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Abdul Qayyum

Kashmir Institute of Development Studies

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ABDUL QAYYUM**

1 INTRODUCTION

Monetary economics provides one of the important tools, that is monetary policy, to deal with the macroeconomic problems of the economy. It is concerned with the supply of money and the demand for money. It is often assumed that the money supply is exogeneously determined by the authorities, and the demand for real money is determined by market. The demand for money is of crucial importance in the conduct of monetary policy. It helps to understand macroeconomic activities and to prescribe appropriate policy instruments to deal with macroeconomic problems. The effectiveness of the monetary policy, however, depends on the shape and stability of the estimated demand for money function.

Most empirical studies of the money demand in Pakistan used conventional regression analysis. These are mainly concerned with the estimation of two types of money demand functions such as long-run static and short-run partial adjustment mechanism. However, the researchers employing the technique of cointegration in the empirical testing of money demand function have cast serious doubt on the results of these studies. This is because in conventional regression analysis the variables underlying the economic relationship are stationary. Moreover, most macroeconomic series, such as money supply, prices and income etc., are nonstationary, leading serious implications for conventional R^2, t, F and D-W statistics. Because of nonstationarity of the variables, these statistics remain no longer standard (Phillips, 1986) and therefore, these can not be used to make inference on the estimated numerical values of the economic relationship. Cointegration analysis resolves these problems by providing consistent estimates of parameters, irrespective of the presence of conventional problems of serial correlation, multicolinearity and simultaneity (Stock, 1987). All these evidences lead us to the importance of re-examining the demand for money functions using cointegration analysis.

Currency is considered to be the most important monetary aggregate that people want to hold in less developed countries. These countries, including Pakistan, do not have sophisticated banking system and well organised money markets. Further, banking habits are not well established. Currency comprises approximately 36 per cent of the total monetary assets in Pakistan. Although the currency is a predominant part of the monetary aggregates, the estimation of the demand for currency function is continuously ignored by researchers.

This paper aims to estimate the demand for real money (currency) in Pakistan by employing cointegration method. Next section formulate an econometric model, while section three discuss methodology for estimation. Empirical evidence on money demand presented in the following section and final part concludes the paper.

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* The author is Assistant Professor, University of AJK, Muzaffarabad, Pakistan.

II ECONOMETRIC MODEL OF THE MONEY DEMAND

The theories of money demand such as the quantity theory of money and the transaction demand for money postulates that the real money demand depends on two types of variables. The first type is scale variable, which has positive effect on the money demand. The second type is a set of opportunity cost variables, for instance, interest rate(s) and the rate of inflation. These have inverse relationship with the money demanded. In functional form the demand for real money can be written as

$$\mathbf{RMd_t = f(RY_t, r_t, \pi, D_t, \varepsilon_t)} \quad (1)$$

Where

RMd_t = Real money demand (currency),
RY_t = Real income,
r_t = The yield on long-term government bonds.
π = Measured rate of inflation (i.e., percentage change in the log of consumer price index 1985=100)
D_t = Seasonal dummies
ε_t = random error term assumed to be independent and identically distributed (iid).

Let us suppose that the individual time series data are non-stationary. Further assume that the variables of the real money demand and its determinants are cointegrated. If these conditions are held, the dynamic money demand model can be represented by the error correction mechanism. The relationship between the cointegration and the error correction mechanism is proved in the Granger representation theorem (Engle and Granger, 1987). Following Johansen (1988) and Johansen and Juselius (1990), the dynamic error correction money demand function is thus approached through the process of autoregressive distributed lag (ADL). Therefore, from the above equation (1) the following ADL formulation could be achieved.

$$\mathbf{X}_t = \sum_{i=1}^{k} \Pi_i \mathbf{X}_{t-1} + \mu_t + \Phi \mathbf{D}_t + \varepsilon_t \quad (2)$$

Where X_t is a vector of variables included in the model, μ_t is constant term, D_t is a vector of dummy variables and ε_t is iid(0, Λ) disturbance term. From this model, using Δ=1-L, where L is the lag operator, we can deduce the following dynamic error correction model of the real money demand

