The Pakistan Development Review
28 : 4 Part II (Winter 1989) pp. 995–1007

Short-run Money Demand and Supply Relations in Pakistan

PETER A. CORNELISSE and JAN MARTENS*

1. INTRODUCTION

Financial variables are known to be highly volatile. Values of many financial variables change swiftly as well as frequently. For policy-makers it pays then to know which shifts can be considered to be part of a normal pattern – which do not have to raise concern – and which other shifts may therefore be regarded as abnormal and which may need to be examined more closely, possibly in preparation of appropriate policy measures.

The present article presents results of statistical tests of money demand and supply relations using monthly instead of the usual annual data. The tests provide among others an indication of the variables contributing to the explanation of monthly variations in money supply and demand and of the time lags involved in the transmission of the impact. The relations also describe the seasonal pattern in money use.

The presentation is organized as follows. In the next section a selection of monthly money-demand relations is presented and discussed. Thereafter, in Section 3, follow money-supply relations. Having these sets of equations available the obvious next step is to test the ability of the monetary approach in explaining monthly price variations. The results are given in Section 4. Finally, Section 5 summarizes the conclusions.

2. AN ANALYSIS OF MONTHLY VARIATIONS IN MONEY DEMAND

The demand for money has intrigued many economists. This has led to a wide diversity in approach of empirical studies in this area. First, these studies reflect different theoretical foundations in the general choice of the explanatory variables, where, in practice, there often appears to exist considerable further room for choice of the precise specification of these variables. The variety is further enlarged by differences in functional form, assumptions regarding adaptation behaviour and the

*P. A. Cornelisse is Professor of Public Sector Economics at Erasmus University, Rotterdam. During the preparation of this article J. Martens was also attached to this university.

treatment of other technical problems.[1] And, finally, certain economic properties of groups of countries, such as the prevalence of rationing and fixed interest rates in financial markets of many developing countries,[2] have led to still wider diversity in the shape of money-demand relations.

What the great majority of tests reported in the literature has in common, however, is the use of annual data. In a sense this is surprising in view of the possibly volatile nature of money demand which may be largely overlooked when using observations on money stocks which are one year apart. On the other hand, tests of functions for periods of less than one year are handicapped by the scarcity or even unavailability of monthly or quarterly data.

An effort has been made in this section to overcome this problem and to derive a monthly money-demand equation for Pakistan.[3] As the exercise concentrates on the short-term nature of the equations tested, a conventional specification has been used which does no justice to the great variety in form and content of money-demand equations prevailing in the literature. Specifically, the explanatory variables used in the equations below are real gross national product, the rate of interest and expected inflation. The first variable is introduced as a determinant of money demand for transaction purposes, whereas the other variables represent costs of holding money. The rate of interest is a proxy for the revenue forgone by holding money rather than lending it out and the expected rate of inflation indicates the expected loss of value of money balances as compared with real assets. Even though they are conventional, a brief discussion of each of these explanatory variables is in order.

Most empirical tests of real money demand apply real income as the scale variable, an approach which has also been adopted in this section where data relating to GNP at 1980-81 market prices have been taken from Government of Pakistan (Various Issues). Of course the major problem is that data on national product refer nearly always, as in the present case, to one-year periods, whereas the test at hand requires data relating to periods of one month. In the absence of direct information an approximative procedure has been followed here to derive monthly data. The procedure consists of two steps. In the first step annual income is divided over the twelve months. It would of course be too crude to assign equal values to all months within each year of observation, because the resulting stepwise growth path

[1] For a convenient summary of different specifications of money-demand relations and their interpretation, [see R. L Thomas (1985), Chapter 10].

[2] The effect of credit restraint on demand for money is examined specifically in C. Wong (1977).

[3] Other demand-for-money equations for Pakistan derived earlier apply annual data, see Ahmad and Rafiq (1987); Khan (1980) and Mangla (1979). Hasan (1987) uses quarterly data, but after correction for seasonal fluctuations.

would concentrate all growth in the first month of each year. Instead a smoothing process has been used assigning mean monthly values to the sixth month of the years of observation and calculating the values of other months by interpolation. In the second step dummy variables are added, one for each of the twelve months, to allow for monthly variation. The value assigned to such a variable in the exercise is the GNP value for the month it represents and zero for other months. Thus, the coefficient found for a dummy variable in the regression analysis provides an indication of the relative deviation of GNP in the corresponding month from the absolute value assigned to it in step one.

