

The stability of the estimated model has been examined by using CUSUM and CUSUMSQ tests, proposed by the Brown et al. (1975). Also some other diagnostic tests were applied on residuals such as Lagrange Multiplier (LM) test for serial correlation, Ramsey Reset test for functional form misspecification, and Jarque-Berra Test for normality. The LM test assumes null hypothesis that residuals are serially uncorrelated while Ramsey Reset assumes that the specified model has linear functional form. Similarly, Jarque-Berra test hypothesizes that the residuals are normally distributed. All of the above hypotheses are tested at 95 percent level of confidence.

For all estimation purposes annual data starting from 1975 to 2006 has been used; it is the period for which a consistent set of data of all the required variables is available. The starting year corresponds to the official division of all financial and economic statistics between East and West Pakistan (Bilquees and Shahnaz, 1994) and the terminal year (2006) is the last year for which official estimates of a consistent M1 data is available. The data is obtained from Handbook of Statistics on Pakistan Economy (2005) and different issues of monthly statistical bulletin both published by the State Bank of Pakistan, Karachi.

Before estimation, logarithmic transformation applied to all variables except real interest rate (call money rate) and inflation (percent change in CPI). The variable per capita real permanent income has been constructed using the long-run trend in the log of per capita real GDP. For this purpose HP filter (λ= 100) has been applied on per capita real GDP since 1950 following Bordo and Junong (1990).[2]

4. Results

Before estimating the ARDL model, we have tested all the variables for stationarity by using Augmented Dickey Fuller (ADF) test and found per capita permanent income and three velocities as differenced stationary and transitory income, inflation and real interest rate as level stationary.[3] The results of ARDL bound test are reported in Table 1 for three specifications of the model with lags ranging from 1 to 3 as the co-integration is sensitive to the choice of lag length. Limiting maximum lag to 3 is normal practice in literature dealing with the annual data. The choice of this procedure is to explore the possible cointegration relationships that might be emerging at various lag levels.

It is found that per capita permanent income, real interest rate, transitory income and inflation are found to have long-run relationship with velocities V(1) and V(2)[4] as the computed F-statistics is higher than the upper limit of the bound with lags higher than one. However, in case of V(0), no such evidence of cointegration. is found. However as discussed earlier, Bahmani-Oskooee and Bohl (2000) consider these results as preliminary due to arbitrary choice of lag selection, and argue that the cointegration evidence based on error correction is more efficient.

[2] Although the study is confined to 1975 and 2006, the use of longer time series is more appropriate for extracting a trend from the series.

[3] ADF test results can be obtained from the author.

[4] For Model of V(1), bound test for cointegration initially conducted with intercept, and result thus obtained indicated V(1) is fractionally cointegrated (Bahmani-Oskooee, 2005). Later, trend was introduced in estimation which remarkably improved the result of the bound test. Therefore, test results for V(1) includes trend.

Tables 1. F-Test for Cointegration

	Lag 1	Lag 2	Lag3
V(0)	0.9586	2.3210	1.6950
$V(1)^{n}$	3.6802	7.6956	4.6223
V(2)	2.1978	8.2214	4.5264

At 95% level Critical Values of bound is 2.850 - 4.049
^{n} Estimated using trend

In the next stage, we choose the optimal lag length for a given model and estimate long run dynamics of the ARDL model. According to Pesaran (1997), AIC and SBC perform relatively well in small samples. However, the SBC is slightly superior to the AIC (Pesaran and Shin, 1999) and it is parsimonious in the sense it uses minimum acceptable lag while selecting the lag length and avoids unnecessary loss of degrees of freedom. Therefore, using SBC criteria optimal lag lengths (1,0,0,0,0) for M0 velocity, (0,0,3,3,2) for M1 velocity, and (3,3,0,0,0) for M2 velocities selected which respectively corresponds to the variables velocity of money, permanent income, interest rate, inflation and transitory income.

