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THE DEMAND FOR INTERNATIONAL RESERVES: A CASE STUDY OF INDIA

MOHAMMAD KASHIF
RESEARCH SCHOLAR
DEPARTMENT OF INTERNATIONAL BUSINESS
SCHOOL OF MANAGEMENT
PONDICHERRY UNIVERSITY
KALAPET, PUDUCHERRY

DR. P. SRIDHARAN
ASSOCIATE PROFESSOR
DEPARTMENT OF INTERNATIONAL BUSINESS
SCHOOL OF MANAGEMENT
PONDICHERRY UNIVERSITY
KALAPET, PUDUCHERRY

ABSTRACT

Global international reserve holdings have accelerated sharply in recent years. Among top ten major reserves holders, India comes on eighth position as on March 2016. Developing countries particularly India is in line to hoard international reserves. This study uses autoregressive distributed lag (ARDL) approach to estimate India's demand for international reserves for quarterly period of 1985Q1-2014Q4. Our results suggest that the India's demand for international reserves is mainly determined by trade openness and propensity to import. Our study shows that demand for reserves in India is highly sensitive to current account vulnerability and less sensitive to the economic growth.

KEYWORDS
India, international reserves, unit root, cointegration.

1. INTRODUCTION

A country accumulates international reserves to finance external payment imbalances, intervening in international capital markets and secure a buffer to cushion the economy against financial crises. International reserves are "Those external assets that are readily available to and controlled by monetary authorities for direct financing of payment imbalances through intervention in exchange markets to affect the currency exchange rate, and/or for other purposes" (Balance of Payments Manual, [International Monetary Fund], 2014). International reserves or foreign exchange reserves are a country's external assets that include gold, Special Drawing Rights (SDRs), foreign currency deposits and bonds held by monetary authorities, gold and reserve position at the IMF. The top ten holders of international reserves account for nearly two-thirds of the world's total international reserves. Most of them are from Asia. China, with USD 3.2 trillion as on March 2016, tops the list. Ten years ago it had only USD 822 billion. Second is Japan with USD 1.2 trillion at the end of 2015. The list is going on but India comes on eighth position with nearly USD 361 billion as on March 2016.

Research on international reserves was started during 1960s particularly when Heller (1966) presented the estimations of the optimum level of international reserves by comparing marginal cost to marginal benefit. As strong justification to hold reserves have been provided it is important to analyse the determinants of international reserves. The issue of the determination of reserves has broadly been discussed in the literature (see Heller, 1966; Frenkel and Jovanovic, 1981; Lane and Burke, 2001; Flood and Marion, 2001; Irefin and Yabaa, 2012; Grubel, 1971; Kenen and Yudin, 1965); Kelly, 1970; Frenkel, 1974; Heller and Khan, 1978; Clark, 1970; Ben-Bassat and Gottlieb, 1992; Chin-Hong et al., 2011; Claassen, 1975; Courchene and Youssef, 1967; Edwards, 1983; Huang and Shen, 1999; Lizondo and Mathieson, 1987; Landell-Mills, 1989; Lane and Burke, 2001; Aizenman and Marion, 2002; Eichengreen and Mathieson, 2000; IMF, 2003; Romero, 2005; Malathy and Madhumati, 2007; Obstfeld et al., 2008, 2009; Prabheesh et al., 2007; Shegal and Chandan, 2007 and Gantt, 2010). They were able to get some explanatory variables as determinants of international reserves through empirical research. The determinants of reserves holding reported in the literature can be grouped into five categories: economic size of economic growth, current account vulnerability, capital account vulnerability, exchange rate flexibility, and opportunity cost. 'Buffer stock model' is largely used among all these models. The model suggests that monetary authorities hold international reserves as a buffer to control variations in external payment imbalances. This model has been remained as applicable in floating exchange regime as it was during the Bretton Woods regime.

