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Financial Liberalisation and the Demand for Money in Pakistan

ASHFAQUE H. KHAN

I. INTRODUCTION

An efficient and liberalised financial sector is essential for promoting economic growth and welfare. The process of financial liberalisation through "deepening" and eliminating distortion and segmentation of financial markets improves the process of the mobilisation of savings as well as the efficiency of investment, thereby accelerating the overall rate of economic growth. At the end of 1989 Pakistan undertook an ambitious financial sector reforms programme with the aim to improve the effectiveness of monetary policy through greater reliance on market forces. The main liberalisation policies were aimed at liberalising interest rates, reducing controls on credit, enhancing competition and efficiency in the financial system, strengthening the supervisory framework, and promoting the growth and deepening of financial markets.[1]

Prior to undertaking the financial sector reforms several important events relating to financial system and exchange rate took place during the early 1980s. For example, a partial interest-free banking system was introduced in 1981 and with effect from July 1, 1985 the system of interest-bearing deposits of banks was fully replaced by a system based on profit and loss sharing (PLS). Furthermore, Pakistan moved away from a fixed exchange rate system to a managed floating exchange rate system in January 1982.[2]

These events along with the recently introduced financial sector reforms may have altered the institutional environment by improving the quality of economic

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[1] For a detailed discussion on financial sector reforms in Pakistan see Khan (1993).

[2] For a detailed discussion on these two changes, see Ahmad and Khan (1990).

signals, expanding the array of financial opportunities and putting greater reliance on market-determined interest rates. These changes have widespread implications for the conduct of monetary policy because the relationship between money demand and incomes and interest rates are being affected as a result of changes in the financial structures. In particular, the changes in institutional environment caused by financial liberalisation may have clouded the stability and predictability of the monetary aggregates. It may be noted that the existence of a stable and predictable relationship between monetary aggregates, economic activity, prices, and interest rates is essential for the conduct of effective and meaningful monetary policy. The new developments in the financial sector warrant a thorough investigation of the stability of the demand for money in Pakistan. This paper focuses on these issues in the background of the financial liberalisation process.

The issue of the demand for money and its stability have been widely studied in Pakistan.[3] These studies have, however, ignored the stationary properties of the time series variables and as such their findings may be treated with caution and scepticism. It has been widely, or rather universally, accepted that most time-series data used in economic analysis are non-stationary in nature. A regression of one non-stationary series on another can give rise to the so-called spurious regression problem and lead to incorrect statistical inferences.[4] Thus, prior to estimating any functional relationship it is essential to determine the nature of the long-run movements in the variables being studied.

Recent advances in econometric theory and practice have developed a new dynamic modelling approach, which is encapsulated in the cointegration and error correction models. The concept of cointegration was developed by Granger (1983) and was further refined by Engle and Granger (1987). The basic idea of cointegration is that if two or more variables are cointegrated then it confirms the existence of long-run relationships between these variables and that it can be legitimately used in an error correction model. If, on the other hand, they are not cointegrated, the variables under investigation have no long-run relationship among themselves.[5]

The purpose of this paper is to examine the impact of financial sector reforms in particular, and other institutional changes that have taken place since the early 1980s in the areas of banking and exchange rate regime in general, on the demand for money in Pakistan by employing cointegration and error correction models. For

[3]See for example, Khan (1980, 1982) and Ahmad and Khan (1990).

[4]Spurious regression is particularly likely when the adjusted R^2 exceeds the Durbin-Waston (*DW*) statistic. For further details see Granger and Newbold (1974).

[5]For a detailed survey on cointegration and error correction model see Perman (1991) and Cuthbertson *et al.* (1992).

the purpose at hand, we use quarterly time-series data covering a period from 1971:III to 1993:II (88 observations).

The rest of the paper is organised as follows. Section II discusses the methodology and data while results are reported and discussed in Section III. The policy implications that stem out from the analysis as well as concluding remarks are presented in the final section.

