OPEN ECONOMY DEMAND FOR MONEY IN PAKISTAN

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ABSTRACT

We examine the determinants of open economy demand for money in Pakistan using Johansen-Juselius co-integration approach and vector error correction model. It focuses upon current float exchange rate regime and quarterly data from 2001Q1 to 2010Q2. The results based on estimation procedure that uses four lags indicate that although M1 is co-integrated with income and interest rate yet the estimate of interest rate is wrongly signed in the co-integrating vector. Adding nominal effective exchange rate in the estimation procedure provides evidence of one co-integrating vector and correctly signed parameters in co-integrating space. The positive estimate of nominal effective exchange rate has implication that monetary authorities should consider nominal exchange rate as valid determinant of M1 If it is used for monetary targeting.

Keywords: Open economy, Demand for Money, Floating Exchange Rate, Interest Rate.
JEL Classification: E41; E52; F31;

INTRODUCTION

The traditional empirical literature considers opportunity cost and scale variable as relevant determinants of demand for money. However, monetary developments in rest of the world do affect the demand for money in a country. Generally, the effects of monetary shocks are transmitted from one country to other through interest rate and exchange rate changes. Mundell (1963) first emphasized the importance of exchange rate as relevant determinant of demand for money without providing any plausible explanation or estimating money demand function. The breakdown of Bretton Wood system ushered new era of exchange rate regimes. Majority of the countries adopted flexible exchange rates with hope that it would reduce exchange rate volatility and provide monetary authorities independence in formulating effective monetary policy. However, exchange rate changes and resulting currency substitution has casted doubt on this advantage of flexible exchange rates. High currency substitution implies that smaller changes in exchange rate will lead larger changes in the demand for money (Bordo & Choudhri, 1982). Hence, the notion that flexible exchange rate is associated with independence in formulating effective monetary policy is an empirical issue instead of settled fact.

There are two types of effects of exchange rate changes on demand for real money balances. First, exchange rate depreciation increases the value of individuals' holdings of foreign assets. If individuals' consider increase in value of their foreign assets holdings as an increase in their wealth, they would increase their demand for domestic money (Arango & Nadiri, 1981). This is called wealth effect of exchange rate changes. On the other hand, individuals may reduce their demand for real money balances if they perceive further depreciation of domestic currency (Bahmani-Oskooee & Pourheydarian, 1990). This effect of exchange rate changes on demand for money is called substitution effect.

There is considerable empirical evidence of exchange rate as the relevant determinant of money demand around the world. McNown and Wallace (1992) estimated money demand function for the U.S and found that $M1$ monetary aggregate is co-integrated with income and interest rate but $M2$ monetary aggregate is not. When they included nominal exchange rate in money demand equation for $M2$, the result indicated the presence of co-integrating vector. They then concluded that for the floating period of the U.S. dollar, long run stationary of the demand for $M2$ requires including effective exchange rate. Arango & Nadiri (1981) also evaluated the effect of exchange rate changes on demand for money in Canada, Germany, UK and the US and obtained insignificant estimate of exchange rate and significant coefficient for expected exchange rate. Bahmani-Oskooee & Pourheydarian (1991) showed that exchange rate is a significant determinant of money demand in Canada and the US but not in Japan. Bahmani-Oskooee & Shabsigh (1996) also estimated demand for money in Japans and found that while $M2$ monetary aggregate is co-integrated with interest rate, income and nominal effective exchange rate, $M1$ monetary aggregate is not. Other studies that have examined the effect of exchange rate on demand for money are Bahmani-Oskooee & Bahmani (2014) for Korea, Arize & Nam

(2012) for seven Asian countries[4], Arize (1989) for four Asian countries namely Pakistan, Philippine, South Korea and Thailand, Bahmani-Oskooee & Shin (2002) for Korea, Abdullah *et.al.,* (2010) for five Asian countries namely Indonesia, Malaysia, Philippine, Singapore & Thailand, Valadkhani, (2008) for Asian-Pacific countries namely China, Fiji, Japan, Malaysia, the Philippine and Singapore. All these studies demonstrate significant effect of exchange rate changes on demand for money in relevant countries.

