Demand for money and exchange rate: Evidence for wealth effect in India

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Abstract

External factors such as variations in exchange rates should, to some extent, affect the composition of optimal money holdings. It was Robert Mundell who proposed the idea that demand for money could depend on the exchange rate in addition to the income and interest rate. Changes in exchange rate may have two effects on the demand for domestic currency, wealth effect and currency substitution effect. The main objective of this paper is to examine the effects of exchange rate on domestic demand for money in India covering the period of 1998Q1 to 2009Q4. The statistical and time series properties of each and every variable are examined using the conventional unit root test and utilizes Johansen-juselius cointegration analysis to test for the existence of a long run relationship between the determinants and the error correction from the long rum money demand is then used. The results shows a little evidence for the basic contention that exchange rates have a significant influence on money demand and increase in exchange rate not results in reduced domestic demand for money in India.

Keywords

Cointegration and Error correction, Demand for money, Exchange rate, India, Substitution effect and Wealth effect.

JEL: E41, F41

Introduction

The year 1990s witnessed an upsurge in international capital flows the world over in general and in India particular. This was due to several components such as financial liberalization and innovations, permeably of information technology and germination of institutional investors. Up till 1973, the Indian rupee pursued a fixed exchange rate regime wherein the rupee was pegged to the pound sterling. With the breakdown of the Bretton Woods system in the early 1970s, India switched over to a system of managed floating exchange rates in March 1992. The exchange rate in India under the current regime is by and large market determined. The floating of major world currencies in the early seventies initiated an empirical trend towards analysis of the role of exchange rates in demand for money. Much of this research has focused upon experiences of industrialized countries while similar evidence in a developing country setting is relatively sparse. There have been growing efforts among economists to revise the conventional closed-economy specification of demand for money to take into account the impact of exchange rate. External factors such as variations in foreign exchange rates should, to some extent, affect the composition of optimal money holdings. The precursor of this study was the work of Mundell (1963). In 1963 the Nobel laureate Robert Mundell proposed the idea that demand for money could depend on the exchange rate in addition to the income and interest rate. Though Mundell was the first to introduce this proposition, he did not have any empirical proof that justified his theory.

Changes in exchange rate may have two effects on the demand for domestic currency, wealth effect and currency substitution effect. Assume that wealth holders evaluate their asset portfolio in terms of their domestic currency. Exchange rate depreciation would increase the value of their foreign assets held and hence be wealth enhancing. To maintain a fixed share of their wealth invested in domestic assets, they will repatriate part of their foreign assets to domestic assets, including domestic currency. Hence, exchange rate depreciation would increase the demand for domestic currency. On the other hand, exchange rate movements may generate a currency substitution effect, in which investors' expectation plays a crucial role. If wealth holders develop an expectation that the exchange rate is likely to fall further following an initial depreciation, they will respond by raising the share of foreign assets in the portfolio. Currency depreciation in a sense means higher opportunity cost of holding domestic money, so currency substitution can be used to hedge against such risk. In this regard, exchange rate depreciation would decrease the demand for domestic money.

There is conflicting evidence in empirical studies on the relationship between exchange rate and demand for money. No consistent and commensurate conclusion emerges for these studies. The main objective of the paper is to examine the effects of exchange rate on domestic demand for money in India.

Literature Review

There is a diverse spectrum of money demand theories which address a broad range of hypotheses. For the classical economists, the quantity of money provided an explanation of movements in the price level: movements in the price level result solely from changes in the quantity of money. Then, the Cambridge economists explicitly stressed the demand for money as a public demand for money holdings and formally established the relationship between the demand for real money and real income. The Keynesian theory further developed the money demand theory based on the three motives that prompt people to hold money and introduced the role of interest rates in determining the demand for real money balances. The post-Keynesian theories, starting with the inventory-theoretic approach, emphasized the transactions costs under certainty while the precautionary demand for money approach introduced the concept of uncertainty. The buffer stock models or portfolio approach evaluated the demand for money under the portfolio optimization framework. Lastly, the consumer demand theory analyzed the demand for money under the utility maximization framework. Having provided a comprehensive theoretical review, it can be concluded that these diverse demands for money theories share common important scale variables. They establish a relationship between the quantity of money demanded and a set of economic variables.

Studies Support Substitution Effect Argument

Arango, Sebastian and M Ishaq Nadiri (1981) study for Canada, Germany, the U.K., and the U.S. found that, in all cases exchange rates exert a statistically significant negative effect on the demand for money balances. Darrat's (1984), and Ghamdi (1989) studies found that exchange rate along with foreign interest rate have significant negative effect on the demand for money function in Saudi Arabia. Bahmani Oskooee and Malixi (1991) assessed whether a change in exchange rate has any impact on the demand for money in thirteen developing nations, their estimates shows that, in the long run a changes in real exchange rate has a significant negative effect on the demand for money function in nine out of eleven cases.