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \mu_t + \Phi \mathbf{D}_i + \varepsilon_t \quad (3)$$

where

$$\Gamma_i = -\mathbf{I} + \Pi_1 + \ldots\ldots + \Pi_i, \quad i = 1, 2, \ldots k \quad (4)$$

and

$$\Pi = -\mathbf{I} + \Pi_1 + \ldots + \Pi_k \quad (5)$$

This model includes variables both in levels and in differences. If the individual series have unit root at frequency one, that is they are individually I(1), then first difference of the series are stationary. Moreover, if there is a cointegrating relationship between I(1) variables then the linear combination of these variables is I(0). It means that $\Pi_i X_t$ term is stationary. Thus all the variables in the model are stationary. Therefore, this equation can be estimated with the ordinary least square method[1] (Granger and Lee, 1989). The error correction model captures the short-run dynamics of the demand for money. If the objective is to investigate the cointegrating vectors and the long-run relationship among the variables of real money demand and its determinants, then the analysis of the matrix Π of equation (3) is crucial. It contains all the relevant information. For example, if matrix Π has full rank called p, then ($\mathbf{X_t}$) is a stationary process. On the other hand, if the matrix of Π has zero rank, then ($\mathbf{X_t}$) is first order autoregressive process. This implies that there is no long-run information in the data. Moreover, if rank (Π) = r, where $0 < r < p$, there exists r cointegrating relationships among the variables[2]. The other p-r linear combinations of the variables act as common stochastic trends. So in this case the long-run matrix can be factorized as p×r matrices of α and β of the form $\Pi = \alpha\beta'$. In the presence of the cointegration relationship, the vector β has the property that $\beta' \mathbf{X_t}$ is stationary, though $\mathbf{X_t}$ itself is nonstationary. The vector α contains the loading vector, the elements of which weight each cointegrating relationship in each of the p equations of the system. The expected sing of the error correction parameter is negative. It gives the speed of adjustment towards the state of equilibrium.

The estimation of the error correction model (that is, equation 3) and test of its stability are the main objectives of the study. To reach the final version of the dynamic model of the money demand, there are some questions that must be solved as a prerequisite. These relate to the unit root analysis and the multivariate cointegration relationship. The coexistence of unit roots in the series and cointegrating relationship among the set of variables give strong support to an error correction mechanism as a dynamic specification of money demand. Therefore, the term $\Pi \mathbf{X}_{t-k}$ in equation 3 needs some more elaboration. Suppose that

$$\Pi \mathbf{X}_{t-k} = \mathbf{M}_t - \beta_i \mathbf{Z}_t = \mathbf{ECM}_t \qquad (6)$$

where M_t and Z_t are integrated series, I(1). If these series are cointegrated, then ECM_t is I(0). In this situation, the vector β_i are the parameters of the long-run cointegrating relationship between the real money demand and its determinants. The knowledge about the cointegrating vector is vital before estimating equation 3,

[1] Moreover, Banerjee et al (1990) shows that Instrumental Variable method and OLS yield same estimates. For similar results, see also Wickens and Bruesch (1988)

[2] It , that is r, can be said: 1) the number of cointegrating vectors, 2) the rank of Π, 3) the number of columns of α, 4) the number of columns in β, and 5) the number of nonzero canonical correlations between the elements of ΔY_t and the elements of Y_{t-1} (Dickey and Rossana, 1994).

because if β is known, the error correction model (i.e., equation 3) would be estimated by ordinary least squares. Fortunately, it is already proved by Engle and Granger (1987) that if the superconsistent estimates of β such as $\hat{\beta}$ from the cointegrating regression is used, then the remaining coefficients will be estimated as efficiently asymptotically as if β were known *a priori.* It is recommended to use Johansen (1988) maximum likelihood method to estimate cointegrating vector β (Engle and Granger, 1991).

The vector $\mathbf{M}_t$ is the real currency (RC) and the vector $\mathbf{Z}_t$ contains a set of explanatory variables which include real income(RY), the rate of inflation (π) and the long-term government bond rate (r_b). Moreover, all variables are transformed into logarithmic form.