A few words must also be devoted to the rate of interest as an explanatory variable, if only to acknowledge its often-mentioned limitations in developing economies with constrained financial markets. In Pakistan these limitations also used to apply, but a new complication arose in 1980 when the concept of interest was gradually abolished with a view to the Islamization of the economy. Although other remunerations for the use of capital are allowed, a single indicator of the price of money is hard to come by. In the tests the call money rate reported in IMF's International Financial Statistics has been used. But this rate has remained constant at 6.25 percent since the end of 1985. All this means in effect that the limitations regarding the use of the interest rate in a money-demand equation hold a *fortiori* in Pakistan. These objections notwithstanding, the rate of interest has been introduced in the equations tested here simply in order to verify the validity of the considerations mentioned.

The third major regressor, the expected rate of inflation, is often considered to be of particular importance in money-demand relations for developing countries, because of the limited availability of financial instruments. Under these conditions investment in real assets may be the principal alternative to holding money balances such that the inflation rate may be a significant proxy for the costs of holding money. The difficulty lies of course in the quantification of this variable. The traditional assumption of expectations regarding inflation being formed by recently experienced inflation[4] will also be adopted here, where an attempt is made to determine which time lag translates experiences into expectations better than others.

Several functional forms have been tested, but, for simplicity, only the results obtained with linear equations have been presented here as they appeared to be as good as those obtained with other forms. Further, demand for $M1$ as well as $M2$ has been tested. As results for $M2$ appeared to be slightly superior to those for $M1$ only the former have been reported. Finally, in analyses using monthly data the question of the speed of adaptation gains special importance, so, in accordance with

[4] As a measure of inflation has been used the percentage increase in the consumer price index as given in IMF (Various Issues).

the partial adaptation hypothesis, tests have also been performed including the lagged endogenous variable. The adaptation function used here is

$$RM2 = RM2(-t) + z\,(RMD2 - RM2(-t)) = z\,RMD2 + (1 - z)\,RM2(-t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

The basic equation describing real demand for money in this paper is

$$RMD2 = a_0 + a_1 RY + a_2 R + a_3 EPI + a_{4i} \Sigma D_i \quad \ldots \quad \ldots \quad (2)$$

Substituting it into (1) we get:

$$RM2 = za_0 + za_1 RY + za_2 R + za_3 EPI + za_{4i} \Sigma D_i + (1-z)\,RM2(-t), \quad (3)$$

where $RM2$ = real balances of $M2$; $RMD2$ = demand for real $M2$; z = adaptation coefficient; RY = real monthly GNP; R = call money rate; EPI = expected price increase (expressed in percentage changes per year); D_i = dummy variable for months (i = 1 to 12).

The OLS estimates for variants of Equations (2) and (3) are presented in Table 1. Note first of all that the coefficients not only have the expected sign, but are also (highly) significant. Surprisingly, this also applies to the regression coefficients of the rate of interest, both for the period up to 1985 – when the rate still varied – and for the entire period including the period after 1985 – when the rate remained constant. Further, the regression coefficients are fairly stable, except for the coefficient of the rate of interest which increases considerably when the period of observation is extended beyond 1985.

For the period 1975–1989 results of one regression based on annual data are included so as to allow a comparison with the outcomes for the same period, but using monthly data. It can be seen that the coefficient of RY is indeed lower by a factor 12 in the former regression, otherwise the coefficients do not show remarkable differences. However, while serial correlation is disturbingly high in the monthly equations, it is acceptable in the yearly equation. This lends support to the partial adaptation assumption suggesting that adaptation in money demand balances is not instantaneous, but takes less than a year. Indeed, introduction of the lagged endogenous variable improves the DW statistic considerably (see the third and last rows in Table 3). The one-month lag appears to perform better than lags of greater length. Yet, the coefficients of $RMD2(-1)$ suggest a relative adaptation of actual real money balances to desired balances one month later of only about 15 percent.