Badinger (2002) stated that the conventional theory of reserves demand have some deficiencies. First, it assessed the demand in separation from the domestic money market, thus neglecting the importance of monetary approach to balance of payments. Second, it confronted the spurious regressions because nearly all studies estimated the demand for reserves employing Ordinary Least Squares or two stage least square methods. Third, the studies analysed the cross-sectional data, thereby neglecting the institutional characters of individual economies. This paper is an endeavor to overcome most of these issues to determine international reserves demand function for India making use of the Autoregressive Distributed Lag (ARDL) approach.

The rest of the paper is organized as: After this introduction, section 2 presents relevant literature review, section 3 provides need for the study; section 4 objectives of the study, section 5 research methodology, section 6 results and discussion, section 7 findings and conclusion in Section 8 following the limitations in section 9.

2. LITERATURE REVIEW

Talahite and Beji (2013) addressed the issue of international reserves in India and Tunisia and provided some possible alternative policy to the accumulation of international reserves. Chin-Hong et al. (2011) examined the determinants of international reserves in Malaysia applying cointegration technique proposed by Johansen and Juselius (1990) over the period spanning from 1975 to 2007. They found that international reserves and the specified determinants have long run relationship. The economic size and opportunity cost had respectively positive and negative relationship to the reserves. Irefin and Yabaa (2012) estimated Frenkel and Jovanovic's buffer stock model in case of Nigeria using Autoregressive Distributed Lag Approach (ARDL) proposed by Pesaran et al. (2001) over the period 1999Q1-2011Q2. They found that monetary policy rate, exchange rate, income and imports had a long run relationship to international reserves. Khan et al. (2005) analysed Pakistan's reserves demand function deploying cointegration technique and error correction model over the period 1982Q1 to 2003Q2. They set up a stable long-run reserves demand in Pakistan. The long run reserves policy of Pakistan appeared to be determined by foreign trade, volatility of balance of payments and opportunity cost of holding reserves.

Dash and Narayanan (2010) examined the relationship among trade flows, exchange rate and demand conditions in terms of their impact on international reserves in India using multivariate cointegration technique developed by Johansen (1995) and vector error correction model on monthly data over the period 1994:Jan-2008:Oct. Their study found that a long run and significant relationship existed among exports, world exports and real effective exchange rate. The study suggested

that a minimum amount of reserves was desirable as a precautionary motive. Shegal and Chandan, (2007) analyzed international reserves demand in a co-integration-error correction framework for India. Their study has utilized quarterly data from 1990Q2 to 2006Q1. They employed Gross domestic product, money supply, short run external debt, Portfolio investment and variability in the balance of payment as independent variable whereas international reserves as dependent one. They estimated most of the variables had significant influence on international reserves in India. The study suggested that India hold international reserves mainly for precautionary purpose. Chakravarty (2009) assessed buffer stock model for foreign reserves demand in Indian context assuming high capital mobility and exchange rate flexibility. He employed Autoregressive Distributed Lag Approach (ARDL) and volatility of international transactions, opportunity cost, exchange rate flexibility and some scale variables as independent variables whereas international reserves minus gold as dependent one. He used a different volatility measure i.e. export receipts volatility. Their findings showed that the demand for international reserves was related positively to international transaction volatility and a scalar variable while opportunity cost exhibited negative relationship. However, he couldn't show flexibility of exchange rates a significant variable impacting reserves demand of Indian economy.

Aizenman and Marion (2002) compared the demand for foreign exchange reserves in the Far-East with the developing economies. They found that accumulation of international reserves is the result of many economic factors like volatility of international transactions, political considerations and exchange rate arrangements. After Asian financial-crisis in 1997, their model under predicted international reserve holdings. Their study proved that 'sovereign risk and costly tax collection to cover fiscal liabilities lead to a large precautionary demand in reserves'. Peter and Machiel (2004) stated that the objective of managing international currency reserves has changed from retaining liquidity to expand total profit. They recognized long-term local government bonds, international government bonds and equities as those investments which give high return. Frenkel (1978) stated that (MPI) i.e. marginal propensity to import determines openness to external shock of a country and hence it would exhibit positive relation with international reserves. Marginal propensity to import (MPI) was computed as the ratio of imports to GDP. He concluded that "optimal reserve holdings would increase as the volatility of reserves increased." He showed that reserves volatility was certainly a strong predictor of international reserve holdings.

