

An Annual Money Demand Function for Pakistan: Some Further Results

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The paper highlights the main issues involved in the theoretical and empirical estimation of the money demand function in Pakistan. Much of the recent empirical work on money demand has used income as a scale variable. Our work seeks to assess the relevant importance of the permanent income as an argument of the demand function for money. The results of our estimation indicate that a stable money demand function exists using permanent income.

Much of the recent empirical work in the general area of monetary economics has focused on the estimation and testing of the demand function for money. We do not intend to give a survey of the whole literature since it is well documented elsewhere, e.g. Boorman [5], Goldfeld [12], Barro and Fischer [3], Feige and Pearce [8] and David Laidler [16]. Even at the risk of some oversimplification, the main issues involved in the estimation of the demand for money are as follows: (1) Is the demand for money measured in nominal terms, proportional to the price level? (2) Should income or wealth or perhaps both be included in the demand for money function? (3) Is the rate of interest an important variable in the function? (4) Are there any significant economies of scale in money holdings? (5) What influence does the rate of inflation or its expected rate exert on the demand for money? (6) How close is the complementarity relationship between money and physical assets as suggested by McKinnon [18] in the process of economic development?

Although there has been a substantial amount of research on the money demand for developed economies, very few studies exist in the case of Pakistan. These studies, e.g. Rao and Choudary [23], Akhtar [2] and Abe, Fry *et al.* [1] are limited in scope. The analysis focuses only on testing the McKinnon hypothesis, using current income as the scale variable in the money demand function. This procedure is incomplete because wealth and/or permanent income, rather than current income, should appear as an argument in the demand for money function.

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The purpose of this paper is to examine the range of issues (1) to (5) noted above, in the light of the empirical evidence from Pakistan. It re-examines the existing empirical evidence on the demand for money in Pakistan by using permanent income as a scale variable in the money demand function. Also it is important to consider as to which interest rate is the relevant determinant of the demand for money. The paper also tests whether the conventional money demand formulation is adequate to explain the monetary experience of an economy like Pakistan.

The plan of the paper is as follows. The first section briefly spells out the money demand model used conventionally for estimation purposes, while the second section discusses the methodological issues involved. The third section tests the applicability of the model to Pakistan. In discussing the results, particular emphasis is placed on nominal versus real money demand. The fourth section notes briefly the limitations of the analysis. The policy implications of the analysis form the subject matter of the fifth section. Main conclusions of the analysis presented in the paper are then briefly highlighted in the final section.

MONEY DEMAND MODEL: GENERAL CONSIDERATION

The general features of our money demand function are standard. Desired money balances, M^* are assumed to be a function of interest rate, r , and a constraint variable, X , i.e.

$$M^* = M(X, r) \quad (1)$$

where X is either GNP, permanent income or some measure of wealth. Most econometric studies deflate the nominal money demand either by the price level or population or both. This is done to isolate the effect of changes in the demand for money balances resulting from changes in the price level or population as opposed to changes in income. To test the hypothesis that the demand for money function is homogeneous of degree zero in general prices,¹ desired real balances should be made invariant with respect to changes in the price level.

Several aspects of the model require clarification about: (1) the level of constraint variable X , (2) the list of possible components of the interest rate

¹The author is gratefully indebted to Prof. Syed Nawab Haider Naqvi, Director, PIDE, for drawing his attention to the distinction between absolute versus relative prices in the analysis of money demand function. In examining the economic response to changes in actual and expected rates of inflation, both empirical and theoretical models of the demand for money have traditionally assumed that all prices change equiproportionately. This is based on the theoretical assertion that if nominal income and all prices change in the same proportion, then underlying effects on commodity demand functions can be ignored. However, in a recent study, Policano and Choi [21] have developed a choice-theoretic framework of the household behaviour. A significant result of their analysis is that assumption of equiproportionate price change is unrealistic and that the net effect of a change in relative prices on household's money demand depends on the purchase frequencies and price elasticities of the relevant commodities.

vector, r , and (3) the process by which actual money balances, M , approach their long-run equilibrium values, M^* . As to first problem, the choice of the appropriate scale variable would depend on the additional means of discriminating among different theories of the demand for money. The level of income has played an important role in the empirical tests of the transaction demand for money, e.g. Baumol [4] and Tobin [28]. Frequently, use of the wealth variable has been preferred in portfolio analysis. Friedman [9] employs the concept of permanent income in the money demand function to reconcile the cyclical and secular behaviour of velocity. In our estimation of the model for the sake of comparison, we have used nominal GNP, nominal permanent income, real income and real permanent income as the scale variables.