The coefficients for the dummy variables have been derived in an iterative

Table 1

Monthly Money-demand Equations (Linear), 1975–1989

Period	Const.	*RY*	*R*	*EPI*	*RM2*(−1)	Dummies	$\bar{R}^2$	*DW*
1975 : 1 –	46.1	3.96	−4.17	−1.71			.980	.66
1985 : 12	(3.86)	(48.8)	(5.36)	(11.4)				
	54.6	4.08	−4.93	−1.73		6 : .084; 8 to 11 : −.132 to −.191	.987	.71
	(5.54)	(59.1)	(7.59)	(14.2)		(2.31) (3.58 to 5.47)		
	13.1	0.05	−1.07	−0.28	0.84	1, 5, 6, 11, 12 : 006 to .015; 7 : −.008	.996	2.05
	(2.35)	(3.63)	(2.76)	(2.90)	(20.2)	(3.41 to 8.95) (4.51)		
1975 –1989	138.9	0.33	−11.15	−2.61			.993	2.21
(Years)	(3.33)	(16.1)	(4.56)	(5.52)				
1975 : 1 –	55.9	4.32	−7.35	−1.67			.983	.49
1989 : 6	(3.47)	(42.9)	(7.43)	(8.32)				
	66.9	4.30	−7.98	−1.74		6 ; .071; 8 to 11 : −.129 to −.181	.986	.47
	(4.59)	(47.2)	(8.90)	(9.64)		(1.59) (2.92 to 4.04)		
	19.3	0.53	−1.64	−0.27	0.86	1, 5 6, 12 : .004 to .013; 4, 7, 9 : −.003 to −.008	.998	2.15
	(3.15)	(4.06)	(3.96)	(3.05)	(30.5)	(2.71 to 8.41) (1.98 to 5.01)		

Notes: Absolute *t*-ratios are in parentheses.
$\bar{R}^2$ = is the coefficient of determination adjusted for degrees of freedom.
DW = is the Durbin-Watson statistic.
Months are indicated by numbers starting with January = 1.

process in which those variables with insignificant coefficients were successively dropped. Comparison of the remaining coefficients with those of real income suggests that the latter's monthly variation is rather moderate in size. Further, judging by the coefficients of determination, the contribution of the dummy variables to the explanation of variation in money demand seems to be small, but then it should also be considered that the other variables leave only little variation unexplained. The improvement in the *DW* statistic after introduction of the dummy variables is negligible or worse. Nevertheless, a significant pattern of monthly variations in real money demand is clearly discernible with peaks around the middle and the end of the calendar year in rhythm with the harvest periods.

As indicated above, expectations as to price increases are assumed to be formed by past experience. In the present analysis there is an opportunity to test with more than the usual precision which period in the past appears to be most suitable. Thus, experiments have been made with actual price increments for different periods to test which duration and which lag would yield the best results as measured by the *t* ratio of variable *EPI*. According to this criterion inflation experiences during a period of 21 months starting 8 months back give the most accurate indication of expectations about inflation. This finding suggests a rather slow process of adaptation to alterations in inflation rates.

Finally, it is worth noting that the income (point) elasticities of money demand derived from the four equations relating to the period 1975–1989 and reported in the lower half of Table 1 are between 1.05 and 1.20 when measured at the midpoint of the period observed. This is a remarkably narrow range considering the differences in the equations from which the elasticities have been derived. According to all equations the elasticity tends to decline slowly over time: probably it is just under unity at the present time.

3. MONTHLY MONEY-SUPPLY RELATIONS

Empirical tests of money-supply relations are not as common as those of money-demand relations. Just like tests of money demand, they are usually based on annual data, even though the data needed for analyses of monthly variations of money-supply relations are often directly available. This opportunity will be used in the present section.

The explanatory variable used here is high-powered money or base money. It can, of course, be argued that this does not portray the way monetary expansion is managed in Pakistan where the National Credit Consultative Council indicates for each year the room for increase in credit. Remarkably, a large part of the Council's members consists of representatives of organizations which have an interest in credit expansion. Even then, if rules of prudent monetary management are observed, there are limits to actual money creation which are precisely related to base money.