James M. Mcgibany and Farrokh Nourzad (1995) analyzed the effect of changes in the level and volatility of exchange rates on the demand for money in US. His basic contention that a depreciation and an increased exchange rate volatility results in reduced domestic demand for money. Omar Marashdeh (1997) estimated the demand for money in Malaysia and indicated the presence of currency substitution in Malaysia. Mohsen Bahmani-Oskooee (2002) examined the long-run demand for money of Hong Kong and confirmed that currency depreciation would reduce the demand for domestic currency. Parvez Azim, Nisar Ahmed,Sami Ullah, Bedi-uz-Zaman.Muhammad Zakaria (2010) estimated the demand for money in Pakistan. The results showed that income and inflation variables are positively associated with money demand while exchange rate negatively affects money demand. The negative effect of exchange rate on money demand supports the theoretical expectation that as domestic currency depreciates the demand for domestic currency declines.

Studies Support Wealth Effect Argument

Bahmani-Oskooee and Pourheydarian found a positive and statistically significant relationship between demand for real Ml balances and the actual exchange rate for Canada and the U.S. but not for Japan. M. Azali, Ahmad Zubaidi Baharumshah & Muzafar Shah Habibullah (2001) empirically investigates the long-run relationship between exchange rate and money demand in Malaysia. In their analysis the exchange rate showed a positive sign. Sharifi Renani and Hosein (2007) estimated the demand for money in Iran; their results revealed that income and exchange rate are positively associated with M1 while inflation negatively affects M1. The positive effect of exchange rate on M1 indicates that depreciation of domestic money increases the demand for money, supporting the wealth effect argument.

Study	Data	Methodology and variable	Substitution effect/ wealth effect
James M. Mcgibany and Farrokh Nourzad (1995)	1974.Q1-1990.Q4 USA	ECM & PAM RM, TB,E, VE,R	Currency Substitution Effect
Omar Marashdeh (1997)	1980:M1-1994:M10 Malaysia	Cointegration & ECM RM, RGDP, E, R, π	Currency Substitution Effect
Mohsen Bahmani-Oskooee (2002)	1985Q1-1999Q4 Hong Kong	ARDL RM,RGDP,R,FR,E	Currency Substitution Effect
Parvez , Nisar , Sami Ullah, Zaman, Zakaria (2010)	1973-2007 Pakistan	ARDL RM, RGDP, π, E	Currency Substitution Effect
Bahmani-Oskooee and Pourheydarian	1973.Q1-1987.Q4 Canada, US, Japan	RM,RGDP,E	Wealth effect for Canada and US &Currency Substitution Effect for Japan
M. Azali, Ahmad Zubaidi Baharumshah & Muzafar Shah Habibullah (2001)	1987:Q1-1998:Q2 Malaysia	LR test M1,M2, GDP, TB, NE	Wealth effect
Sharifi Renani and Hosein (2007)	1985:Q3-2006:Q1 Iran	ARDL M1,GDP, π, E	Wealth effect

RM=real money, RGDP= real GDP, TB=Treasury bill rate, E=Real Exchange rate, NE= foreign interest rate, ARDL= Auto regressive distributive Lag model, ECM= error correction model, PAM= partial adjustment model, LR= likely hood ratio test nominal exchange rate, VE=volatility of exchange rate, R=interest rate, π=inflation, FR=

Model, Data and Methodology

The general specification begins with the following functional relationship for the demand for money:

$$M/p=f(s,oc,e)$$

Where, the demand for real balances (M/P) is a function of the chosen scale variable(s) to represent the economic activity and the opportunity cost of holding money (oc) and exchange rate (e). Presently, economic theory does not state the correct mathematical form of the demand for money function. Although there are several functional forms of specifying money demand function, there is general consensus that the log linear version is the most appropriate functional form because it performs better than the other forms and it allows for interpretation of coefficients of variables in logarithms as elasticities.

In order to investigate the effects of exchange rate on domestic demand for money in India, the following data are used. The data used in this study are cumulated from various secondary sources. The variable such as Broad money (M3), wholesale price index (WPI) and real Gross domestic product, real effective exchange rate (REER) are collected from Centre for Monitoring Indian Economy data base. The data collected over a period of 1998Q1 to 2009Q2. The WPI estimated 1993-94 constant prices, whereas GDP is estimated on the basis of 1999-00 constant price. To investigate the above issue the study uses the logarithmic transformation 46 quarterly observations. The choice of sample period is due to the availability of data and coverage of floating exchange rate regime.