On the second problem, most studies contain convincing evidence that interest rate should appear in the demand for money function. In dealing with the relevant measure of the opportunity cost of holding money, however, there is still disagreement as to which measure should be used as an argument of the demand for money function. The problem stems partly from the fact that the theory provides little guidance on this issue. Our expectation is that interbank call money rate, r_c , and government bond rate, r_g , should be the important variables. On the other hand, some economists, e.g. Wong [30] and Khan [15] have argued that in developing countries rates of interest are controlled by the authorities, and do not always reflect accurately market conditions. Under these circumstances, the expected rate of inflation becomes a more appropriate proxy for the opportunity cost of holding. Again the question is empirical and can not be decided by *a priori* reasoning alone.

The third problem to be satisfactorily tackled would require a complete comparative static analysis. However, we have assumed throughout this paper that adjustment mechanism is instantaneous and actual money balances adjust to their desired level in one year. This is based on the view that lags are shorter, if not negligible, in the developing countries because of higher risks and uncertainties due to economic and socio-political instability and lack of a variety of financial assets available for the wealth holders to undertake portfolio switches.²

METHODOLOGY

Following general practice money stock has been treated in this paper as a proxy for the demand for money. It is assumed that the money market is always in equilibrium and the variables which appear in the demand function do not belong in the money supply function.³ If we focus on theories that emphasize the transaction motive for holding money, then the proper definition of money is not a profound problem. We have defined money as consisting of

²See for example, Park [19].

³If the money stock involving demand and supply elements simultaneously determined money stock and interest rates then we have the identification problem making the income and interest rate elasticity estimates biased.

those assets that serve as generally acceptable media of exchange, i.e. currency in circulation and private demand deposits of commercial banks. For Pakistan, data on all scale variables appropriate for a money demand function are available only on annual basis. Our estimates are based on mid-year observations of each year over the period 1958-1971.⁴

Several studies on money demand have calculated the permanent income series by relating it to the consumption, e.g. Friedman [9]. In the absence of reliable estimates of consumption expenditure, we define permanent income as the following average of current and past incomes.

$$Y_{pt} = .4Y_t + .3Y_{t-1} + .2Y_{t-2} + .1Y_{t-3} \dots \quad (2)$$

Rausser and Laumas [24] do not consider it to be necessary that the measure of permanent income relevant in determining consumption expenditure should also be the one which determines the demand for cash balances.

The definitions of the variables are as follows: M_1 is the domestically-held money stock, r_c is the interbank call money rate at Karachi, r_g is annual yield on long term government bonds. Y is nominal GNP and Y_p is nominal permanent income. For estimating the real money demand function, the relevant variables were deflated by the implicit GNP deflator. The data on money and GNP were taken from annual *Pakistan Economic Survey*; r_c and r_g were taken from 'Report on Currency and Finance 1971-72' [25]. All equations have been estimated using the log-linear form.

One of the primary concerns in the literature on money demand has been the stability of the estimated function. Stability of the money demand function is measured by how well the model explains movements in the dependent variable once the sample period is divided into subperiods. This is done to see whether there is any evidence of systematic long-run shifts that make the estimated relationship unsuitable for forecasting and policy purposes. Stability is measured by different methods.⁵ The nature of the data and the sample size make it difficult to rigorously address this question. However, the Chow test⁶ enables us to test whether the new observations have been generated by the same model.

BASIC RESULTS

Nominal Money Demand

All regression equations estimated in this paper use the log-linear form. The estimated coefficients, based on equation (1) of the model, using OLS are

⁴Post 1971 data was not included due to major structural shift in the economy.

⁵For example, see Chow [6], M. Khan [14] and Goldfeld [12].

⁶Let RSS_1 be the residual sum of squares with n_1 observations. Let RSS be the residual sum of squares with $n_1 + n_2$ observations. Then we can use the F-test as:

$$F = \frac{(RSS - RSS_1)/n_2}{RSS_1/(n_1 - k - 1)}$$

with $n_1, n_1 - k - 1$ degrees of freedom.

given in Table 1.⁷ Several aspects of the results warrant comment however. The statistical fit of the equation comes out to be exceedingly close and the income and interest rate elasticities possess the anticipated signs. The coefficients of Y_p or GNP are significantly different from zero and one at very high confidence level. The coefficients of r_c or r_g come close to being significant. The equilibrium elasticity of money demand with respect to the r_c in Pakistan, evaluated at the sample mean of r_c is $-.003$. Such a low value for r_c casts doubt on the view that money is a substitute for other short-term liquid assets. When both interest rates are included equation (3) of Table 1, the coefficient of r_g becomes significant.