II. METHODOLOGY

Following the standard practice, the money demand function is specified to depend on a scale variable (income or wealth), the opportunity cost of holding money (interest rate), and expected rate of inflation.

$$m_t = f[y_t, R_t, \dot{P}^e_t] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

using logarithmic form, Equation (1) is written as

$$ln\, m_t = \alpha_0 + \alpha_1 ln\, y_t + \alpha_2 ln\, R_t + \alpha_3 ln\, \dot{P}^e_t + U_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

where

m_t is the real money balance (M_1 and M_2 definition); y_t is the real income; R_t *is* the nominal interest rate (short or medium term time deposit rate); $\dot{P}^e_t$ is the expected rate of inflation (actual inflation is used as a proxy for expected inflation).

Since this paper uses cointegration and error correction models a few words regarding these are in order. The cointegration technique tries to establish the linear long-run equilibrium relationship between two or more variables. Behind this technique lies the idea that some non-stationary variables may drift apart in the short-run, but they converge toward an equilibrium in the long-run. In order to test such a proposition, we first need to determine whether a variable is stationary or not. As described by Granger (1986) and Engle and Granger (1987), a non-stationary time series X_t is said to be integrated of order d if it achieves stationarity after being differenced d times. This is usually denoted by $X_t \sim I(d)$. Furthermore, two $I(d)$ variables are said to be cointegrated if a linear combination of them is integrated of any order less than d. Thus, to test for cointegration between two variables X_t and Y_t (both integrated of the same order) we need to obtain an estimate of a linear combination between X_t and Y_t, say $Z_t = X_t - \beta Y_t$ where Z_t may be interpreted as a disequilibrium error or short-run deviations from the long-run equilibrium

relationship and β is the cointegration vector. If $X_t \sim I(1)$ and $Y_t \sim I(1)$, in order for X_t and Y_t to be cointegrated the residuals or disequilibrium error term $(X_t - \beta Y_t) \sim I(0)$. An important correspondence exists between cointegration and error correction mechanism. For any set of cointegrated variables there exists a valid error correction representation of the data.[6] Error correction mechanism represents a systematic disequilibrium adjustment process through which X_t and Y_t are prevented from "drifting too far apart".[7]

The application of technique described above involves four steps. In step I, we determine the orders of integration for each variable under consideration, i.e., differencing each series successively until stationarity is achieved. In step II, we estimate cointegration regressions with Ordinary Least Squares (OLS) method using variables with the same order of integration. Test for stationary residuals of the cointegration regression is performed in step III. Finally, we estimate the error-correction model.[8]

III. RESULTS

In this section we report the results of cointegration and error correction dynamic specification of the money demand function. As described in the preceding section, the estimation procedure involves four steps, therefore, the results are presented in the same order.

Testing for the Order of Integration

Testing for the order of integration or testing for stationarity is the first step towards testing for cointegration. To this end, the Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) class of unit root tests are applied to the first difference of the natural logarithm of each variable over the period 1971:III to 1993:II with and without a time trend. The results are reported in Table 1. Both the DF and the ADF test statistics reject the null-hypothesis of non-stationarity for all the variables to be used in the money demand function at the 5 percent level. The calculated values for both the DF and the ADF tests are found to be less than the critical values at the 5 percent level which suggest that all the series are stationary in first difference and are integrated of order 1.

[6] See Engle and Granger (1987).
[7] See Perman (1991).
[8] For a detailed discussion on data and their sources see Khan (1994).

Table 1

Tests for the Order of Integration

Variables	Dickey-Fuller (DF)		Augmented Dickey-Fuller (ADF)	
	Without Trend	With Trend	Without Trend	With Trend
$\Delta \ln M_1$	−12.56	−12.62	−6.8	−7.17(2)
$\Delta \ln M_2$	−11.99	−12.01	−5.32(2)	−5.42(2)
$\Delta \ln y$	−6.05	−9.30	−3.70(1)	−6.55(1)
$\Delta \ln R_1$	−11.06	−11.06	−9.32(1)	−9.39(1)
$\Delta \ln R_2$	−15.64	−15.60	−10.56(2)	−10.78(2)
$\Delta R R_1$	−12.10	−12.03	−11.45(1)	−11.38(1)
$\Delta R R_2$	−13.67	−13.60	−12.10(2)	−12.05(2)
$\Delta \dot{P}$	−12.14	−12.07	−5.82(1)	−6.46(1)

Note: The Dickey-Fuller (DF) and the Augmented Dickey-Fuller (ADF) tests are based on the following regressions:

$$(1-L)X_t = \lambda_0 + \lambda_1 X_{t-1} + U_t$$

$$(1-L)X_t = \lambda_0 + \lambda_1 X_{t-1} + \sum_{i=1}^{n} \psi_j (1-L)X_{t-i} + U_t$$

- Values in parentheses are the number of lags used in the ADF test.
- The critical value of the DF and the ADF statistics from the [Fuller's (1976), p. 373] table are −2.93 and −2.89 for 50 and 100 observations respectively at the 5 percent level of significance.