3. NEED/IMPORTANCE OF THE STUDY

International reserves have lucid involvements for exchange rate stability. They have implications for financial markets and in short for overall economic activities. A continuous debate can be seen in the literature about the need to keep international reserves [see Aizenman & Marion (2002, 2002a)]. Participants have diverse views about reserve holdings. Some economists argue that international reserves are ineffective and unutilised as Friedman (1953) defied that under fixed exchange rate system international reserves remain unutilised. On the contrary, some economists argue that international reserves are essential to settle down the payment imbalances in balance of payment [see Kemal (2002)]. By accumulating large stocks of international reserves, monetary authorities can purchase national currency in international capital markets, to stabilize its value. In brief, international reserves play a crucial role for the economy. Keeping in mind these things, we empirically determine the demand for international reserves for India.

4. OBJECTIVES

We set the following objectives to determine the demand for international reserves for Indian economy:

- To determine international reserves demand function for India.
- To introduce autoregressive distributed lag (ARDL) approach to identify the determinants of international reserves.
- To suggest some policy implications to policy makers regarding financial policies for Indian economy.

5. RESEARCH METHODOLOGY

We used time series data of quarterly frequency for the period of 1985Q1-2014Q4. Our estimation process involves overall five variables namely total international reserves (IR), economic growth (Econ), vulnerability to external shocks (Imp), real effective exchange rate (Reer) and trade openness (Topen). Total international reserves is the dependent variable and rest are independents. According to IMF balance of payments manual, international reserves are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs; intervention in exchange markets to affect the currency exchange rate; and other related purposes. We use the definition of international reserves suggested by International Financial Statistics. International reserves comprise of- (i) Gold (ii) foreign currency deposits of the monetary authority (iii) Reserve position in the IMF (iv) Special Drawing Rights. We exclude gold from international reserves for the purpose of our analysis for three reasons. First, gold accounts for only 3 per cent of world reserves holding when evaluated at 35 SDRs per ounce. Second, gold holdings of developing economies are negligible. Third, there is concern whether monetary authorities consider gold as liquid as international currency holdings. Generally, central banks regard gold as 'the lender of last resort'.

Economic growth plays a crucial role in the determination of total international reserves. Economic growth is captured by real gross domestic product (GDP) for estimation purpose. Vulnerability to external shocks (Imp) is captured by total import of goods and services divided by real GDP. real effective exchange rate are taken in their real term and trade openness is proxied by sum of total export and total import of goods and services divided by real GDPAll figures used in this study (chapter) are in current US dollar. Data for all variables are obtained from the International Monetary Fund's *international financial statistics,* World Development Indicators of the World Bank and the database of OECD countries.

We develop following model relating total international reserves to some macroeconomic variables for India:

$$\mathbf{IR = \mathit{f}(Econ, Imp, Reer, Topen)} \quad (1)$$

The explicit form of this model is represented as under:

$$IR_t = \beta_0 + \beta_1 Econ_t + \beta_2 Imp_t + \beta_3 Reer_t + \beta_4 Topen_t + \varepsilon_t \quad (2)$$

All the variables were transformed into their logarithmic forms. Transformation is to avoid the situation in which the residuals may reflect multiplicatively accumulating errors or not normally distributed.The logarithmic form of our model will be:

$$Ln(IR)_t = \beta_0 + \beta_1 Ln(Econ)_t + \beta_2 Ln(Imp)_t + \beta_3 Ln(Reer)_t + \beta_4 Ln(Topen)_t + \varepsilon_t \quad (3)$$

Where IR is total international reserves minus gold, Econ is economic growth proxied by real gdp, Imp is propensity to import proxied by total import of goods and services divided by real gdp, Reer is real effective exchange rate in real terms and Topen is trade openness captured by sum of total export and total import of goods and services divided by real gdp. All terms are taken in current US dollar.