Table 2. Full Information Long Run Coefficient Estimation

Variables (optimal Lags)	Models 1(V(0)) (1.0.0.0.0)	Model 2(V(1)) (0.0.3.3.2)	Model 3(V(2)) (3.3.0.0.0)
Y^{p}	1.6101*	-0.3670**	1.5425*
	(3.1888)	*(-1.7593)*	*(2.589)*
r	0.0093	0.0396*	0.0023063
	(0.8364)	*(7.2307)*	*(0.25478)*
π	0.00924	0.0476*	0.015088**
	(0.799)	*(7.9165)*	*(1.6767)*
Y^{t}	-0.0000299	0.00008516*	0.00006380*
	(-1.1513)	*(3.5878)*	*(3.0711)*
Intercept	1.7988*	0.016583*	079531*
	(17.655)	*(4.6035)*	*(10.3148)*
Trend		0.01658*	
		(12.1766)	

* indicates 5% level of significance; ** 10% level of significance; figures in parenthesis are t-statistics

The results of the long run co-integrating relationship of three forms of velocities with its variables are reported in Table 2. Coefficients of all the three models of velocities are generally in conformity with our theoretical foundation. Per capita permanent income bears a positive sign in both V(0) and V(2) velocity function, as envisaged earlier. In quantum, one percent increase in the per capita permanent income will increase the V(2) velocity by 1.54 percent in the long run. For V(1), however, the relationship was found to be negative but insignificant.

The impact of transitory income is also positive and significant but very small for V(1) and V(2). This implies first, both V(1) and V(2) are pro-cyclical which links the underlying behavior of velocity with the per capita permanent income. Second, the impact of the business cycle fluctuations on velocity of money and thus on the money demand is although very trivial but significant.

While a significant and positive relationship between the interest rate and V(1) has been found, both the V(0) and V(2) are found to be insensitive to the changes in the real interest rate. This indicates that economic agents respond to interest rate increase by switching their deposits away from demand deposits that effectively bear zero rate of return to interest-bearing time deposits. On the other hand, inflation has been found having a significant relationship with V(1) and V(2) in the long-run and insignificant with V(0).

The short run dynamics of the velocities of money have been given in Table 3 for three definitions, i.e., V(0), V(1) and V(2). Not much interpretation could be attached to the short-run coefficients. All they show is the dynamic adjustment of these variables. However, the negative coefficient of the error correction term with significant t-statistic confirms the cointegration among the variables in all three velocities. As argued by Bahmani-Oskooee and Bohl (2000), this evidence of cointegration is more efficient than the bound test. These cointegrating relationships are due to the interest rate, inflation, and transitory income in case of V(1) velocity, and due to per capita permanent income and the transitory income in case of the V(0) and the V(2) velocities.

Besides, the results show that all three estimated models cannot reject the null hypotheses of LM tests, Ramsay- reset test and the Jarque-Berra test. In other words residuals are serially uncorrelated, normally distributed, and the specified models are functionally linear. These test results show that the estimated error correction models are statistically adequate. The graphical presentation of CUSUM and CUSUMSQ tests is provided in Figure 1. All the graphs of CUSUM and CUSUMSQ statistics stay comfortably well within the 5 percent band indicating that the estimated relationships of all three velocities are stable.

Table 3. Full Information Short run Estimate with ECM

	Model 1 V(0)			*Model 2 V(1)*			*Model 3 V(2)*		
	0	**1**	**2**	**0**	**1**	**2**	**0**	**1**	**2**
$\Delta V(m)_{-1}$								0.606*	0.463*
								(4.20)	(2.56)
ΔY^p	0.837*			-0.276			0.441*	-1.278*	-0.746*
	(3.15)			(-1.15)			(2.09)	(-4.55)	(-2.44)
Δr	0.002			0.008	-0.038*	-0.026*	0.003		
	(0.41)			(1.68)	(-4.39)	(-3.86)	(0.52)		
$\Delta \pi$	0.003			0.006	-0.049*	-0.0318*	0.010**		
	(0.41)			(1.10)	(-4.89)	(-4.08)	(1.96)		
ΔY^t	1.0E-5			-3.0E-6	-4.0E-5*		3.0E-5*		
	(2.44)			(-0.47)	(4.12)		(3.91)		
ΔTrend				0.016*					
e(-1)		-0.33*			-0.994*			-.409	
		(-2.44)			(-6.80)			(-4.04)	
Adjusted R^2			0.34			0.78			0.62
LM Stats			0.25			2.73			6.67
Ramsey's Reset			0.008			0.09			1.99
Normality			1.63			0.53			4.71