Cointegration Regressions

The variables which were tested for the order of integration and were found to have the same order, are used to estimate cointegration regressions with the help of the Ordinary Least Squares. Various specifications of the long-run money demand function pertaining to m_1 and m_2 definitions of money are estimated and the results are reported in Tables 2 and 3 respectively. A cursory look at Table 2 (results pertaining to m_1 definition) is sufficient to see that the ADF[9] and CRDW[10] statistics reject the null-hypothesis of no cointegration between money (m_1 definition), real income, real interest rates, and the rate of inflation.

Thus, the multivariate regression of money (m_1 definition), real income, real interest rate, and inflation indicate that these four variables are cointegrated, that

[9]Here the DF and the ADF tests are applied to the residuals of the cointegration regression instead on the levels or difference of the series themselves.

[10]The Durbin-Watson from the cointegration regression (CRDW) is yet another quick way to test the stationarity of the residuals. If CRDW approaches zero then two or more variables are not integrated. Under the null hypothesis of non-cointegration CRDW should be close to zero, so we seek a value of the CRDW which is high enough to reject the null hypothesis.

is, there exists a stable long-run equilibrium relationship between these variables. On the other hand, the multivariate regression of money (m_1 definition), real income, nominal interest rate, and inflation (eq. c) failed to pass the ADF test which indicate that these variables are *not* cointegrated.[11] The income elasticity of money demand is found to be in the neighbourhood of 1.1 which suggests that the demand for money has been rising at a rate which is more or less proportional to income growth. The coefficient of the real interest rate, which has a negative sign, is very low (0.008) which is consistent with the findings of Ahmad and Khan (1990).

Table 2

Cointegration Regressions for ln m_1

	Constant	ln y	$R_1 - \dot{P}$	$R_2 - \dot{P}$	ln R_1	ln R_2	$\dot{P}$	$\bar{R}^2$	CRDW	DF	ADF
a.	−5.45	1.09	−0.008					0.93	0.43	−3.38	−4.66 [5]
	(−13.99)*	(29.85)*	(−1.77)*								
b.	−5.53	1.09		−0.007				0.93	0.45	−3.47	−4.95 [5]
	(−13.67)*	(28.75)*		(−1.90)*							
c	−5.68	1.17			−0.37		−0.35	0.96	0.39	−3.01	−4.16 [4]
	(−18.04)*	(35.55)*			(−6.36)*		(−0.89)				
d.	−5.99	1.21				−0.41	−0.80	0.95	0.69	−4.20	−4.08 [5]
	(−18.73)*	(34.29)*				(−6.87)*	(−2.02)*				
e.	−5.14	1.05					−0.25	0.93	0.25	−2.89	−5.46 [4]
	(−13.99)*	(32.24)*					(−0.53)				

Note: Figures in parentheses are *t*-statistics.
numbers in square brackets are lag length.
*means significant at the 5 percent level.
For critical values see Pesaran and Pesaran (1991).
The errors from the cointegration equations are derived to perform the DF and the ADF tests based on the following regressions:

$$(1-L)\,e_t = \beta_0 + \beta_1 e_{t-1} + V_t \qquad (DF)$$

$$(1-L)\,e_t = \beta_0 + \beta_1 e_{t-1} + \sum_{i=1}^{K} \phi_j\,(1-L)\,e_{t-i} + V_t \qquad (ADF)$$

The results of cointegration regression corresponding to the m_2 definition of money are reported in Table 3. A look at Table 3 indicates that the ADF and CRDW statistics reject the null hypothesis of no cointegration between money (m_2 definition), real income real interest rates, nominal interest rate and inflation. In other words, these variables are cointegrated, that is, there exists a stable long-run