We start with a standard money demand function in which real money balances, M/P, are expressed as a function of real income, interest rate and exchange rate. We expect the estimate of income is expected to be positive; an estimate of interest rate is expected to be negative. The effect of exchange rates can be negative or positive.

$$\mathbf{Ln\ (M/P)_t = \alpha + ln\beta_0 Y_t + \beta_1 R_t + \beta_2 lnE_t + u_t} \qquad (1)$$

Where, M/P= real money, (M3/WPI), Y= Real gross domestic product (1999-00 constant price) R= interest rate on 3 year deposit, E= real effective exchange rate (6 country export based) and U= error term

Empirical Result

The first step of the strategy of our empirical analysis involves determining the order of integration of the series used in the analysis by applying unit root test. The key concept underlying time series process is that of stationarity. Most time series are trended and therefore in most cases are nonstationary. The problem with nonstationary or trended data is that the standard OLS regression procedure can easily lead to incorrect conclusion. A series of Augmented Dickey-Fuller unit root test is performed to determine the degree of integration of the variables.

Table shows the ADF test results for both at the level and the first difference on intercept and intercept and trend.

	Intercept only		Intercept and trend	
Variables	Level	First difference	Level	First difference
	Prob: value	Prob: value	Prob: value	Prob: value
Ln M3/wpi	0.9967 (3)	0.0001(2)	0.9746 (3)	0.0003(3)
Ln Y	0.9859(1)	0.0000(0)	0.4071(0)	0.0000(0)
Ln E	0.1178(2)	0.0002(0)	0.9746(3)	0.0003(2)
R	0.7813(0)	0.0001(0)	0.7813(0)	0.0005(0)

(Numbers in parenthesis are the number of lags)

The reported result in table reveals that the hypothesis of a unit root can't be rejected in all variables in levels. However, the hypothesis of a unit root is rejected in first differences at 0.05 level of significant which indicates that all variables are integrated of degree one, I(1). That means all the variables achieve stationarity only after first differencing.

The next step in our empirical analysis is to test for cointegration. Since the variables are considered to be I(1), the cointegration method is appropriate to estimate the long run demand for money. The concept of cointegration is that non-stationary time series are cointegrated if a linear combination of these variables is stationary. The cointegration requires the error term in the long-run relation to be stationary. Suppose there are two variable Y_t ad X_t and both Y_t and X_t follows I (1) process, Still the linear combination $U_t=Y_t - \alpha X_t$ is I (0). If so, both Y_t and X_t are said to be cointegrated and *a* is the cointegrating parameter. The maximum likelihood approach to test for cointegration is based on the following system of equations

$$\Delta x_t = \pi x_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta x_{t-i} + \varepsilon_t$$

The number of independent cointegrating vector is equal to the rank of matrix π, If rank of $\pi = 0$; then π is a null matrix and equation turns out to be a VAR model, whereas If rank of $\pi = 1$, there is one cointegrating vector and πx_{t-1} is an error correction term. Johansen suggests that it can be done by testing the significance of characterizes roots of π.

Suppose that π is a 3x3 matrix and the ordered characteristics roots are $\lambda_1 > \lambda_2 > \lambda_3$

If rank of $\pi = 0$ then $\lambda_i = 0$; hence, $\ln(1 - \lambda_i) = 0$ whereas, If rank of π = unity then $0 < \lambda_1 < 1$ and $\ln(1 - \lambda_1)$ will be negative and the rest $\ln(1 - \lambda_2) = \ln(1 - \lambda_3) = 0$

Johansen suggests two test statistics to test the null hypothesis that numbers of characteristics roots are insignificantly different from unity.

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

λ_i = estimated characteristic roots or Eigen values

T = the number of usable observations

λ_{trace} test the null hypothesis

$r = 0$ against the alternative of $r > 0$

$\lambda_{\max}$ test the null hypothesis

$r = 0$ against the alternative of $r = 1$

The theory expressed in equation (1) asserts that there exists a linear combination of this non-stationary that is stationary. Solving for the error term, we can rewrite the relation (1) as

$$\varepsilon_t = M/p_t - \alpha - \beta_0 y_t - \beta_1 r_t - \beta_2 e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Since $\{\varepsilon_t)$ must be stationary, it follows that the linear combination of integrated variables given by the right hand side of must also be stationary. ADF test for residual of the cointegrating regression reveals that the null hypothesis can be rejected at 0.05 level of significance, and the variable (ε_t) is stationary of degree zero I(0).

The criterion for selecting the lag length consist an important step. There are different tests that would indicate the optimal number of lags. The study utilizes the SC criterion to ensure sufficient power of the Johansen procedure.

