An Empirical Analysis of Macroeconomic Variables Affecting Foreign Exchange Reserves Accumulation in India

Aruna Kumar Dash
IBS Hyderabad, IFHE

C S Shylajan
IBS Hyderabad, IFHE

Subhendu Dutta
IBS Hyderabad, IFHE

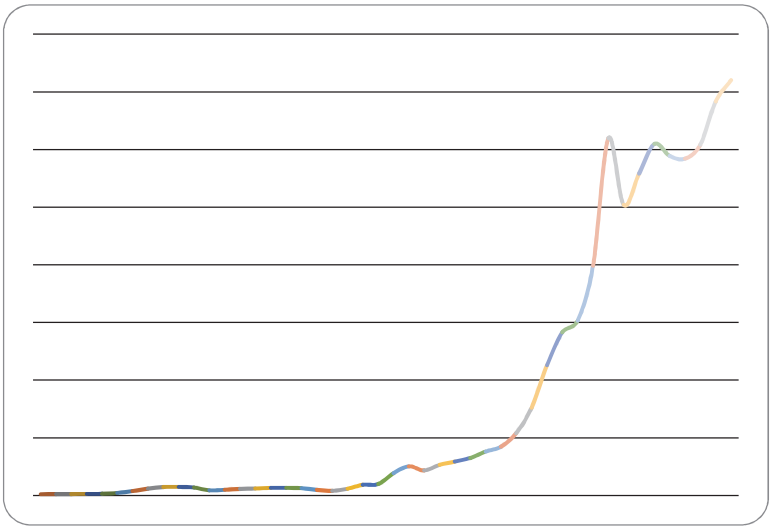
This paper investigates the determinants of foreign exchange reserves in India by using Auto Regressive Distributed Lag (ARDL) model during 2000:Q1 to 2014: Q4 by using the variables such as foreign exchange reserve, nominal exchange rate, inflation, current account deficit, trade openness and short term debt/GDP. We found that in the long run, variables such as inflation and short term external debt/GDP affects the foreign exchange reserves. One percent increase in inflation reduces the foreign exchange reserves by 0.12% where as one percent increase in short term external debt/GDP increases the foreign exchange reserves by 0.46%. On the other hand, in the short run, exchange rate affects positively foreign exchange reserves of India.

INTRODUCTION

There has been a dramatic accumulation of foreign exchange reserves in emerging economies especially in Asia. During the Asian financial crisis, many developing countries came to recognize the importance of increased international reserves as a form of self-protection against crises. Theoretically, two ratios are used as proxies for measuring current account vulnerability and capital account vulnerability. These are the ratio of reserves to imports (to measure current account vulnerability) and the ratio of reserves to short term external debt (to measure capital account vulnerability). The ratio of reserves to imports measures the number of months a country is able to finance its current level of imports. The ratio of reserves to short-term external debt measures the capacity of a country to service its external liabilities, should external financing conditions deteriorate sharply. According to the Greenspan-Guidotti rule, a ratio of foreign exchange reserves to short term external debt greater than one signals that a country holds an adequate level of reserves to face the risk of a financial crisis, while a ratio less than one may suggest a vulnerable capital account (Greenspan, 1999 and BIS, 2000).

In India, like China there has been a huge accumulation of foreign exchange reserves especially since 1990s (Fig-1). Among the major economies with current account deficit (CAD), India is the second largest foreign exchange reserve holder after Brazil. India's foreign exchange reserves at US$360.2 billion as at end-March 2016 mainly comprised of foreign currency assets (FCA) amounting to US$336.1 billion, which accounted for about 93.4 per cent of the total. Gold at US$20.1 billion was the second largest component of foreign exchange reserves. Special drawing rights (SDR) and the reserve tranche position in the IMF were at US$1.5 billion and US$2.45 billion, respectively (RBI, July 2016)[1]. It is relevant to address the questions such as what factors drive the increase in foreign exchange reserves and why a country would hold large amounts of reserves. Aizenman and Lee (2005, 2007) compared the relative importance of precautionary and mercantilist motives in explaining the hoarding of international reserves by developing countries. The mercantilist motives focuses on hoarding reserves to defend export competitiveness while the precautionary motives considers the reserves holdings as a way to hedge against balance of payment instability. Their empirical results suggest that precautionary motives have played a more prominent role in reserve accumulation.

FIGURE 1
FOREIGN EXCHANGE RESERVES IN INDIA (US $ MILLION)



Source: Reserve Bank of India (RBI)

Against this backdrop, an attempt is made in this paper to examine the determinants of foreign exchange reserves in India by using quarterly data during 2000:Q1 to 2014: Q4. The paper is organized as follows. Following an introduction in Section I, Section II discusses the review of theoretical and empirical literature. Section III discusses nature and sources of data, variables defined and methodology used. Section IV highlights the empirical results followed by conclusions and policy implications in Section V.

THEORETICAL and EMPIRICAL LITERATURE

Foreign exchange reserves are reserve assets held by a central bank in foreign currencies. Reserves include foreign currency assets (FCA), gold, special drawing rights (SDR), and reserve position in IMF etc. Conventionally, three motives were identified behind holding foreign exchange reserves by the economies (BIS, 1993). They are (1) transaction needs; (2) intervention needs and (3) wealth diversification. Many of the developing economies who have limited access to external borrowings and experience ups and downs in foreign exchange earnings hold reserves for meeting transaction needs.