[11] Although the CRDW statistics is sufficiently higher than zero and suggests cointegration but the ADF test accept the null hypothesis of non-cointegration. Due its higher power, [Engle and Granger (1987), p. 226] recommend the use of the ADF test.

equilibrium relationship between these variables. However, the multivariate regression of money (m_2 definition), real income, nominal interest rate (interest rate on time deposit of short maturity i.e. less than one year) and inflation indicate that these four variables are not cointegrated because they failed to past the ADF test. The income elasticity of money demand is once again found to be in the neighbourhood of 1.1 which suggest that the growth of m_2 definition of money has been more or less proportional to the growth of income. The coefficient of the real interest rate which has a negative sign, is very low (0.004). However, the interest elasticity (nominal) of money demand is 0.32 and suggests that a ten percent increase in the interest rate will reduce money demand by 3.2 percent. These findings are consistent with Ahmad and Khan (1990).

Table 3

Cointegration Regressions for ln m_2

	Constant	ln y	$R_1 - \dot{P}$	$R_2 - \dot{P}$	ln R_1	ln R_2	$\dot{\bar{P}}$	$\bar{R}^2$	CRDW	DF	ADF
a.	−4.38	1.03	−0.004					0.93	0.31	−2.93	−5.52[5]
	(−11.65)*	(29.11)*	(−1.02)								
b.	−4.28	1.01		−0.001				0.93	0.27	−2.72	−5.70[5]
	(−10.87)*	(27.30)*		(−1.39)							
c.	−4.64	1.12			−0.38		−0.90	0.95	0.39	−3.01	−4.16[4]
	(16.47)*	(35.80)*			(−7.22)*		(−0.52)				
d.	−4.75	1.12				0.32	−0.23	0.94	0.45	−3.30	−4.40[5]
	(14.62)*	(31.07)*				(−5.24)*	(−3.04)*				
e.	−4.10	1.00					−0.80	0.93	0.19	−2.58	−5.99[4]
	(11.89)*	(32.49)*					(−1.76)*				

Note: Figures in parentheses are *t*-statistics.
Numbers in square brackets are lag length.
*Means significant at the 5 percent level.
– For critical values see Pesaran and Pesaran (1991).
– For the DF and the ADF tests see note of Table 2.

Error Correction Model

In the final stage, an error correction model Equation (3) is estimated for those monetary aggregates for which cointegrating relationships are found.

$$\Delta m_t = \alpha_0 + \alpha_1 \Delta m_{t-i} + \alpha_2 \Delta y_{t-i} + \alpha_3 \Delta R_{t-i} + \alpha_4 \Delta P_{t-i} + \alpha_5 (m - \hat{m})_{t-1} + \varepsilon \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where the symbol Δ represents a first difference of a variable and $\hat{m}$ stands for fitted values Equation (2).

This stage involves regressing the first difference of each monetary aggregate onto the first difference of all variables (both contemporaneous and lagged) plus the lagged value of the dependent variable and the lagged value of the error correcting term i.e., the error term from the cointegration regression. Table 4 documents the results of the error correction model for money demand corresponding to m_1 and m_2 definitions of money. The coefficients of the error correction term in the money demand equation corresponding to both definitions of money are fairly stable (around 0.2) and statistically significant. This suggest that about 20 percent of the previous quarters discrepancy between actual and equilibrium value of the dependent variable is corrected each quarter. The statistical significance of this coefficient indicates that market forces are in operation to restore long-run equilibrium following a short-run disturbance due to the introduction of various reforms including the recent financial sector reforms.

IV. CONCLUDING REMARKS

The purpose of this paper has been to examine the impact of financial sector reforms in particular, and other institutional changes that have taken place since the early 1980s in the areas of banking and exchange rate in general, on the demand for money in Pakistan.