The long-run nominal income or permanent income elasticity for Pakistan is one of the most significant results of this study. Regardless of the specification of the demand function, all estimates of this parameter lie between 1.28 and 2.00. The use of permanent income further increases the income elasticity.

On balance, the estimates of equation (1) of the model based on nominal magnitudes seem satisfactory in terms of absolute performance. The bulk of the evidence from these equations employing annual data indicates rather clearly that permanent income rather than measured income is the most relevant constraint on the equilibrium level of the demand for money balances. One aspect that deserves additional attention is the estimate of the long-run income elasticity. The results of Table 1, taken as a whole, seem to suggest that relevant income elasticity cannot be pinned down accurately, and is significantly greater than unity. As regards the existence of economies of scale in money holding, the results are comparable with those studies of long-run such as Friedman [9] and Laidler [16]. All these studies including our results suggest that economies of scale in money holding are non-existent.

Real Money Demand Function

The use of real money demand is preferred on the grounds that it seems useful to regard the nominal quantity of money as determined by conditions of supply, and the real quantity of money as determined by conditions of demand. The estimated coefficients and their t-values are reproduced in Table 2. An important similarity exists between income elasticities for both nominal and real demand functions, ranging between 1.28 and 1.53 for the current income variable and between 1.69 and 2.88 for the permanent income variable. There is no compelling reason why the permanent income elasticity of money demand should be higher than the income elasticity of money demand.⁸ However, the

⁷The single-equation models of money demand will yield unbiased estimates if the explanatory variables are exogenously determined. Demand for nominal balances should be estimated using Two Stage Least Square (TSLS) method because of the possible causation running from money to nominal income. Yet *a priori* theoretical reasoning alerts us to the danger of accepting such a relationship without an adequate empirical analysis.

⁸Dr. Kemal in a private conversation has suggested that perhaps this may be due to the fact that because permanent income increases consistently and is not affected by the transitory component, people adjust their real balances accordingly and therefore one would expect higher elasticity of money demand with respect to permanent income as suggested in the consumption studies.

Table 1

Estimated Coefficients of Nominal Money Demand Model

Equation No.	C	Y_p	Y	r_c	r_g	R^2	F	DW
(1)	8.87 (-6.94)*	1.69 (13.46)*		-.025 (-.55)		.98	314.1	1.06
(2)	-14.52 (-4.97)*	2.32 (7.26)*			-.71 (2.18)*	.99	440.3	2.03
(3)	11.83 (-5.49)*	2.23 (7.55)*		-.071 (1.86)*	-.96 (2.96)*	.99	360.7	1.80
(4)	-4.45 (-3.50)*		1.27 (9.88)*	-.16 (-1.70)		.97	306.1	1.35
(5)	-9.77 (3.42)*		1.80 (5.77)*		-.62 (.645)	.98	304.1	1.27
(6)	-11.75 (3.31)*		2.00 (5.26)*	-.04 (.94)	-.31 (.91)	.98	201.1	1.26

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Note: All equations are estimated using log-linear form. C is the intercept term; Y_p is nominal permanent income; Y is nominal GNP; r_c is interbank call money rate; r_g is average annual yield on Government bonds. The t-values are given in parentheses, and a star (*) indicates that coefficients are statistically significant at 95 percent confidence interval.

Table 2

Estimated Coefficients of the Real Money Demand Model

Equation No.	C	y_p	y	r_c	r_g	R^2	F	DW
(1)	-12.30 (-6.19)*	2.88 (8.66)*		.009 (.238)		.95	99.6	1.50
(2)	-16.15 (-1.15)	2.36 (6.09)*			.22 (1.71)	.96	127.1	1.62
(3)	-16.66 (-3.97)*	2.41 (5.79)*		-.02 (.45)	.25 (1.69)	.96	78.7	1.50
(4)	-4.66 (-4.10)*		1.53 (7.34)*	-.18 (-2.06)*		.94	44.8	1.34
(5)	-6.42 (-1.96)*		1.39 (4.28)*		.48 (3.65)*	.93	75.3	1.13
(6)	-6.66 (-1.82)*		1.38 (4.06)*	.02 (.45)	.43 (2.52)*	.93	46.6	1.41

Annual Money Demand Function

Note: C is the intercept term; y_p is real permanent income; y is GNP divided by implicit price deflator; r_c and r_g have been defined before. The t-values are expressed in parentheses and a star (*) indicates that coefficients are statistically significant at 95 percent confidence interval.

overall values of these elasticities generally greater than unity can be defended. As Friedman has pointed out:

"Much empirical evidence indicates that the income elasticity is not very different from unity. The empirical evidence seems to me to indicate that the elasticity is generally larger than unity, perhaps in the neighbourhood of 1.5 to 2.0 for economies in a period of rapid economic development, and of 1.0 to 1.5 for other circumstances. Other scholars would perhaps set it lower" [11, p. 34].