* indicates 5% level of significance; ** 10% level of significance

5. Concluding remarks

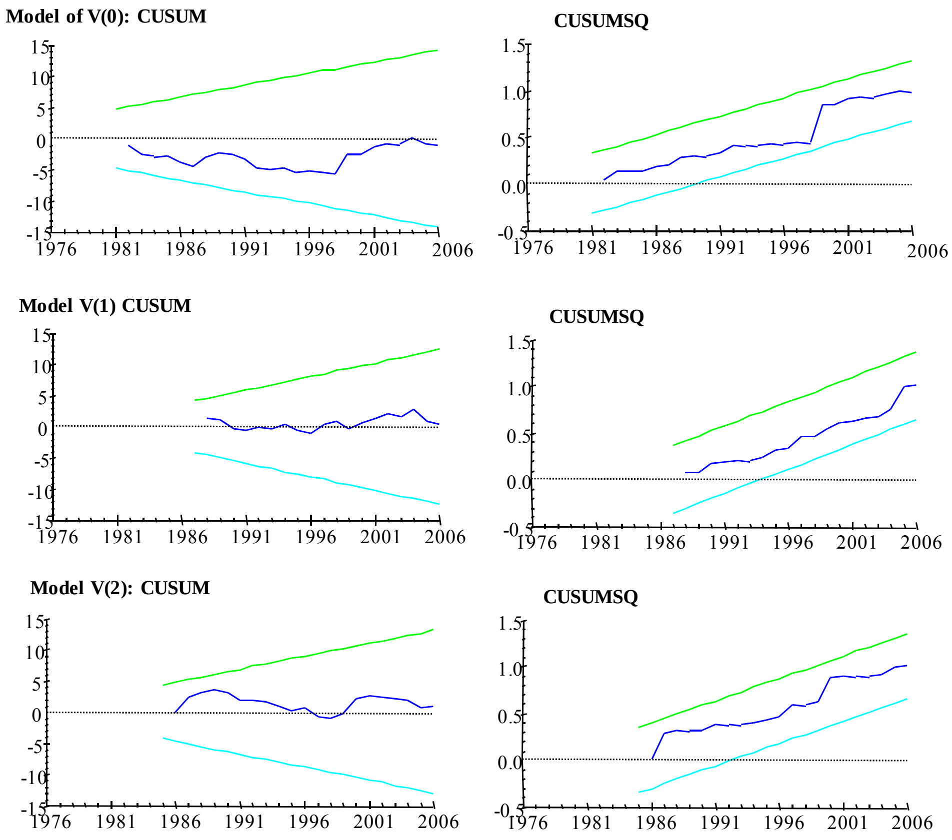
The paper explores the factors that determine the long run behavior of income velocity of money. The estimated result shows that in long run the M0 and M2 velocities depend on the income and the business cycle fluctuations and are independent of the interest rate fluctuations - a believed root cause for velocity instability. On the other hand, we have found M1 velocity depends on the interest rate and inflation besides income.

In terms of the policy perspective, independence of both M0 and M2 velocities from interest rate fluctuations strengthens their role as nominal anchors for monetary policy. Interestingly this is the case in practice in Pakistan: the monetary authority of Pakistan uses M0 and M2 as nominal anchors for operational and intermediate targets respectively while it had never used M1 officially for policy purposes. Instead, official reporting of M1 by the authority has been abandoned since 2006.

We also find stable relationships between income velocities of money and their determinants on the basis of CUSUM and CUSUSMQ tests. These results are contrary to both Omer and Saqib (2009) and Moinuddin (2009). However, our results are in line with Narayan et al. (2009) who use panel cointegration to estimate the money demand function in South Asian countries of India, Pakistan, Bangladesh, Sri Lanka and Nepal. Based on their finding of stable money demand function for the above countries (except Nepal), they suggested that the monetary targeting is a viable option for conduct of monetary policy for the central banks of these countries including Pakistan.