Johannsen Cointegration Result

Sample adjusted 1998Q4-2009Q2				
Unrestricted cointegration Rank test (Trace)				
Hypothesized No of CE(s)	Eigen Value	Trace statistics	5 percent critical value	Porb.**
r=0*	0.521476	54.79789	47.85613	0.0097
r≤1	0.233246	23.10480	29.79707	0.2409
r≤2	0.142192	11.68449	15.49471	0.1727
r≤3*	0.111622	5.089383	3.841466	0.0241
Unrestricted cointegration Rank test (Maximum Eigenvalue)				
Hypothesized No of CE(s)	Eigen Value	Max-Eigenvalue statistics	5 percent critical value	Porb.**
r=0*	0.521476	31.69309	27.58434	0.0140
r≤1	0.233246	11.42031	21.13162	0.6054
r≤2	0.142192	6.595103	14.26460	0.5381
r≤3*	0.111622	5.089383	3.841466	0.0241

(denotes the rejection of the hypothesis at the 0.05 level. And ** are Mackinnon-Hauge-Michelis (1999) p-values.)*

Normalized cointegration coefficients			
M3SA	Y	E	R
1.0000	1.3279(0.0485)	0.37204(0.20547)	-0.166449(0.0401)

(Standard error in parenthesis)

The above table shows that the null hypothesis of no cointegration is rejected at the conventional level (0.05) and the study conclude that there exists a relationship among the proposed variables in the long run. Both Trace and Eigen value test indicates that there is at least one linear combination in the long run, and hence, there is a long run equilibrium relationship between variables in the model. The cointegration equation is depicted in above table which reveals that the GDP and real effective exchange has a positive effect on the demand for money supporting wealth effect argument. On the other hand, the 91 days Treasury bill rate has a negative effect on the demand for money.

The Dynamic Short Run Relationship (ECM)

By specifying the long run demand for money in an error correction model, the short run as well as the long run effects of all right hand side variables in equation (1) are estimated in one step, which is a major advantage that error correction modeling has in comparison to other estimation.

The dynamic relationship includes the lagged value of the residual from the cointegrating regression (ε_{t-1}) in addition to the first difference of variables which appear in the right hand side of the long run relationship (real income, interest rate and exchange rate). The inclusion of the variables from the long run relationship would capture short run dynamics. Therefore, the dynamic relationship is stated as follows

To start, we define the error correction term by

$$\varepsilon_t = M/p_t - \alpha - \beta_0 Y_t - \beta_1 R_t - \beta_2 E_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

β_0, β_1,β_2 are cointegrating coefficient $\varepsilon_{t=}$ the error from a regression of M/p_t on Y_t, R_t and E_t.

The ECM simply defined as

$$\Delta M/p_{t=} \alpha\varepsilon_{t-1} - \beta_0 \Delta Y_t - \beta_1 \Delta R_t - \beta_2 \Delta E_t + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

The equation (3) says that Δ M/p_t can be explained by the lagged $\alpha\varepsilon_{t-1}$, ΔY_t, ΔR_t and ΔE_t, where, α and β are short run parameters. All the variable in the ECM are stationary, and therefore, the ECM has no problem of spurious regression.

Error correction	D(real money)	D(Y)	D(E)	D(R)
Coint Eq1	-0.16065	0.0747	-0.0142	-0.71067
Standard error	(0.078)	(0.087)	(0.0919)	(0.291)
t statistics	-2.0554	0.8542	-0.1544	-2.4346

The table shows the speed of adjustment coefficients, which reveals that only two variables are adjusting. The adjustment coefficient on cointegration equation 1 for the real money is negative, as it should be, but quite rapid 16% per quarter. The adjustment coefficient for Treasury bill rate is also negative, as it should be, but quite rapid 71% a quarter, and both adjusting coefficient are showing significant. But the estimated error correction model enjoys a very low goodness of fit.

Conclusion

In 1963, the Nobel Laureate, Robert Mundell was the first to propose the idea that the demand for money could depend on the exchange rate. The main reason behind his conjecture is that an appreciation of foreign currency, or a depreciation of domestic currency, raises the domestic currency value of foreign assets that are held by domestic residents. If this is perceived by people as an increase in wealth, the demand for domestic currency could rise. However, if the depreciation of domestic currency induces the expectation of further depreciation, the opposite effect would take place with the public deciding to hold more foreign currency and less domestic currency. In this paper, we argue that since exchange rate has a wealth effect, it could have a direct impact on the demand for money in India. The study utilizes Johansen-juselius cointegration analysis to test for the existence of a long run relationship between the determinants. The cointegrating regression so far considers only the long-run property of the model, and does not deal with the short-run dynamics explicitly. Clearly, a good time series modeling should describe both short-run dynamics and the long-run equilibrium simultaneously. For this, the error correction from the long rum money demand is then used as a dynamic model to estimate the shoot run money demand. Having controlled for the effect of other factors, we found a little evidence for our basic contention that exchange rates have a significant influence on money demand and increase in exchange rate not results in reduced domestic demand for money in India. The positive effect of exchange rate on M1 indicates that depreciation of domestic money increases the demand for money, supporting the wealth effect argument, an increase in exchange rate raises the value of the foreign asset in terms of domestic currency.

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