The most unexpected result in estimated real money demand equations is the wrong sign of interest rates. However, paradoxically, the r_g coefficient is still significant. Perhaps the apparent puzzle can be solved if we keep the 'Fisherian distinction' in mind between nominal and real interest rates and the role of expected rate of inflation in holdings of real money balances. If we are willing to assume that people do not suffer from money illusion, then even with nominal interest rates going up, money holders will build up their balances to match their needs for transaction purposes.⁹

To test the hypothesis that demand for money function is homogeneous of degree zero in prices, and ignoring the problem of income distribution, our best fitted equation for real money balances is given below:

$$\log m = -8.62 + 2.08 \log y - .27 \log r_e + .25 \log P$$

(-2.86) (4.80) (-2.47) (.59)

$$R^2 = .96 \quad DW = 1.98$$

Since the coefficient of $\log P$ is insignificantly different from zero, we cannot reject the hypothesis that demand for money balances is invariant with respect to prices.

We now turn to the question of the stability of money demand function, which provides an additional test of the appropriateness of the specification of our model. However as suggested earlier, Chow test is a weaker test in detecting changes in the structure. As an illustration, consider the estimation of money demand from the data with 12 observations for equation (3) of Table 1. The estimates are:

$$\log M = -15.85 + 2.45 \log Y_p - .059 \log r_e - .64 \log r_g$$

(-5.20) (7.39) (-1.73) (-2.02)

$$R^2 = .99 \quad DW = 1.68 \quad RSS_1 = .00743$$

We want to test whether the next two observations have been generated by the same model. To test this, we have already estimated this equation containing 14 observations, with RSS as .01273. Hence the F-ratio is given by:

⁹Although two wrongs do not make a right it is interesting to note that similar unexpected signs of the interest rate coefficients have been obtained by Abe, Fry *et al.*

$$F = \frac{(.012736 - .00743)/2}{(.00743)/8} = 2.85$$

F-value for 2 and 10 degrees of freedom at the 5 percent level of significance is 4.10. Hence we can't reject the null hypothesis. It is, therefore, safe to conclude that the last two observations came from the same structure as the first 12. The same is found true for equation (3) of Table 2.

We do not find any strong evidence that rate of inflation influenced the demand for money over this period. We regressed all real and nominal money demand equations with also \hat{P} (rate of change in implicit GNP deflator with respect to time) variable and found its coefficient having the expected negative sign but insignificantly different from zero. Given the focus of our study, we have not investigated McKinnon's hypothesis [18]. However, Akhtar [2] and Abe, Fry *et al.* [1] do obtain strong support for this theory.

LIMITATIONS OF THE ANALYSIS

So far we have analyzed the properties of essentially one specification, embodied in equation (1) of the model. We have used the most common definition of money- M_1 . Some writers have preferred a broader definition such as M_2 , which also includes time deposits at commercial banks. Our analysis has also relied on a simple adjustment mechanism. While this is conventional in annual money demand estimation, careful consideration of the partial adjustment mechanism in money holdings should be undertaken in the short run functions. Our analysis also assumes that the costs of adjusting the pattern of asset holdings are the same for households and firms. If we were dealing with quarterly data, it may be helpful to disaggregate over classes of agents as well as over assets.

On some econometric issues, all of the estimates reported in this paper have been obtained by using OLS technique. It would have been worthwhile to estimate the model by applying the Cochrane-Orcutt technique [7] for correction of serial correlation.¹⁰ As mentioned earlier, the problem of simultaneous equation bias have been ignored. However, in the absence of a complete model, the choice to carry out a simultaneous equation estimation would have been somewhat arbitrary. Finally, the stability of the estimated coefficients has been tested in a restricted manner. Perhaps a more useful way of looking at the overall performance of equation (1) would have been the use of dynamic simulation technique. Most of these limitations stem from the nature and unavailability of quarterly data on scale variables on Pakistan.