The vector β_i can be interpreted as the long-run cointegrating relationship between the aggregate real money demand, real income, the rate of inflation, the rate of interest and the long term government bond rate. The theoretical expectations about the signs of the estimated parameters are $\beta_1 > 0$ and β_2, β_3 **and** $\beta_4 < 0$. In addition, it is hypothesised that β_1, the long-run income elasticity of money, is unity.

III ECONOMETRIC METHODOLOGY

In the preceding section general dynamic model of real money demand is specified. The long-run money demand function is also discussed. Now we select to apply the following three step methodology to achieve the objective of stable dynamic money demand functions. To estimate the final version of the error correction model, that is equation 3, the following three step methodology is being adopted.

STEP I The univariate statistical analysis of time series.

STEP II The multivariate cointegration analysis and the estimation of the long-run money demand function by using the Johansen (1988) maximum likelihood method.

STEP III Estimates a parsimonious error correction money demand function. Then to test this function for parameter stability and predictive failure performance.

STEP I: UNIVARIATE ANALYSIS

In the process of model specification it is assumed that the individual data series are nonstationary. This assumption may be transformed into a testable hypothesis. It is that the individual series are generated by the unit root process.

In this study, at first stage, we test whether a time series is a stationary There are different techniques that are available to test the hypothesis of stationarity of the data. Detail can be seen in Qayyum (1995). In this paper we applied the Dickey and Fuller (1979, 1981) tests named as Augmented Dickey Fuller (ADF) test. Consider the ADF regression equation

$$\Delta y_t = \alpha + \beta\, t + \rho y_{t-1} + \sum_{t=1}^{n} \lambda_i \,\Delta\, y_t + \varepsilon_t \qquad (6)$$

$$\text{for } i = 0, 1, 2, \ldots\ldots\ldots, n$$

where y_t is any time series to be tested for unit roots, t is time trend and ε_t is white noise error term. In the case i = 0, then it is simple Dickey-Fuller (1979, 1981) test[4]. First we test the hypothesis that $\rho = 0$ in equation 6 by t-statistics called τ_t, to test the significance of the estimated ρ and provided by Fuller (1976) and MacKinnon (1991).

Another test is performed to test the following testable hypotheses that can be inferred from the model, that is:

i. $(\alpha, \beta, \rho) = (0, 0, 1)$
ii. $(\alpha, \beta, \rho) = (\alpha, 0, 1)$

The first hypothesis says that the series is a random walk with zero drift against the alternative of random walk with a drift. The second hypothesis is concerned with the hypothesis of random walk with a drift against the alternative of trend stationary hypothesis. Dickey and Fuller (1981) established test statistics, that is Φ_2 and Φ_3 for testing of the null hypotheses i and ii, respectively. This Φ-statistic has F-distribution under the null and the critical values are given in Dickey and Fuller (1981) Tables V and VI for Φ_2 and Φ_3 statistic, respectively.

STEP II: MULTIVARIATE COINTEGRATION ANALYSIS

The second and important step of the methodology deals with the theory of cointegration. This stage starts with the testing of hypothesis of no cointegration between the real money demand and its determinants. To analyse the prospects of the existence of cointegrating relationship between the variables of real money demand and its determinants the Johansen (1988) maximum likelihood method is applied. This method is first applied by Johansen and Juselius (1990). In this study we are interested in investigating the long-run relationship among the money demand and its determinants in Pakistan. The dynamic money demand we have specified is given in the equation 3.

The main hypothesis to be considered is that there exists r cointegration vector(s). The inference on the 'r' of the system can be conducted through the method of likelihood ratio (LR) test. The null of

$$\mathbf{H_{0(r)}}: \quad \mathbf{rank(\Pi) \le r} \qquad (7)$$

is tested against the unrestricted alternative of

$$\mathbf{H_{1(r)}}: \quad \mathbf{rank(\Pi) = p} \qquad (8)$$

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4 Banerjee et al (1993) says that the lag structure in the ADF tests is *ad hoc*, it seems safest to over-specify the ADF regression.