There is a considerable evidence of exchange rate as a relevant determinant of demand for real money balances in Pakistan. The evidence gathered from this empirical literature supports both wealth effect and substitution of exchange rate changes on demand for money in the country. The empirical studies that provide evidence of wealth effect include Hafeez-ur-Rehman & Afzal (2003), Bahmani-Oskooee & Rehman (2005) and Hsing (2007).[5] On the other hand, Bahmani-Oskooee & Malixi (1991), Anwar & Asghar (2012) and Faridi & Akhtar (2013) demonstrate substitution effect of exchange rate changes on demand for money is more dominant.[6]

This paper also examines the effects of exchange rate changes on demand for real money balances in Pakistan. Contrary to earlier studies that have considered both fixed and flexible exchange rates, this study focuses upon recently adopted floating exchange rate regime and checks whether wealth effect or substitution of exchange rate changes on demand for money is more predominant. Rest of the paper proceeds as: section 2 reviews empirical literature on demand for money in Pakistan. In section 3 method of estimation is discussed and estimation results are given in section 4. Section 5 concludes.

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[4] Arize & Nam (2012) used restricted vector auto regression for evaluating the effect of exchange rate on demand for money in seven South Asian countries from 1973Q1 to 2009Q4. The countries included in their analysis are India, Korea, Malaysia, Pakistan, the Philippine, Sri Lanka and Thailand.

[5] All these studies except Hafeez-ur-Rehman & Afzal (2003) used real effective exchange rate. Rehman & Afzal (2003) on the other hand, used black market exchange rate to test whether the wealth effect or substitution effect of exchange rate changes on demand for money in Pakistan is more dominant.

[6] Hye *et.al.,* (2009) in their estimated money demand function obtained insignificant effect of exchange rate changes on demand for money in the country.

Empirical Literature on Demand for Money in Pakistan

Money demand function plays an important role in the transmission of monetary policy in a country. For monetary policy to be effective, it is important that the relationship between demand for real money balances and its determinants must be stable and predictable. Predictability also implies that stable money demand function will result desirable effects of any changes in money supply on key macroeconomic indicator. Demand for real money balances has been widely researched topic due to its importance in formulation and transmission of monetary policy in the country. This research has mainly focused on interest rate and some scale variable such as current income, permanent income and wealth as determinants of money demand in the country.