The caveat of this study, however, is small sample size, which may raise questions on the robustness of estimation results. A bootstrap simulation technique has also been used to check the deviation of the variance, and the result shows that the bootstrap standard error remains close to the estimated standard error. However, this result is not sufficient to complement the robustness tests recommended in literature, which could not be taken due to small sample size. Even if the recent annual information is incorporated in the existing sample, the sample size remains insufficient for the conduct of the robustness tests. A natural way out is to use the quarterly data. Therefore, working with the quarterly data that provides substantial data size to conduct the robustness tests on the estimated parameter, could be a potential for future research.

Figure 1. CUSUM and CUSUMSQ of Recursive Residuals of Velocity Models



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Annexure 2. Recent studies on the stability of money demand function

Study	Country	Sample	Method*	Variables	Results
Asano. H(1999)	Australia	65-95	JJ, VECM	Yr, M, P, i	Money demand function is stable
Haug. A and R. Lucas (1996)	Canada	53:1-90:4	EG, JJ, PO,	M1, Yr i (short)	Stable cointegration relationship
Hamori N. and S. Hamori (1999)	Germany	69:1-94:4	JJ, Chow	Yr, M1, M2, M3 i (call)	Unstable
Bahmani-Oskooee M(2001)	Japan	64:1-96:3	ARDL, CUSUM, CUSUMQ	M2, Yr i	Stable relationship
Narayan P K (2008)	USA	59:1-04:2	LM, structural break unit root, bound test	M1, M2, Yr, i (3-m tb)	M2 demand is stable
Bahmani-Oskooee M and Chomsisengphet (2002)	OECD: Australia, Austria, Canada, France, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, UK, USA	79:1-98:3, 67:1-98:3, 57:1-98:4, 77:1-98:3, 74:1-98:3, 66:1-98:4, 66:1-98:3, 69:1-98:4, 75:4-98:4, 57:1-98:2, 57:1-98:2, 57:1-98:4	JJ, CUSUM, CUSUMQ	M2 (real), Yr i (long) NEER	Money demand is stable in most of the countries except Switzerland and UK
Narayan P.K, Narayan S, and V. Mishra (2009).	India, Pakistan, Bangladesh, Sri Lanka, Nepal	74-02	Panel	M2 (real), Yr i (short) NEER	Cointegrated and stable money demand for all countries except Nepal
Lee C C. and Mei-Se C(2008)	China	77-02	ADF, ZA unit root test for structural break, JJ	M1, M2, Yr, i(1-yr deposit)	Unstable

Ramchandran N(2004)	India	52-01	CUSUM, CUSUMQ JJ	M3, Yr, P	Stable relationship
Darrat A F and Ahmed A M(1996)	UAE	74:1-92:2	JJ Chow, FH test	M1 (real) Def, Pe i(d) i(f) NER	The explanatory variables exert significant effect on M1 money holding. Additionally the relationship is stable.
Akinlo A E (2006)	Nigeria	70:1-02:4	ARDL, JJ, CUSUM, CUSUMQ	M2, Yr, NER, i	Cointegration and stable relationship exists between the variables
Bahmani-Oskooee M and Hafez R(2005)	India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Thailand	72:1-00:4	ARDL, JJ, CUSUM, CUSUMQ	M1 (real) M2 (real) Yr P, E	M1 money demand is stable in India, Indonesia, and Singapore. For remaining countries M2 is stable.
Moinuddin (2009)	Pakistan	74-06		M2, Y i	M2 is unstable
Husain et al (2006)	Pakistan	72-05		M2, Y P, i INV,	M2 demand is stable
Qayyum (2006)	Pakistan	60-99		M2, GDP, inflation, interest rate, government bond rate	M2 demand is stable

Note: (1) EG is Engle and Granger; PO is Phillips and Ouliaris; ;JJ is Johnsons and Julius; VECM is Vector Error Correction Method; ARDL is Auto Regressive Distributed Lag; ZA is Zivot and Andrew; ADF isr Augmented Dickey Fuller; CUSUM is Cumulative Sum of Recursive Residuals; CUSUMQ is Cumulative Sum of Squares of Recursive Residuals; FH is Farley- Hinich Test;

(2) Yr, M, P, i, i(d), i(f), Def, Pe, NEER, and INV represent real GDP, money supply, prices, interest rate, interest rate domestic, interest rate foreign, non-oil GDP deflator, non-oil expected inflation, nominal effective exchange rate.