We employed the cointegration and error correction models and used quarterly data for the period from 1971:III to 1993:III. We began by testing the stationarity of two monetary aggregates (m_1 and m_2 definitions of money), real income, interest rates, and inflation rates using the DF and the ADF tests. These tests showed that all of these variables are integrated of order 1. Having established this, we proceeded to test for cointegration using the Engle-Granger two step procedure. The results showed that the monetary aggregate of m_2 definition is cointegrated with real income, real interest rates, nominal interest rate of medium term maturity, and the inflation rate, but *not* with the interest rate of short-term maturity. On the other hand, monetary aggregate of m_1 definition is found to be cointegrated with real income, real interest rate and inflation, but *not* with nominal interest rates of both the short-term and medium-term maturities. These results suggest that there exists a long-run stable equilibrium relationship between these variables and that the above-mentioned institutional changes in banking practice, exchange rate regime and recently introduced financial liberalisation have *not* caused instability in the demand for money in Pakistan. This is because these changes were introduced in a gradual manner.

Table 4

Estimates of Error Correction Model

Regressor	D_1m_1	D_1m_2	D_1m_2	D_1m_2	D_1m_2
C	–0.004 (–0.46)	0.020 (–20)	–0.021 (–2.12)	–0.016 (–1.75)	–0.013 (–1.31)
D_1m_1 (–1)	0.060 (0.63)				
D_1m_1 (–2)	0.248 (3.11)				
D_1m_1 (–3)	0.029 (0.34)				
D_1m_1 (–4)	0.660 (7.85)				
D_1m_2(–1)		0.088 (0.92)	0.054 (0.57)	–0.078 (–0.77)	–0.084 (0.91)
D_1m_2(–2)		0.334 (3.40)	0.248 (2.58)	0.338 (3.99)	0.320 (3.45)
D_1m_2(–3)		0.110 (1.02)	0.120 (1.16)	0.101 (1.09)	0.102 (0.99)
D_1m_2(–4)		0.623 (5.99)	0.672 (6.63)	0.459 (4.91)	0.540 (5.25)
D_1y	0.414E–6 (0.06)	–0.100E–6 (–0.01)	–0.596E–6 (–0.08)	0.560E–6 (0.09)	0.139E–5 (0.21)
D_1y(–1)	–0.576E–5(–0.92)	–0.177E–5(–0.24)	–0.248E–6 (–0.03)	–0.111E–5 (–0.18)	–0.271E–5 (–0.40)
D_1y(–2)	0.500E–5 (0.79)	0.854E–5 (1.20)	0.105E–4 (1.46)	0.908E–5 (1.48)	0.796E–5 (1.19)
D_1y(–3)	0.637E–5 (1.01)	0.100E–4 (1.41)	0.825E–5 (1.33)	0.753E–5 (1.20)	0.598E–5 (0.88)
D_1y(–4)	–0.368E–5 (–0.59)	–0.288E–5 (–0.41)	–0.231E–5 (–0.32)	–0.821E–6 (–0.13)	–0.243E–5 (–0.36)
D_1RR_1		0.006 (3.08)			
D_1RR_1(–1)		0.005 (2.40)			
D_1RR_1(–2)		0.001 (0.61)			
D_1RR_1(–3)		0.002 (0.96)			
D_1RR_2			0.005 (2.77)		
D_1RR_2(–1)			0.005 (2.76)		
D_1RR_2(–2)			0.002 (1.19)		
D_1RR_2(–3)			0.002 (1.22)		
D_1R_2					–0.004 (–1.12)
D_1R_2(–1)					0.003 (0.88)
D_1R_2(–2)					0.006 (1.57)
D_1R_2(–3)					0.001 (0.42)
D_1P	–1.013 (–6.95)			–0.715 (–4.45)	–0.695 (–4.39)
D_1P(–1)	–0.918 (–4.80)			–0.628 (–2.69)	–0.435 (–1.86)
D_1P(–2)	–0.892 (–4.11)			–0.473 (–1.77)	–0.256 (–1.07)
D_1P(–3)	–0.910 (–4.60)			–0.524 (–2.17)	–0.344 (–1.66)
D_1P(–4)	–0.675 (–3.98)			–0.581 (–2.93)	–0.360 (–2.14)
D_1P(–5)	–0.364 (–2.35)			–0.355 (–2.14)	
ECT(–1)	–0.126 (–2.16)	–0.207 (–4.51)	–0.212 (–4.73)	–0.165 (–2.89)	–0.203 (–3.32)
$\overline{R}^2$	0.79	0.65	0.64	0.74	0.70
DW	2.07	1.78	1.78	1.98	2.08

Note: *t*-statistics are given in parentheses of each parameters.