by the trace statistic. Similarly, the validity of **H0**(r) against the alternative of **H0**(r+1) can be tested by looking at the maximal eigenvalue statistic[5]. The likelihood ratio (LR) test statistic for the hypothesis that there are at most 'r' cointegrating vector is:

$$-2 \ln \mathbf{Q} = \mathbf{T} \sum_{i=r+1}^{N} \ln (1 - \hat{\lambda}_i) \qquad \textbf{(9)}$$

where $\check{\lambda}_{r+1} \ldots \check{\lambda}_N$ are N-r smallest canonical correlations. It is proved by Johansen (1988) that these statistics are asymptotically distributed as χ^2 with r(p-r) degrees of freedom. The precise relevant critical values can be found in Osterwald-Lenum (1992).

In estimating cointegrating relationship between the demand of money and its determinants the significance of the estimated parameters is tested by Likelihood Ratio (LR) test. The LR test has Chi-square distribution, and the Chi-square values are calculated by imposing zero restriction on the estimated coefficients of individual variables. The hypothesis of long-run money-income proportionality can also be tested. It means that the log-run income elasticity of money demand is equal to one. This hypothesis is also tested by LR test.

STEP III: SHORT-RUN DYNAMIC MONEY DEMAND FUNCTION

This step involves the estimation of the parsimonious demand for money function using error correction mechanism, that is equation 3. The results from the previous two steps are important in the estimation of this model. Step I indicates the variables that must be differenced to achieve stationarity. These integrated variables are subject to inclusion in the Step II which provides the estimates of the long-run money demand function. It also dictates the variables that are placed in the error correction term, that is $\Pi_i X_{t-k}$. If these variables are found to be cointegrated, then the combination of the integrated I(1) variables is stationary I(0). Therefore, the residual term, called error correction term, is stationary.

The estimation starts with the unrestricted general model. In which every variable enters with a lag length of four quarters. As all the variables in the model are stationary, this function can be estimated by OLS. The preferred money demand function would pass a number of diagnostic tests. These tests are summarised in the following section.

To test the hypothesis of no serial correlation in the residual term Brush-Godfrey (1981) version of Lagrange Multiplier (LM) test is applied. Functional form misspecification is tested through Ramsey (1969, 1970) RESET test. Jarque-Bera (1980) test of normality is used to test the normality of the residual term. To test the structural stability of the estimated model Chow's (1960) first test. The Chow's

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[5] Johansen and Juselius (1990) suggests that the maximal eigenvalue test has greater power than the Trace test.

(1960) second test is used as predictive failure test. The accuracy of predictions is judged by using root mean square predictive errors (RMSE)[6] .

The quarterly series of currency and the yield on government bonds (r_b) are taken from International Financial Statistics (IFS) published by International Monetary Fund (IMF). The quarterly series of the consumer price index (1985 = 100) are calculated from IFS (various issues). The time series of GNP is not available quarterly. The annual series of GNP are from annual reports of IFS (various issues) and the Economic Survey (various Issues). Then the quarterly series are interpolated. The interpolation method used is as given in Qayyum (1995).

IV. PREFERRED MONEY DEMAND FUNCTION

IV.1. Testing of Unit Roots

Table 1 reports the Dickey-Fuller (1979) τ_t-statistic corresponding to the parameter ρ for the individual series. To test the hypothesis that the $\rho = 0$, the calculated t-values are compared with the tabulated τ_t-values given in Mackinnon (1991). These statistics show that all variables are I(1) in their levels and I(0) in the first difference at the 5 per cent level of significance. To confirm this finding of I(1) variables, the ADF test is also performed on the first difference of the data. The results are also reported in Tables 1. The calculated t-statistics show that except for the consumer price index (1985 = 100) and gross national expenditures (GNP) at current prices the estimated parameter ρ for all other variables are significantly different from zero at the five per cent level. The results lead to conclude that the consumer price index and nominal GNP are integrated of order two, I(2). All other series, however, are I(1).