6. RESULTS AND DISCUSSION

In experiential research on the data that is time series in nature, generally the problem of unit root or non-stationarity arises. We employed Augmented Dickey Fuller (ADF) and Phillips Perron (PP) test to check stationarity of all the variables under study. Non-stationarity causes the conventional tools of econometrics such as ordinary least square (OLS) and two stage least square (2SLS) inappropriate. To avoid this problem, the co-integration technique has been proposed by Engle and Granger (1987); Johansen and Juselius (1990, 1992). The restriction for co-integration analysis is that all variables should be non-stationary at level and become stationary of the same order. The unit root tests available in the literature may be employed to determine order of integration. The results obtained from the available tests may differ based on power of the tests. This may produce a bias in selecting the unit root test which gives the same order of integration for each variable in the system. Another problem may arise also i. e., the variables under consideration may be integrated of different orders, which leaves the co-integration techniques useless. To avoid this problem, Pesaran and Shin (1999); Pesaran, Shin & Smith (2001) proposed a bounds testing autoregressive distributed lag (ARDL) approach which does not consider the order of integration. The ARDL approach can be applied to test any long run relationship despite of whether the variables become stationary at the same or different order. If any long-run relationship is found among the variables, we can assess long-run coefficients and corresponding lagged error correction term to understand the long-run effect of the variables and the speed of adjustment.

To capture the speed of adjustment, we can write equation (3) in an error correction format as:

$$\Delta \text{LnIR}_t = \beta_0 + \sum_{i=1}^{m} \beta_1 \Delta \text{LnIR}_{t-i} + \sum_{i=0}^{m} \beta_2 \Delta \text{LnEcon}_{t-i} + \sum_{i=0}^{m} \beta_3 \Delta \text{LnImp}_{t-i} + \sum_{i=0}^{m} \beta_4 \Delta \text{LnReer}_{t-i} + \sum_{i=0}^{m} \beta_5 \Delta \text{LnTopen}_{t-i} + \beta_6 \varepsilon_{t-1} + \mu_t \quad (4)$$

Pesaran, Shin & Smith (1999) develop a two step process to estimate equationn (3). First, the null hypothesis (H_0) of non-existence of long-run relationship among IR_t, $Econ_t$,Imp_t, $Reer_t$ & $Topen_t$ is defined by $H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0$. The approximate critical values for the F-statistics are obtained from Pesaran et. al (2001). Rejection of null hypothesis implies that a long-run relationship among IR_t, $Econ_t$,Imp_t, $Reer_t$ & $Topen_t$ exists. The relevant t-statistics to test the null hypothesis are the well-known F-statistics with critical values calculated by Pesaran et. al (2001). To apply the ARDL process, we model equation (3) as follows:

$$\Delta \text{LnIR}_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta \text{LnIR}_{t-i} + \sum_{j=0}^{p} \gamma_j \Delta \text{LnEcon}_{t-j} + \sum_{k=0}^{p} \gamma_k \Delta \text{LnImp}_{t-k} + \sum_{l=0}^{p} \theta_l \Delta \text{LnReer}_{t-l} + \sum_{m=0}^{p} \psi_m \Delta \text{LnTopen}_{t-m} + \lambda_1 \text{LnIR}_{t-1} + \lambda_2 \text{LnEcon}_{t-1} + \lambda_3 \text{LnImp}_{t-1} + \lambda_4 \text{LnReer}_{t-1} + \lambda_5 \text{LnTopen}_{t-1} + \varepsilon_t \quad (5)$$

Where, all variables are defined as before. Pesaran and Shin (1999); Pesaran et. al (2001) tabulated two sets of critical values. One set assumes all variables are I(1) and another assumes all variables are I(0). This provides a band covering all possible classifications of the variables into I(1) and I(0) or fractionally integrated. If the calculated F-statistic lies above the upper level of the band, the null is rejected indicating co-integration. If the calculated F statistic falls below the lower level of the band, the null cannot be rejected supporting lack of co-integration. If, however it falls within the band, the result is inconclusive.