The present study also found income elasticity of money demand in the neighbourhood of 1.0 –1.1 and suggests that the demand for money has been rising at a rate proportional to the growth of income. As regards the interest rate, the coefficient of the real rate of interest is found to be very low while nominal interest rate elasticity is found to be 0.32 which suggests that money demand can be reduced by increasing the nominal interest rate.

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Comments on "Financial Liberalisation and the Demand for Money in Pakistan"

Dr Khan is an authority on money demand behaviour in Pakistan. Over the past decade or so, he and his associates have written a series of papers on this topic. The novelty of the present paper is that he has used the now popular methods of cointegration and error correction to test for the stability of the money demand function in Pakistan.

I agree with Dr Khan that financial deregulation in Pakistan since the early 1980s might have made the money demand function unstable. An empirical investigation of the stability of money demand function by the method of cointegration has thus been appropriate. In fact, despite an impressive number of studies on money demand behaviour in Pakistan, until now the question of stability of the money demand function was not subject to rigorous investigation. Dr Khan's paper is thus a timely contribution to the literature on money demand in Pakistan. However, although Dr Khan's paper is a useful and an important piece of work, as both a researcher interested in the money demand behaviour in developing countries and as a user of the methods of cointegration and error correction I would like to take this opportunity to make the following general and specific comments on the paper in its present form.

As indicated above, the paper examines the question of whether recent financial deregulation might have made the money demand function in Pakistan unstable. Even though there are theoretical reasons to suspect that financial deregulation may make the money demand function unstable, for the benefit of non-specialist readers there is a need for a discussion on how and why financial deregulation affects the intercept and slope parameters in the money demand function and hence makes it unstable. The concept of stability of the money demand function also needs to be precisely defined so that any instability in the money demand function either due to financial deregulation and innovation or institutional change can be examined. In my view, Dr Khan did not clearly set the objectives of the paper and therefore he was not able to apply the methods of cointegration and error correction to find the answers of those questions which might have been relevant to the issue he had intended to address. For example, the objective of the

paper was to examine the question of whether financial deregulation might have made the money demand function in Pakistan unstable. The method of cointegration is an approach which, if judiciously applied, may provide useful information on the effect of financial deregulation on the stability of the money demand function, but a mere establishment of the presence of a cointegral relationship over the whole sample period does not provide a precise answer to the question of instability caused by financial deregulation. In fact, besides the cointegration technique, the conventional regression analysis may be useful to determine the precise effects of financial deregulation on both the intercept and slope parameters in the money demand function and the value of coefficient of adjustment of real money balances. In my view, as the main objective of the paper is to examine the effect of financial deregulation on the stability of money demand function, an integrated approach which combines cointegration and conventional regression analysis may provide answers to questions which most researchers ask about the likely effects of financial deregulation on the money demand function.

Besides these general comments, I have a few specific comments on the paper in its present form.

First, why have quarterly, rather than annual data been used to investigate the alleged instability in the money demand function. It is true that quarterly or monthly data give a large number of high-frequency observations required for large sample tests, but they do not add additional information relative to what annual data may yield. Given that the idea of stability of the money demand function is essentially a long-run property, the validity of it needs to be investigated by at least annual data. In fact, the intensity of debate on the Monetarist view that there exists a stable money demand function has now raised doubt about the appropriateness of any quarterly model of money demand as the dynamic form of a quarterly model often exhibits instability. For Pakistan, quarterly data for real income are not available. This is another reason why annual data might have been appropriate for the present study.

Second, as it is well-known that the power of most of the unit root tests is low, it would have been worthwhile to visually examine the patterns of the time series of variables in the money demand function. In fact some subjective judgement is required to interpret the time series properties of macroeconomic variables as different tests often give conflicting results.