Mangla (1979) focused on the issues involved in theoretical and empirical estimation of demand for money in Pakistan and employed ordinary least square approach for evaluating the effect of opportunity cost variable and scale variable on real money demand for the period 1958-1971. He used interbank call money rate and government Treasury Bill Rate for proxying opportunity cost of holding money. Similarly, nominal GNP, nominal permanent income, real income and real permanent income were used as scale variables. Other studies that used OLS approach for evaluating the determinants of money demand in Pakistan are Khan (1980) and Nisar & Aslam (1983). These studies are spurious due to use of non-stationary data and ordinary least square approach (Akram & Rafiq, 2013). Bahmani-Oskooee & Malixi (1991) included in their money demand equation inflation, real output and real exchange as $M1$ determinants. Hossain (1994), on the other hand, evaluated the effect of real income and interest rate on narrow and broad monetary aggregates. He used Treasury bill rate and interbank call money rate to substitute interest rate in the estimation. Johansen co-integration approach was used for carrying out the analysis from 1951-1991. Qayyum (2001) applied Johansen co-integration approach for examining the determinants of business and personal sector money demand function. Personal sector money demand function included real income, deposit interest rate, bond rate and rate of inflation as its determinants. On the other hand, business sector determinants of real money demand consisted of real sales, rate of interest on deposits and rate of inflation. Hafeez-ur-Rehman & Afzal (2003) employed auto regressive distributed lag model for analyzing the impact of black market exchange rate on demand for narrow and broad money in Pakistan. Other variables included in the model are inflation rate and real income. Qayyum (2005) employed co-integration and error correction approach for estimating dynamic demand for money ($M2$) in Pakistan. The variables included in dynamic demand function are real income, inflation and interbank call money rate and Treasury bill rate as opportunity cost variable. Khan & Sajjid (2005) also applied ARDL approach for investigating long and short run relationship between real money balances, real income, domestic interest rate, inflation rate, foreign interest rate and real effective exchange rate. Hsing (2007) also estimated real money demand function for Pakistan. He applied Box-Cox method and regress money stock (*M2*) on real income, domestic and foreign interest rate and real effective exchange rate. Hye *et.al.,* (2009) evaluated the effects of stock prices on money demand for Pakistan. Other regressors included in the model are interest rate, economic activity, inflation and exchange rate. Omer (2010) attempted to contribute the ongoing debate about whether the Central Bank should adopt inflation targeting or continue with monetary targeting. Stable money demand function is a pre-requisite for effective monetary targeting. He applied ARDL method for estimating the regression equation that included velocity of money (for *M0, M1 and M2*), real permanent income per capita, real interest rate, transitory income and expected inflation. Sarwar *et.al.,* (2010) evaluated the determinants of money demand using ARDL methodology. They regressed divisia type weighted aggregate instead of simple sum official aggregates for $M_0\,M1$ and $M2$ on price dual of divisia for each monetary aggregate, real income and financial innovation. Malik & Aslam (2010) evaluated the impact of financial innovation on demand for money using ARDL approach. They regressed real money ($M2$) on real income, interest rate and financial innovation constructed by taking broad money to reserve money ratio. Anwar & Asghar (2012) tested the stability of money demand function utilizing ARDL approach. The estimated equation consisted of narrow money (M1) and broad money (*M2*), real income, inflation rate and exchange rate. Faridi & Akhtar (2013) also employed the same approach for estimating money demand function for Pakistan from 1972-2011. They regressed narrow and broad monetary aggregates on real income, interest rate, financial innovation, exchange rate and total population. Sarwar *et.al.,* (2013) were mainly interested in examining the stability of money demand function based on official monetary aggregates namely reserve money (M_0), narrow money ($M1$) and broad money ($M2$). They employed Johansen & Juselius (1990) co-integration approach for examining the effect of income, interest rate and financial innovation[7] on all three monetary aggregates. They found $M2$ as most stable money demand function and concluded that monetary authorities in Pakistan instead of targeting interest rate should target broad monetary aggregates for achieving desired results.

The above discussion shows that opportunity cost along with some scale variables and macroeconomic variables linking domestic economy with foreign economy are used as determinants of money demand in Pakistan. Opportunity cost variables included Treasury bill rate, interbank call money rate, deposit interest rate and bond rate. The scale variables used in the empirical literature on money demand in Pakistan are nominal income, nominal permanent income, real income, real permanent income, real sales and industrial production. The variables employed for evaluating the effect of disturbances in rest of the world are black market exchange rate, real exchange rate, real effective exchange rate, and foreign interest rate. Other variables included in the estimation of money demand function for Pakistan are inflation, expected inflation, price dual of divisia, financial innovation and total population. The methods employed in estimation of real money demand for Pakistan are ordinary least square, Johansen co-integration, autoregressive distributed lag models and Box-Cox methodologies. Furthermore, all studies except Sarwar *et.al.,* (2013) have used M_0, $M1$ and $M2$ to denote monetary aggregates. Sarwar *et.al.,* (2010) on the other hand, used divisia type weighted aggregate instead of simple sum official aggregates for M_0 $M1$ and $M2$. It is evident that none of these studies has examined the effect of exchange

[7] Sarwar *et.al.,* (2013) constructed financial innovation by subtracting currency in circulation from ($M2$) and divided the result with GDP, that is $M2 - CC / GDP$. Subtraction of currency circulation (CC) $M2$ from gives the money within the banking system and the ratio of this difference to GDP yields the efficiency of banking system.