7. FINDINGS

The findings of the study are provided as under:

7.1 UNIT ROOT TEST

In Table (1) we have presented Augmented Dickey Fuller (ADF) and Phillips Perron (PP) test statistics for all the variables. From the table we can see straightaway that based on these tests, Reer is stationary at level while the other four variables namely LnIR, LnEcon, LnImp, LnTopen are nonstationary at the same level showing the integration order of I(0) and I(1) respectively. These results restrict us from the use of the standard co-integration techniques developed by Engle & Granger (1987). In such case the ARDL bounds testing approach of Pesaran et. al (1999) is useful in testing for the long run relationships among the variables.

TABLE 1: UNIT ROOT TEST RESULTS

Variables	Augmented Dickey Fuller (ADF)		Phillips-Perron (PP)	
	Level	*1st difference*	*Level*	*1st difference*
LnIR	-1.13	-5.94***	-1.30	-5.94***
LnEcon	0.14	-3.32**	0.11	-4.78**
LnImp	-1.13	-3.13**	-1.54	-5.08***
LnReer	-3.36**	-7.82***	-2.86	-7.82**
LnTopen	-1.12	-3.11**	-1.41	-5.33***

*** and** denotes significant at 1% and 5% level.

7.2 CO-INTEGRATION

The bounds test for co-integration involves the comparison of the F-statistics against the critical values, which are extracted from Pesaran, Shin & Smith (1999), as explained earlier. Using equation (3), each variable in our model equation (2) is taken as a dependent variable in the calculation of the F-statistics. The calculated F statistics are provided in Table 2.

When international reserves is the dependent variable for India, the calculated F-statistic F_{IR} (IR/Econ, Imp, Reer, Topen) = 4.21 is higher than the upper bound critical value of 4.01 at the 5% significance level. However, when the rest of the variables in the model are taken as a dependent variable, the calculated F-statistic is lower than the lower bound critical value (2.86) at the 5% level. This suggests that the null hypothesis of no co-integration cannot be accepted for India and that there exists a unique co-integration relationship between international reserves and its determinants. In other words, we have established that international reserves, economic growth, propensity to import, real effective exchange rate and trade openness are co-integrated only when international reserves is the dependent variable.

TABLE 2: F-STATISTICS FOR COINTEGRATION

k	90% level		95% level		99% level	
	I(0)	*I(1)*	*I(0)*	*I(1)*	*I(0)*	*I(1)*
4	2.45	3.52	2.86	4.01	3.74	5.06
Calculated F-statistics:						
F_{IR} (IR/Econ, Imp, Reer, Topen) = 4.21						
F_{Econ}(Econ/IR, Imp, Reer, Topen) = 1.69						
F_{Imp}(Imp/Econ, IR, Reer, Topen) = 2.01						
F_{Reer}(Reer/Econ, IR, Imp, Topen) = 2.53						
F_{Topen}(Topen/Econ, IR, Reer,Imp) = 1.37						

Note: Critical values are extracted from Pesaran, Shin & Smith (1999); k is number of regressors.

7.3. LONG RUN AND SHORT RUN ESTIMATES

Having found a long-run relationship between international reserves and its determinants when international reserves is the dependent variable, we now estimate the long-run elasticities based on specification (2). The long run results are presented in Table 3. The model shows theoretically correct signs for the explanatory variables. Our results suggest that all the regressors except real effective exchange rate have a statistically significant effect on total international reserves. Interestingly, total international reserves seem to be mainly determined by the propensity to import and trade openness. For instance, our results reveal that a 1 per cent increase in trade openness induce an increase in international reserves by around 5 per cent. Meanwhile, we find that a 1 per cent increase in economic growth leads to a 0.32 per cent increase in international reserves whereas 1 per cent increase in import deter 2.5 per cent in international reserves. Our results suggest that all the determinants under consideration significantly affect India's demand for international reserves.