Third, although Dr Khan has discussed the methods of cointegration and error correction in detail, it is not clear to me which precise estimating equation he has used to test for unit roots. I have the impression that he has used the following estimating equation.

$$\Delta Z_t = \beta 0 + \beta 1\, t + (\alpha - 1)\, Z_{t-1} + \sum \gamma i\, \Delta Z_{t-i} + \text{error term} \quad \ldots \ldots \quad (1)$$

where z is the generic term for any variable subject to unit root testing. The t-ratio of $(\alpha-1)$ in this specification is used for determining whether there is a unit root in the level of the variable Z_t. It follows from the fact that the specification (1) is essentially an alternative form of the basic estimating equation.

$$Z_t = \beta 0 + \beta 1\, t + \alpha\, Z_{t-1} + \sum \gamma i\, \Delta Z_{t-i} + \text{error term} \quad \ldots \ldots \ldots \quad (1')$$

When the DF/ADF tests cannot reject the null hypothesis of a unit root, one has to use an estimating equation of the following form

$$\Delta^2 Z_t = \delta 0 + \delta 1\, Z_{t-1} + \text{error term} \quad \ldots \ldots \ldots \ldots \ldots \ldots \quad (2)$$

and test for the unit root in the first-difference of the variable.

If the unit root tests results reported in Table 1 are from the above estimating Equation (1), the results suggest that the time series of all the variables in the money demand function do not have a unit root. Such results would then be opposite to what Dr Khan claims (i.e., the time series of all the variables in the money demand function have a unit root). However, if Dr Khan had used the estimating Equation (2), his claim that the time series of all the variables in the money demand function have a unit root is correct.

Fourth, under the variable definition column in Table 1, Dr Khan has reported M1 and M2 (definitions of the nominal stock of money) rather than m1 and m2 (definitions of real money balances). Given that the appropriate variable in the money demand function is real money balances, there is a confusion about the actual definition of money used for unit root testing. It is also not clear whether Dr Khan has investigated the time series properties of the inflation rate. It is the inflation rate which enters the money demand function and therefore the time series properties of the inflation rate, rather than that of the price level, are relevant to the present study. Assuming that the reported results are for the inflation rate, I am sceptical about Khan's claim that the inflation rate has a unit root. On the whole, I think that Dr Khan should clearly and precisely define the variables used for unit root testing in order to avoid any confusion.

Fifth, Dr Khan has reported two cointegration equations in both Tables 2 and 3 which contain a definition of the real interest rate. I am puzzled as to why he used such a definition of the interest rate in the money demand function. In an asset-theoretic model of money demand, the nominal interest rate is the appropriate proxy for the cost of holding money. For example, the expected real return from holding

narrow money equals minus the expected rate of inflation ($-\pi^e$) and the expected real return from holding substitute assets (e.g., an interest-bearing financial asset) equals the nominal interest rate minus the expected rate of inflation ($i-\pi^e$). It follows that the appropriate measure of the relative return from holding money compared with the financial assets is minus the nominal interest rate [$-\pi^e-(i-\pi^e) = -i$]. It is true that in his model of finance in economic development, Ronald McKinnon uses the real deposit rate of interest in the money demand function. But the theoretical justification of the real interest rate in his money demand function is different from that in the asset-theoretic approach to money demand. Dr Khan should therefore explain why did he think that the real interest rate may be appropriate in the money demand function for Pakistan.

Sixth, I have made the point earlier that the main objective of the paper has been to examine the effect of financial deregulation on the stability of money demand function in Pakistan. Because a mere presence of a cointegral relationship does not tell much about the effect of financial deregulation on the stability of the money demand function unless the tests are designed in such a way that they provide relevant and precise answers, Dr Khan should have estimated the cointegrating equation for at least two sub-samples. Given that financial deregulation in Pakistan has started since the early 1980s, he could have estimated the cointegrating equation, say, for 1972–81 and 1982–90. Such an exercise is both relevant and useful as it often provides information on any structural change in the money demand function. Even without formally testing for equality of parameter values obtained for two sample periods, it is sometimes possible to say whether there has been any structural change in the money demand function over time.

Seventh, as there is no standard guidelines for the specification of an error correction model, it would have been better if Dr Khan had reported a range of diagnostic test statistics so that the robustness of the error correction model might have become evident. Diagnostic test statistics for both functional form mis-specification and stability are particularly important for selecting a specific error correction model from the general form of the model.

The above comments have highlighted aspects of the paper where in my view there are shortcomings and hence an improvement can be made by revising the paper in the light of these comments. As I have not explicitly mentioned the strong areas of the paper because of time and space constraints, my comments should not therefore devalue the work of Dr Khan in any sense.

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