Having explored the existence of unit root in the individual series, we move on to test some specific hypotheses. On this track we start from testing general hypothesis of difference stationary (DS) against the alternative of trend stationary (TS). The simple form of difference stationary hypothesis is the process of random walk. To test this hypothesis in the univariate series, $\Phi2$-statistic is calculated, which has F-distribution (Dickey and Fuller, 1981). Tables 1 column four, give the calculated values of $\Phi2$-statistic. As may be seen, the hypothesis of random walk can not be rejected for the following series: real currency (RC), interest rate on government bonds (r_b), consumer price index (LCPI), the rate of inflation (π) and nominal income (LY) at the 5 per cent level.

If the hypothesis of random walk is rejected for a series, tests are carried out to examine the hypothesis of random walk with drift. While testing the hypothesis of random walk with a drift, the $\Phi3$-statistic is calculated, which also has F-distribution and the results are reported in Table 1. In the light of these results, we are not able to

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[6] There are other measures of forecasting accuracy are available, such as mean square errors (MSE), mean absolute error (MAE), root mean square percentage error (RMSPE), etc.

reject the hypothesis of random walk with a drift for the series such as LRC and RY at the five per cent level.

The univariate analysis supports the hypothesis that macroeconomic time series being used in this study are not stationary in their level. Most of the series require first differencing to become stationary. It implies that the implicit assumption about the stationarity of data maintained in the estimation of demand for money functions in Pakistan was not true. The rejection of stationarity assumption cost doubt of their results. The results obtained in this part provide firm grounds to switch from the conventional regression methods to the conitegration methods to estimate the demand for money functions. This estimation of the money demand function by applying cointegration technique is the subject matter of the next section.

IV.2 The Long-run Demand for Real Currency: A Cointegration Analysis

We have investigated a number of cointegrating vectors by applying the likelihood ratio test that is based on the maximal eigenvalue and trace statistics of the stochastic matrix of the Johansen (1988) procedure. The variables included in the estimation process are real currency (RC), real income (RY), the rate of inflation (π) and the rate of interest on government bonds (r_b). The lag length of the VAR is 7 quarters. Three seasonal dummies are also included. Table 2 summarises results from the likelihood ratio tests. The null hypotheses of zero and one cointegrating vectors are rejected against the alternative of two cointegrating vectors, which is accepted, at the 5 per cent level. The first vector of the two cointegrating vectors can be represented as the long-run money demand equation.

The long-run cointegration relationship between the variables is obtained by using Johansen (1988) maximum likelihood method. So the estimated long-run money demand function is (χ^2 values in the parentheses)

$$\widehat{\mathbf{RC}} = \underset{(27.16)}{0.94}\,\mathbf{RY} - \underset{(26.77)}{9.33}\,\pi - \underset{(17.16)}{0.21}\,\mathbf{r_b} \qquad \mathbf{(10)}$$

All the variables satisfy *a priori* sign restrictions. The results indicate that the real income, the rate of inflation and the bond rate significantly[3] determine the long-run real currency holdings. This implies that economic agents hold currency or buy real asset or long-term assets instead. The finding that interest rate is significant is disagrees with that of Lewis and Breen (1975) who found no role of interest rate in determining the demand for real currency. The estimated coefficient of income is close to one. We formally tested the money-income proportionality hypothesis. The calculated χ^2 value is 1.22, which is lower than the tabulated value at the 5 per cent level of significance, which leads us to accept the unity hypothesis. This finding about the presence of economies of scale is in line with the results obtained in earlier

[3] The significance of the individual coefficients is tested by applying the likelihood ratio test. To test significance zero restrictions are imposed on the individual coefficients of the estimated conitegrating vector and the relevant χ^2 values are calculated.

studies of demand for money (M1 and M2) in Pakistan. However, Lewis and Breen (1975) conclude that in Pakistan the income elasticity of currency is greater than one. Furthermore, the long-run currency holdings are highly sensitive to the rate of inflation.

The steady-state solution to the real demand for currency is thus estimated in the following.

$$\widehat{\mathbf{RC}} = \mathbf{RY} - 8.78\,\pi - 0.30\,\mathbf{r_b} \qquad \mathbf{(11)}$$

It is clear that in the long-run the real currency holdings are mainly determined by the rate of inflation and the long-term rate of interest on government bonds.