rate changes on demand for real money in Pakistan for flexible exchange rates alone. This study bridges that gap and evaluates the effects of exchange rate changes on demand for real money balances in Pakistan and for recently adopted fully flexible exchange rate regime.[8]

METHODOLOGY

We employ Johansen (1988) and Johansen & Juselius (1990) co-integration approach for determining which monetary aggregate has long run relationship with its determinants. This approach allows us to examine the question of co-integrating vectors and test their number in multivariate system. In addition all variables are endogenous so results remain invariant with respect to normalization of co-integrating vector.[9] Johansen (1988) and Johansen & Juselius (1990) is a maximum likelihood procedure that uses two test statistics for testing the number of co-integrating vectors and provides estimates of the co-integrating vector that exists among variables of interest. These test statistics are trace and maximum Eigen value and are given as:

$$\lambda_{trace} = -2LnQ = -T\Sigma_{i=r+1}^{N} Ln(1-\lambda_i) \quad (1)$$

and

$$\lambda_{\max} = -2LnQ = -TLn(1-\lambda_{r+1}) \quad (2)$$

Trace and maximum Eigen refers to trace and maximum eigen value test statistics. Trace test tests the null hypothesis that there are r or fewer co-integrating vectors against the general alternative. Maximum Eigen value test, on the other hand, tests the null hypothesis that $r = 0$ against the alternative hypothesis that $r \leq 1$.

RESULTS

Before estimating long run relationship, we examine time series prosperities of set variables used in the estimation. We employ

[8] Pakistan adopted fully flexible exchange rate system in July, 2000 (Hyder & Mahboob, 2005)

[9] See Bahmani-Oskooee & Shabsigh (1996) for detailed discussion on Johansen (1988) and Johansen & Juselius (1990) co-integration approach.

Augmented Dicky Fuller test for testing integrating order of a time series x_t and is formulated as:

$$\Delta x_t = \alpha + \beta_1 T + \beta_2 x_{t-1} + \sum_{i=1}^{k} \gamma \Delta x_{t-i} + u_t \qquad (1)$$

Where Δ is the first difference operator, T is the trend term, x_t is logarithm of the variable being tested and u_t is a white noise error term. α, β_1, β_2 and γ are the parameters to be estimated. We test whether β_1 is zero and calculate ADF test by dividing β_2 with it standard error. The null that x_t is non-stationary is not rejected if the calculated ADF test is greater than critical value. Table 1 show ADF test results in levels and first difference with intercept and intercept and trend.

Comparing calculated ADF test statistics with McKinnon (1996) critical values given in the footnote show that all variables except m_{1t} and y_t are non-stationary in level. m_{1t} and y_t on the other hand are trend stationary even in levels. First difference ADF results demonstrate that the null of unit root is rejected for all variables except m_{2t} which is only trend stationary. Hence we conclude unit root in all variables in levels and stationary at first difference. Since all variables are non-stationary in levels and stationary at first difference in at least one specification therefore the use of Johansen & Juselius approach in examining the number of co-integration vectors among the variables of interest is appropriate.

TABLE-1

STATIONARY TEST OF EACH VARIABLE USING ADF TEST

Variable	Level		1st-difference	
	Intercept	**Intercept & Trend**	**Intercept**	**Intercept & Trend**
i_t	-1.497189(2)	-1.94859(2)	-3.542197(1) [a]	-9.216752(0) [a]
m_{1t}	-0.381467(3)	-6.66088(0) [a]	-5.843097(2) [a]	-5.665425(2) [a]
m_{2t}	-2.013780(1)	-1.267936(1)	-2.805619(0)	-3.836734(3) [a]
$neer_t$	0.712943(2)	-1.048844(2)	-4.924980(1) [a]	-5.097281(1) [a]
y_t	-1.026683(3)	-5.619717(0) [a]	-4.932724(2) [a]	-4.853040(2) [a]

Note: Numbers inside the parenthesis are the number of lags in the ADF Test. a denotes the significance of the test statistic at 5% critical level. The McKinnon (1996) critical values at 5% significance level for the ADF test that includes intercept and intercept and trend are -2.938987 and -3.529758 respectively.