In some of the tests partial adaptation has been assumed to apply, while in others high-powered money has been divided in its (asset-side) components. Data have been taken from IMF (Various Issues). The basic equation tested thus becomes:

$$NMS2 = wb_1 MB + (1 - w) NMS2 (-t) \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where $NMS2$ = supply of nominal $M2$; w = adaptation coefficient; MB = money base, where MB is decomposed into FMB = foreign component of base money (net foreign reserves) and DMB = domestic component and where DMB is further divided into GMB = public component of base money (outstanding central bank loans to the public sector) and OMB = remaining part of domestic money base.

Although the regression results are primarily concerned with monthly variations, the outcome of one regression using annual data has been included also in this table to allow a direct comparison. (See Table 2). Again we see that the coefficients

Table 2

Monthly Money-supply Relations (Linear), 1975–1989

Period	*MB*	*FMB*	*DMB*	*GMB*	*OMB*	*NMS*(−1)	$\bar{R}^2$	*DW*
1975 –1989 (Years)		1.95 (6.62)		2.72 (37.7)	1.78 (7.56)		.995	1.80
1975 : 1– 1989 : 6	2.55 (259.3)						.990	.22
		1.95 (16.9)	2.58 (243.0)				.991	.27
		1.78 (16.4)		2.71 (112.9)	2.09 (25.4)		.993	35
		0.14 (2.17)		0.26 (3.43)	0.20 (3.01)	0.91 (33.2)	.999	1.83
1975 : 1 – 1982 : 3		2.16 (17.0)		2.58 (120.3)	2.38 (23.4)		.992	44
1982 : 4 – 1989 : 6		2.13 (12.2)		2.88 (56.2)	1.49 (8.04)		.974	.43

Notes: See Table 1.

in the equation using annual data do not differ much from those in the corresponding equation on the basis of monthly figures, except for the *DW* statistic. And, again, when using monthly data, introduction of the endogenous variable lagged one month appears to strongly reduce serial correlation suggesting that the partial adaptation hypothesis also applies on the side of money supply.

The results tabulated above show further that base money is indeed a highly significant explanatory variable for nominal money supply in Pakistan. Further, when applying *F*-tests to relations applying separate components of base money as regressors, the coefficients of each of the components appear to differ significantly. Thus, a Rs one million increase in base money tends to translate into different increases of *M*2, depending on the base-money component where the original increase occurs.[5] It is also important to note the significant difference between the outcome of regressions for different sub-periods as indicated in the lower end of the table. Especially the effect of an increase in *OMB* appears to differ markedly between the first and the second half of the period observed. This shows that, in prediction and policy studies, it pays to examine the duration of the most recent period over which the money-supply relation is structurally stable and to be aware of the possibility that a behavioural change, probably due to a policy shift, affects the validity of patterns observed in the past.

4. MONETARIST SHORT-TERM PRICE EQUATIONS

Tests of price equations for one or more countries based on versions of monetarist theories or on blends of monetarist and other approaches are available in fairly large numbers. Such tests have also been made for Pakistan.[6] Generally speaking, good results are obtained in regressions where the dependent variable is the absolute price level. Attempts at explaining variations in relative price changes tend to yield much weaker results, however.

The results reported in the literature are all based on annual data. Although they are rarely mentioned, there are good reasons for this choice, even if data should be available for shorter periods. Short-term price shocks and seasonal price variations seem to be sensitive primarily to real, rather than monetary factors. This can be expected to apply also to Pakistan. The monthly variation in real money demand as found in Section 2 of this paper is mostly of a seasonal nature, reflecting seasonal patterns of economic activity, and is met by similar variation in money supply.

Nevertheless, since the necessary data are readily available from the exercise

[5] Tests of relations for supply of nominal *M*1 (not presented here) lead to a similar conclusion.