TABLE 3: LONG RUN ESTIMATES *(Dependent variable$lnIR_t$)*

Regressors	Coefficient	t-statistics
Constant	14.80	3.41**
$lnEcon_t$	0.32	2.64**
$lnImp_t$	-2.50	-2.88**
$lnReer_t$	0.66	1.43
$lnTopen_t$	4.95	5.39***

*** and ** denotes significant at 1% and 5% level.

We follow Akaike Information Criteria for the selection of lag length which is determined as lag two. The short run estimates are presented in Table 4. The error correction term, ECT_{t-1} is negative and is significant at 5 per cent level, making certain that the series is non-explosive and that long-run equilibrium is attainable.

ECT_{t-1} measures the speed at which international reserves adjust to changes in the explanatory variables before converging to its equilibrium level. The coefficient being 0.07 suggests that convergence to equilibrium to international reserves is only 7 per cent each quarter i.e. around 28 per cent disequilibrium eliminated every year in India.

TABLE 4: SHORT RUN ESTIMATES (*Dependent variable* $\Delta lnIR_t$)

Regressors	Coefficient	t-statistics
Constant	3.56	1.28
$\Delta lnECON_{t-1}$	0.37	0.64
$\Delta lnECON_{t-2}$	1.54	2.64**
$\Delta lnIMP_{t-1}$	-0.90	-1.58
$\Delta lnREER_{t-1}$	0.20	0.79
$\Delta lnTOPEN_{t-1}$	1.28	2.49**
ECT_{t-1}	-0.07	-1.90**
R^2		0.20
Durbin-Watson statistic		1.97
F-statistic		4.45

*, ** and *** denotes significant at 10%, 5% and 1% level.

Table 5 provides a number of diagnostic tests which the short run model was tested for, including, tests of autocorrelation, normality and heteroskedasticity in the error stability term, and stability. We found no evidence of autocorrelation in the disturbance of the error term. The RESET test indicates that the model is correctly specified while the F-statistic indicate the predictive power/accuracy of the model. However, the model fails the Jarque-Bera normality tests suggesting that the residuals are not normally distributed but given the significantly large sample size, we can still use the normal distribution of the estimates asymptotically by relying on the Central Limit Theorem (Theil 1978). Finally, the R^2 of 0.20 indicates that 20 per cent of the variation in international reserves is explained by the variables in the model. Hence, based on these statistical properties, it is reasonable to say that the model is well behaved.

TABLE 5: DIAGNOSTIC CHECKS

Test	Statistics	p-value	Conclusion
Lagrange multiplier testSerial Correlation	3.65	0.46	No serial correlation
BPG Heteroskedasticity Test	15.19	0.00	No heteroskedsticity
Ramsey RESET Test	0.68	0.41	No misspecification
Jarque-Bera Normality test	463.05	0.00	Not normal

8. CONCLUSION

The study employed the cointegration technique known as bounds testing method to test for a long run relationship among international reserves, propensity to imports, real effective exchange rate and trade openness for India. We find evidence of a cointegration relationship among the variables in international reserves demand function only when international reserves is the dependent variable at 5 per cent level of significance. This not only allows us to investigate the long run estimates but also the short run elasticities of India's demand for international reserves.

We find that trade openness has positive impact while propensity to import have negative on international reserves while real effective exchange rates show no significance in our model. These results are consistent with theory, are significant except real effective exchange rate and have plausible magnitudes. Our results suggest that trade openness and propensity to import determine India's demand for international reserves in the long run.

Our study reveals that existing patterns of growing trade openness and greater exposure to financial shocks by India go a long way towards accounting for observed accumulation of international reserves. This confirms that large holding of international reserves is the outcome of foreign trade and India accumulates large stockpiles of reserves mainly for precautionary purposes to avoid external shocks.

9. LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

- We do not consider the cost of accumulation of international reserves. Future research may include this variable to improve the results.
- Our study does not consider any significant effect of Asian financial crisis 1997 and global recession of 2008 on Indian economy.
- We do not employ any dummy variable for the crisis effect. Further research may be done by using the dummy.

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