We have to decide about the number of lags before employing Johansen & Juselius co-integration approach. Instead of relying on some information criterion for choosing lag length, we follow the literature and use four lags due to quarterly data. Table-2 demonstrates the results for λ trace and λ –max for the number of r co-integrating vectors.

TABLE- 2

CO-INTEGRATION RESULTS (WITH INTERCEPT AND LINEAR TREND) WHERE r = NUMBER OF CO-INTEGRATING VECTORS

Variables in CI vector	H_0	H_a	λ_{max}	5% critical values	Trace	5% critical values
m_{1t}, i_t, y_t	$r = 0$	$r = 1$	19.60474	21.13162	32.48572	29.79707
	$r \leq 1$	$r = 2$	10.27015	14.26460	12.88098 [a]	15.49471
	$r \leq 2$	$r = 3$	2.610828	3.841466	2.610828	3.841466
$m_{1t}, i_t, y_t, neer_t$	$r = 0$	$r = 1$	24.21556	27.58434	48.53429	47.85613
	$r \leq 1$	$r = 2$	15.54504 [a]	21.13162	24.31874 [a]	29.79707
	$r \leq 2$	$r = 3$	8.127410	14.26460	8.773686	15.49471
	$r \leq 3$	$r = 4$	0.646276	3.841466	0.646276	3.841466
$m_{2t}, i_t, y_t, neer_t$	$r = 0$	$r = 1$	22.53734	27.59434	47.45476	47.85613
	$r \leq 1$	$r = 2$	13.85690	21.13162	24.91743	29.79707
	$r \leq 2$	$r = 3$	8.613564	14.26460	11.06052	15.49471
	$r \leq 3$	$r = 4$	2.446958	3.841466	2.446958	3.841466

Note: a denotes that the null of no co-integration is rejected for the first time at 95% significance level.

First consider the co-integrating vector of m_{1t}, i_t and y_t. Table 2 shows that the null of no co-integration cannot be rejected by λ-max as its calculated value is lower than critical value at 95% level. On the other hand, calculated λ trace is greater than critical value suggesting that null of no co-integration is rejected. However, the null of least one co-integration cannot be rejected.

Next consider the co-integrating vector that includes m_{1t}, i_t, y_t and $neer_t$. Both calculated λ trace and λ-max are greater than 95% critical values. These larger than critical values indicate the null of one co-integrating vector among m_{1t}, i_t, y_t and $neer_t$ cannot be rejected. However, in the co-integrating vector that includes m_{2t}, i_t, y_t and $neer_t$, none of the calculated statistic is greater than critical value. These smaller than critical values, suggest that null of no co-integrating vector among these variables cannot be rejected. Although there is empirical evidence of at least one co-integrating relationship among m_{1t}, i_t and y_t, yet this evidence is supported only by λ trace test statistic. λ-max, on the other hand does not support co-integration among these variables.[10] However, when nominal effective exchange rate is added to m_{1t} as its determinant, both statistics reject the null of no co-integration and support evidence of at least one co-integration.

The estimates of co-integrating vectors are reported in table 3 to know the magnitude of elasticity's. We normalize the estimated co-integrating vectors by setting the estimate of real money balances to -1. This enables us to express the estimated co-integrating vectors in terms of real money demand function. First consider co-integrating vector m_{1t}, i_t and y_t. Table 3 shows that real income estimate is positive which confirms theoretical prediction that an increase in real income results increase in demand for real money balances. The estimated interest rate coefficient, on the other hand is positively signed which contradicts with theoretical prediction that an increase

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[10] Enders (2010) suggest maximum Eigen value statistic for testing the number of co-integrating vectors due to its strong alternative hypothesis compare to trace statistic.