¹⁰It is common to find economic relationships which are formulated and empirically tested in terms of the levels of time series variables. At the theoretical level, researchers recognize that their models can be formulated in terms of the changes in the variables, yet many do not admit this equivalence when it comes to the estimation of the model. See Plosser and Schwert [20].

POLICY IMPLICATIONS

Over the last two decades, there have been substantial changes in the role attached to money as a determinant of economic activity and the price level. A related issue involved is the prediction regarding the economies of scale in cash holdings due to optimal transaction. Another area of monetary policy, not fully explored concerns the implications of the interest rate elasticity of money demand for the effectiveness of discretionary monetary policy. Over the years, there has been a tendency to regard the effectiveness of such policy as varying inversely with the sensitivity of money demand to interest rates, other things remaining the same.

The significance of some of the questions posed at the beginning of the paper can be better understood in terms of the income and interest rate elasticities of money demand summarized in Table 3 below.

Table 3
Estimates of Elasticity of Money Demand

	Elasticity of Money Demand with respect to			
	Y_p	Y	r_e	r_g
Nominal	2.23	2.00	(-.07 to -.04)	(-.96 to -.31)
Real	2.41	1.53	(-.02 to .02)	(.25 to .43)

Source: Equations (3) and (6) of Table 1 and 2.

However, only tentative policy implications can be drawn from the estimated results on the demand for money in Pakistan. The evidence brought together in the table, taken at its face value, suggests that the relationship between demand for money and some measure of wealth seems to be stable over time. The wealth variable for which permanent income is used as a proxy appears to be a superior scale variable for the demand for money function. *A priori*, there is no reason to prefer one way of generating a permanent income series over another. The aggregated behaviour displayed by income and/or wealth elasticities of money demand do not suggest the presence of economies of scale in cash holdings as the value of these elasticities significantly exceeds unity. However, these conclusions do not necessarily hold for different classes of income distributions.

The evidence is mixed on the relationship between the demand for money and the rate of interest and the choice between a long and short interest

rate for inclusion in the demand function. Although most estimates of the interest rates elasticity tend to favour a negative relationship, the degree of responsiveness involved is very small. The small value of the elasticity of money demand with respect to a short rate casts doubt on the view that money is a substitute for other short term liquid assets in Pakistan.

An important result that emerges from the high value of elasticity of money demand with respect to government bond rate r_g suggests that fairly broad government security markets could be developed. The significant variations in money demand due to changes in r_g could at least provide the basis for the conduct of traditional open-market operations.¹¹ This optimism is based on the view that the spectrum of owners of marketable government securities has observed some structural change over the last decade in Pakistan. Further work is required to study the composition of government debt before we can investigate this question. Nevertheless, security markets will always be somewhat less broad than those of the financially developed economies.

There is also reasonable evidence supporting the existence of a stable demand for money function. This is important for the conduct of monetary policy. An empirical money demand function should have implications for the behaviour of income velocity of money. However, any suggestive implications would require the study of macro framework regarding the growth rate of the productivity of the economy and behaviour of interest rates over time.

CONCLUSIONS

In the process of evaluating each of the questions raised at the beginning of this paper, a considerable amount of information has emerged from our findings. At a glance, the results suggest that equation (1) of the model seems to be doing a satisfactory job of explaining money demand, based on the statistics obtained from within the sample period. In Pakistan, the quantity of money demanded appears to be a stable function of income and relatively more stable function of permanent income. There is considerable uniformity in the coefficient of income. The income elasticity of money demand is generally greater than unity and seems to contradict what a naive quantity theorist would expect in the long-run. The demand for money function seems to be homogeneous of degree zero in general prices.

The evidence on the relevance of interest rates as an argument of the money demand function, the findings of this study do not always conform to *a priori* reasoning. The available results do not provide the most reliable measure of the opportunity cost of holding money. All attempts in this study include more than one interest rates proved to be unsuccessful. Nevertheless, the appropriate specification of the interest rates is more in favour of the interbank call money rate, r_e . This analysis might also suggest that in countries where interest rates are inoperative and in the absence of empirical support

¹¹See for example, Richard Porter [22].

for inflation or expected inflation rate in reflecting the opportunity cost of holding money, some other proxy variable like credit restraint should be used. Perhaps more work needs to be done on this problem.

While the conventional formulation has performed well, it is possible to improve on it in a number of ways. An empirical money demand function should have implications for the behaviour of income velocity of money. As noted, the specification used for developed countries create no problems when annual data are employed. It is therefore worthwhile examining the case using quarterly data on the scale variables for the fine tuning of monetary policy and to improve the forecasting behaviour of money demand.

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