IV.3 The Dynamic Demand for Real Currency: An Error Correction Mechanism

This section estimates the dynamic error correction model of the demand for real currency balances. In this model, the error correction term (ECM) consists of the real currency, real income, the rate of inflation and the bond rate (Equation 1). The final estimated dynamic error correction model is (t-ratios are in the parentheses)

$$\widehat{\Delta\mathbf{RC}} = \underset{(9.33)}{0.11} - \underset{(-2.68)}{0.09}\,\Delta\mathbf{r_s(-2)} - \underset{(-4.80)}{0.38}\,\Delta\mathbf{RC(-1)} - \underset{(-5.03)}{0.37}\,\Delta\mathbf{RC(-3)}$$

$$- \underset{(-9.63)}{0.18}\,\mathbf{ECM(-4)} - \underset{(-2.40)}{0.04}\,\mathbf{D1} - \underset{(-7.23)}{0.09}\,\mathbf{D2} \qquad \mathbf{(12)}$$

$$\mathbf{R^2} = 0.62 \qquad \mathbf{F(6, 109)} = 29.85$$

The residual passed the diagnostic tests of no autocorrelation [$\chi^2(4) = 7.46$], no functional form misspecification [$\chi^2(1) = 0.06$], normally distributed [$\chi^2(2) = 1.41$] and no ARCH [$\chi^2(1) = 3.47$] at the 5 per cent level of significance. The error correction term (ECM) enters into the equation significantly with theoretically correct sign. The estimated coefficient of ECM indicates that approximately 18 per cent of the disequilibrium in the money demand is corrected by the economic agents in the next quarter.

Another equation is estimated by imposing the long-run money-income proportionality restriction. Here the ECM term consists of the residual from the estimated long-run equation (2). The estimated parsimonious error correction function is (t-ratios are in the parentheses)

$$\widehat{\Delta\mathbf{RC}} = \underset{(8.07)}{0.07} - \underset{(-3.32)}{0.11}\,\Delta\mathbf{r_c(-2)} - \underset{(-1.92)}{0.36}\,\Delta\pi - \underset{(-1.80)}{0.35}\,\Delta\pi\mathbf{(-1)} - \underset{(-4.55)}{0.36}\,\Delta\mathrm{RC}\mathbf{(-1)}$$

$$- \underset{(-4.97)}{0.36}\,\Delta\mathbf{RC(-3)} - \underset{(-9.43)}{0.18}\,\mathbf{ECM(-4)} - \underset{(-7.74)}{0.12}\,\mathbf{D1} - \underset{(-3.36)}{0.06}\,\mathbf{D2} \qquad \mathbf{(13)}$$

$$\mathbf{R^2} = 0.64 \qquad \mathbf{F(7, 115)} = 25.67$$

Table 1

THE ADF TEST FOR UNIT ROOTS: QUARTERLY TIMES SERIES OF CURRENCY DEMAND AND ITS DETERMINANTS

Name of variables	Lag Length	τ_t - ratio	Φ2 (a1=a2=a3=0)	Φ3 (a2=a3=0)
LCR	(1)	-1.87	40.05	5.72
ΔLCR	(0)	-15.58	139.54	121.39
RACR	(0)	-1.46	29.34	1.68
ΔRACR	(0)	-13.92	133.18	96.84
LY	(5)	-2.77	4.43	4.27
ΔLY	(3)	-2.73	3.84	3.74
RY	(3)	-1.60	5.69	1.32
ΔRY	(4)	-6.87	18.16	23.60
LCPI	(2)	-2.38	2.45	3.62
π	(3)	-3.19	4.28	5.12
$\Delta\pi$	(2)	-10.20	48.31	58.39
r_b	(1)	-2.14	2.44	2.70
Δr_b	(1)	-11.10	41.81	61.62

Note: The 5 per cent rejection regions for the following tests are as

ADF τ_t < - 3.44 (Mackinnon, 1991)

Φ2 (a1=a2=a3=0) = 4.88 and Φ3 (a2=a3=0) = 6.49 (Dickey-Fuller, 1981)

Table 2

JOHANSEN MAXIMUM LIKELIHOOD PROCEDURE: LR TESTS OF COINTEGRATION BETWEEN THE DEMAND FOR REAL CURRENCY AND ITS DETERMINANTS

Null Hypothesis	Alternative Hypothesis	Maximal Eigenvalue Statistic	Trace Statistic
$r = 0$	$r \geq 1$	41.85*	51.15*
$r \leq 1$	$r \geq 2$	9.24	9.29
$r \leq 2$	$r \geq 3$	0.05	0.05

Note: 1. * shows significant at the 5 % level.