in the opportunity cost of holding money reduces demand for real money balances. Now have a look on the co-integrating vector that includes m_{1t}, i_t, y_t and $neer_t$. Table 3 demonstrates that addition of nominal effective exchange rate as determinant of real money balances in regression equation results correctly signed estimates for both interest rate and real income. However, the responsiveness of real money balances to changes in interest rate has reduced (-0.02). The smaller estimate of interest rate suggests that it will take larger changes in interest rate for bringing desired changes in m_{1t} if it is used as monetary target. The estimate of real income has substantially increased. The estimate of nominal exchange rate is positive. Since nominal exchange rate is defined as number of units of foreign currency per unit of domestic currency. Hence positive estimate of nominal effective exchange rate could be an indication of substitution effect. This can be interpreted that market participants increase their demand for real money balances as domestic currency appreciates.

TABLE-3

CO-INTEGRATING VECTORS NORMALIZED ON m_{1t}

Vector	m_{1t}	i_t	$neer_t$	y_t	C
1	-1.00	0.032	-	2.984	0.246
2	-1.00	-0.002	0.472	3.542	2.839

Results from vector error correction model are reported in Table-4. The error correction term is negatively signed and shows high speed of adjustment of monetary aggregates towards their equilibrium level.

TABLE-4
SUMMARY RESULTS FROM VECTOR ERROR CORRECTION MODEL (VECM) AND DIAGNOSTIC TESTS

Panel A VECM Results				
	Δm_{1t}	Δi_t	$\Delta neer_t$	Δy_t
ecm(-1)	-5.3552 (-3.446)	0.239 (0.144)	0.054 (0.397)	0.034 (0.197)

Panel B Diagnostic Tests		
Serial Correlation LM Test		
Lags	LM-Statistic	Probability
1	10.61979	0.8323
2	13.89670	0.6064
3	18.35787	0.3034
4	19.50513	0.2433
JB Normality Test	7.277164	0.0263
χ^2_{Hetero}	345.2153	0.4112

***Note*:** χ^2_{Heter} is a chi square test for heteroscedasticity. ecm refers to error correction term.

Residuals diagnostic results given in panel B of table 4 suggest the absence of serial correlation and heteroscedasticity. However, the null of normal distribution of residuals cannot be rejected due to low probability of obtaining Jarque Berra estimate.

CONCLUSION

In this paper, we examined the determinants of demand for real money balances in Pakistan for recently adopted flexible exchange rate using Johansen & Juselius co-integration and vector error correction approach. The results show the presence co-integrating relationship among m_{1t}, interest rate and real income yet the interest rate estimate is wrongly signed in co-integrating space. However, when nominal effective exchange rate is added as m_{1t} determinant, the results provide evidence of co-integrating relationship and all parameters confirm their theoretical predictions. However, the results for broader monetary aggregates (m_{2t}) do not support presence of co-integrating relationship. The positive nominal effective exchange rate estimate in (m_{1t}) equation shows that people increase their demand for narrow monetary aggregates as domestic currency appreciates in foreign exchange market. The implication is that since Pakistan economy is well integrated with rest of the world. The effects of foreign disturbance are transmitted into domestic economy through foreign interest rate and exchange rate. In such circumstances, monetary authorities should consider exchange rate as valid determinant of m_{1t} if it is used for monetary targeting.

APPENDIX-A

All data are quarterly from 2000Q1 to 2010Q2 period and is taken from International Monetary Fund *International Financial Statistic*. The variables are defined as:

Real M1: It is defined as $(M1/P)*100$. Seasonally adjusted nominal *M1* is used for generating this variable.

Real M2: refers to *M1* plus quasi money. We have generated this variable by deflating seasonally adjusted *M2* with consumer price index and multiplying by 100. That is *M2* = $(M2/P)*100$.

Nominal interest rate refers to interbank call money rate.

Nominal effective exchange rate is defined as number of units of foreign currency per unit domestic currency.

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