[6] See, for example [M. S. Ali (1986) and S. N. H. Naqvi and A. M. Ahmed (1986), Chapter 2].

presented in Section 2, a series of tests of short-term monetarist price equations – using the consumer price index as the variable to be explained – has been carried out for Pakistan in order to verify the above argument. A small selection of the results is presented in Table 3.

First of all it must be emphasized that the coefficients presented in Table 3 relate to loglinear functions. Contrary to the experience with monthly money-demand and money-supply relations described above where the fit appeared to be insensitive to the type of function selected, monthly monetary price relations revealed great sensitivity as to functional form. But this was to be expected as monetarist price equations are typically of the multiplicative type, such that linear expressions are inappropriate.

With a view to the introductory remarks made above regarding the performance to be expected of monthly monetary price relations, the fit of the equations explaining the absolute level of monthly prices is remarkably good. Further, the coefficients of the explanatory variables all have the expected sign, and the only insignificant coefficient is that of real income and that only in the first equation. Also note that our findings contrast with those of Jones and Khilji (1988) in the sense that the consumer price index is affected positively by growth in money supply.

On the other hand, the results for the equations explaining monthly price changes are very poor without exception. At first sight it may seem strange that an approach successfully explaining variations in absolute magnitudes can fail in explaining variations in differences between these magnitudes. But the explanation is a simple one: an error of only one percent in the former test translates into an error of about hundred percent in the latter where the values of the variable to be explained are smaller by a factor hundred. This handicap also applies in comparisons of statistical explanations of annual price levels and price changes. But it is particularly large for explanations using monthly observations, as monthly price changes are only a fraction of yearly price changes.

5. SUMMARY AND CONCLUSIONS

The tests reported in this paper show that money demand and supply equations based on monthly data perform well and yield regression coefficients which, after correction for the different lengths of period, are close to corresponding coefficients based on annual data. For example, it can be derived from equations for both data sets that the income elasticity of demand for money is just over unity during the largest part of the period 1975–1989 and slowly declining. Further, both annual and monthly data indicate significant differences between the effects of the three main components of base money on money supply.

The use of monthly data suggests that the partial adaptation hypothesis does

Table 3

Monthly Monetarist Price Equations (Loglinear), 1975–1989

Period	Const.	*M2*	*RY*	*R*	*EPI*	*P*(−1)	Dummies	$\bar{R}^2$	*DW*
				Absolute Prices					
1975 : 4	−0.47	0.56	−0.05	0.01	0.01			0.990	0.63
1989 : 6	(1.52)	(8.20)	(0.31)	(7.67)	(9.87)				
	0.32	0.14	−0.18	0.002	0.001	0.88		0.998	2.07
	(2.19)	(3.95)	(2.49)	(1.51)	(3.20)	(25.6)			
				Price Changes					
1975 : 5	0.006	0.006	−0.13	−0.0	−0.0			0.022	1.91
1989 : 6	(1.82)	(0.10)	(0.20)	(0.25)	(0.48)				
	0.006	0.001	−0.09	−0.0	−0.001	0.024		0.024	1.96
	(1.68)	(0.02)	(0.14)	(0.23)	(0.93)	(0.31)			

indeed apply and that the (partial) adaptation to the desired level takes about one month for money demand as well as for money supply. The monetarist equations explaining absolute levels of monthly prices perform very well. Predictably, the results obtained when applying the same approach to changes in monthly price levels are very weak.

REFERENCES

Ahmad, Ather Maqsood, and Mohammad Rafiq (1987) Monetary Anticipations and the Demand for Money: An Application for the South Asian Region. *The Pakistan Development Review* 26 : 4 529–537.

Ali, M. Shaukat (1986) Causality between Money Supply and Price Level: Evidence in Theory and Practice. *The Kashmir Economic Review* 3 : 1 45–56.

Hasan, M. Aynul (1987) A Rational Expectations Macro Econometric Model of Pakistan's Monetary Policy since the 1970s. *The Pakistan Development Review* 26 : 4 513–523.

International Monetary Fund (Various Issues) *International Financial Statistics.*

Jones, Jonathan D., and Nasir M. Khilji (1988) Money Growth, Inflation and Causality (Empirical Evidence for Pakistan, 1973–1985). *The Pakistan Development Review* 27 : 1 45–58.