2. Name of the variables included: RCB, RSAL, π.

Table 3

DYNAMIC FUNCTIONS OF THE DEMAND FOR REAL CURRENCY: A TEST OF STABILITY

Time of Break	F(7, 94) Equation: 12	F(8, 98) Equation: 13
1962:1- 1971:4	0.39	0.48
1962:1- 1973:2	0.86	0.99
1962:1- 1980:4	1.86	1.95
1962:1- 1985:2	0.91	0.73

The test statistics show that the residual term has no serial correlation [$\chi^2(4)$ = 6.38], no ARCH [$\chi^2(1)$ = 3.65] and is normally distributed [$\chi^2(2)$ = 5.23] at the 5 per cent level of significance. The estimated function is well specified [$\chi^2(1)$ = 0.45] at the 5 per cent level. The estimated error correction term has correct sign. It means that in the short-run agents correct their money holdings by more than 18 per cent of the pervious quarters excess demand. Further, the estimated function indicates that in the short-run real cash holdings are determined by the variations in the rate of interest, the changes in the rate of inflation and the changes in the past quarters' money demand behaviour.

The parameter stability of any estimated function has been the more crucial test, particularly for the demand for money equations because after seventies the early estimated money demand functions experienced a structural break. Furthermore, there are several national and international events that might have induced a structural break in the estimated money demand functions.

Many important changes have occurred in the history of Pakistan, such as the fall of the East Pakistan in December 1971, nationalisation of industries particularly the whole banking system in 1973 and introduction of the Islamic modes of banking in 1980, which has replaced the existing interest based banking system in 1985. On the international side crucial event was the 1973 oil crisis. This oil shock is considered to be responsible for the instability of the money damned functions all over the world.

The estimated money demand functions are tested for a possible structural break for the above mentioned points of time. For this purpose the Chow (1960) first test is applied. The calculated F-statistic for these equations are given in Table 3, which reveal that the estimated money demand functions are stable for the whole period.

Furthermore, the forecasting power of the estimated equations are tested by Chow (1960) second test for post-1985:2. The calculated F-statistic for equation (12) is F(24, 85) = 0.51 and for the equation (13) is F(24, 90) = 0.42, which are insignificant at the 5 per cent level, indicating no systematic over or under predictions of the currency demand. The actual and fitted values of money demand, not presented here, reinforce the conclusion of the accurate forecasting by the estimated function. The accuracy of forecast is also judged by RMSE. It is 0.05 for equation (12) and is 0.04 for equation (13).

Further, we have tested the predictive performance of the both estimated equations for the post 1985:2 period. The F-statistic calculated for predictive failure test (the Chow test) is F(24, 77) = 0.45 for the equation (12) and F(24, 82) = 0.42 for the equation (13), indicating that the estimated models do not over predict or under predict. The accuracy of the prediction is also viewed from the plot of the actual and the estimated values (not presented here). The RMSE for the same period is 0.064 for equation (12) and 0.052 for equation (13).

V CONCLUSIONS

In this paper the general demand for real money (currency) model is specified. Three step methodology is described for estimating the dynamic demand for real money function. As a first step we estimated the long-run cointegrating relationships between the money demand and its determinants. The significant long-run relationship is found between the real currency balances, real income, the rate of inflation and the bond rate. Furthermore, the long-run money-income proportionality hypothesis is accepted.

The dynamic parsimonious error correction models of money demand is also estimated, which is free from the conventional econometric problems faced by other studies. Preferred functions were found stable for the whole period. The stability of the estimated equations and their predictive performance is highly encouraging. Moreover, it also implies that the error correction mechanism is the appropriate specification to study money demand behaviour in Pakistan.

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