Khan, A. H. (1980) The Demand for Money in Pakistan: Some Further Results. *The Pakistan Development Review* 19 : 1 25–50.

Mangla, I. U. (1979) An Annual Money Demand Function for Pakistan: Some Further Results. *The Pakistan Development Review* 18 : 1 21–33.

Naqvi, Syed Nawab Haider and Ather Maqsood Ahmed (1986) *P.I.D.E. Macro-econometric Model of Pakistan's Economy.* Islamabad: Pakistan Institute of Development Economics.

Pakistan, Government of (Various Issues) *Economic Survey.* Islamabad: Economic Adviser's Wing, Finance Division.

Thomas, R. Leighton (1985) *Introductory Econometrics: Theory and Applications.* London: Longman.

Wong, Chorng-huey (1977) Demand for Money in Developing Countries. *Journal of Monetary Economics.* 3 : 59–86.

Comments on "Short-run Money Demand and Supply Relations in Pakistan"

Professor Cornelisse and Martens in their article "Short-run Money Demand and Supply Relations in Pakistan" have touched upon a topic which continues to be a favorite of the economists.

The distinguishing feature of this paper is the use of data on monthly basis. Economists who have on occasion, as myself, dealt with the data of the developing countries have always wished to get their hands ideally on data on monthly basis or at least on quarterly basis. But this wish has usually foundered on the rock of the availability of data published only on annual basis. There are now two ways about the fact that abundance of data points make for a richer and more insightful analysis. In this respect this article is a step in the right direction.

Ideally, the data should be allowed to speak for itself, it is especially true for econometric analysis where one of the main purpose is to allow the data to articulate the structure underlying the variables being discussed. Any scheme, however sophisticated, of generating observations artifically would inevitably introduce an element of non-randomness in the information being gleaned from the data. And we know that how crucial, at least in theory, the assumption of randomness is for the validity of statistical tests on the data; it is the peg on which we hang most of the econometric analysis. The above comment should in no way be interpreted as a detraction of the present paper. The point that I am trying to underscore is that the sort of nuance that one may like to read in the empirical results of their paper should be taken with a pinch of salt. In case of this particular exercise the interpolation scheme employed by the authors should not be unacceptable since apparently it has not done any violence to the *a priori* theoretical results.

The choice of explanatory variables for the money demand function in this paper is fairly standard, that is, real income, interest rate and expected inflation. I feel that for economies such as Pakistan monetization should also be included as one of the explanatory variables. Inclusion of the monetization variable would have required the authors to quantify it in order to make it operational. And then to find a way of overcoming the econometric problem of multicolinearity which is usually encountered in cases like this between real income and the monetization variable. Since the authors decided not to include a variable for monetization,

therefore, I would suggest that the authors should have specifically mentioned the possibility of an upward bias in the magnitude of the coefficient of the real income variable. This coefficient could be picking up part of the effect of monetization.

In the case of the rate of interest the paper does not make it clear whether it is real or nominal. From the theoretical point of view it should be real. It is heartening to observe that despite numerous distortions present in the financial system of Pakistan the interest rate variable has the correct sign and is statistically significant.

Professors Cornelisse and Martens have decided to use the broader definition of money. The implication of this is that the components of money demand are treated as homogenous. Considering currency, demand deposits and time deposits as perfect substitutes in Pakistan is a fairly strong assumption. Analysis of money demand at a disaggregated basis, I believe, can result in greater insights. For example, individuals who hold time deposits are relatively financially sophisticated and may not look only at domestic rates of returns. This proposition can best be tested by the inclusion of a suitable foreign rate of interest as one of the explanatory variables for time deposits alone. Lumping time deposits and currency together may mute the impact of the foreign rate of interest.

A minor point that I would like to mention is that in this paper Durbin-Watson has been used as measure for serial correlation in the presence of lagged dependent variables. The correct test in a situation like this is Durbin's *'h'* test.

On the whole, the paper is a useful contribution to the understanding of money demand behaviour in Pakistan and is a commendable research effort.

Syed Saqib Rizavi

Planning Division,
Islamabad.