Foreign exchange market intervention is another major purpose the countries hold reserves. This is especially important for those countries with very open goods and capital markets. The monetary authority of a country in a fixed exchange rate regime needs reserves to intervene in the foreign exchange market to maintain the par value of its own currency. Theoretically, under a flexible exchange rate system, the monetary authority is not obliged to intervene in the foreign exchange market, as currencies are allowed to fluctuate against each other so that external payment imbalances disappear. Consequently, under a pure floating system, countries are not required to hold any reserve. However, under fixed and managed floating exchange rate system, monetary authority holds reserves to influence exchange rates. Claasen (1975) showed that foreign reserves are held by central banks in order to control the current account of the balance of payments. Theoretically, an increase in volume of imports will result in an increased demand for reserves. The ratio of imports to domestic income (average propensity to import) may have a positive or negative effect on the demand for reserves (Heller and Khan (1978). There are many other interconnected factors which influence the demand for foreign exchange reserves in a country.

In literature, economic size of an economy, current account and capital account vulnerability, exchange rate flexibility and opportunity cost of holding forex reserves have been cited as macroeconomic variables which determine the accumulation of reserves (IMF (2003). Aizenman, Lee, and Rhee (2004) claimed that the self-insurance motive became stronger for reserve holding behavior of economies following the Asian currency crisis. In a Korean case study, they have used short-term external debts as a proxy to examine whether increased external financial exposure is a determining factor behind reserve accumulation. Gosselin and Parent (2005) studied the issue of reserve accumulation by central banks in emerging Asia by estimating a reserve-demand function in a panel of eight Asian emerging-market economies. They showed that reserves increased significantly in economies with limited exchange rate flexibility and those with managed floating exchange rates. Aizenman and Lee (2005, 2007) also showed that international reserves during 1980 and 1990s were accounted by precautionary motives and a liberal capital account regime increased international reserves.

Narayan and Smyth (2006) examined the long-run and short-run relationship between China's real exchange rate, foreign exchange reserves and the real interest rate differential between China and the United States using monthly data from 1980 to 2002. Their study shows that in the long run the real exchange rate has a statistically significant positive effect on foreign exchange reserves. Prabheesh, Malathy and Madhumathi (2007) examined demand for foreign exchange reserves in India using co-integration and vector error correction method over the period 1983-2005. Their results show that the ratio of imports to GDP, the ratio of broad money to GDP, exchange rate flexibility and interest rate differential determine India's long-run reserves demand function. The empirical results show that reserve accumulation in India is highly sensitive to capital account vulnerability.

Chaudhry and Hasan (2008) investigated the demand for international reserves during periods of fixed and floating exchange rates in three developing countries: Kenya, Mexico and the Philippines using co-integration methodology. Their co-integration test results reveal that international reserves maintain a long-run stationary relationship with levels of imports, average propensity to import, and variability of imports. Delatte and Fouquau (2009) adopted a nonlinear approach to examine the dynamics of the international reserves holdings by the emerging economies. They investigated the determinants of the demand for international reserves with a panel smooth transition model. In an IMF working paper, Llaudes, Salman, and Chivakul (2010) established that Pre-crisis reserve holdings helped to mitigate the initial growth collapse of emerging markets during the 2008–09 global crisis. To Aizenman and Genberg (2012), "The amount of reserves a country should hold is ultimately a function of the degree of risk aversion on the part of policymakers, the manner and extent to which they choose to adjust to external shocks, the availability of alternative sources of liquidity, and a number of other country-specific factors that are difficult to incorporate into indicators or models, no matter how sophisticated". Chowdhury, Uddin and Islam (2014) attempted to identify the key determinants of foreign exchange reserves in Bangladesh using Augmented Dicky Fuller (ADF) unit root test. Their empirical results confirm that there exists a strong relationship among foreign exchange reserves, exchange rate, remittance, home interest

rate, broad money, Unit Price Index of export and import, and per capita GDP. In a recent study, Sharma and Singh (2014) examined the determinants of international reserves for eight emerging Asian countries, namely China, India, Indonesia, South Korea, Malaysia, Philippines, Singapore and Thailand for the period of 1980-2011. Results showed that trade openness, country size, export volatility and opportunity cost of reserve accumulation are significant factors explaining the determinants of international reserves in emerging Asia.

In our study we use a set of macroeconomic variables which capture the mercantile and precautionary motives and country specific variables. The next section deals with empirical strategy followed to estimate the reserve demand function.

NATURE and SOURCES OF DATA, VARIABLES DEFINED and EXPECTED SIGN and METHODOLOGY USED

Nature and Sources of Data

The data are collected from secondary sources. The study is based on quarterly time series data for the period of 2000:Q1 to 2014: Q4.

The study have made use of four data sources namely Handbook of Statistics on Indian Economy which is a publication of Reserve Bank of India (RBI), International Financial Statistics (IFS) which is a publication of International Monetary fund (IMF), Direction of Trade (DOT) which is a publication of IMF and Ministry of Finance which is a publication of Government of India.

Variables Defined and Their Expected Sign

This study uses quarterly data on each of the variables. Foreign exchange reserve is expressed as the natural log of reserve (reserve minus gold), is collected from IFS. Exchange rate is the log of exchange rate is collected from IFS. Inflation is computed by using Wholesale Price Index (WPI) which is collected from IFS. Current Account Deficit (CAD), which is the difference between credit-debit, is collected from RBI. Trade openness data is not directly available. Hence, we have calculated trade openness as India's total trade as a percentage of GDP. In order to calculate India's total trade, we have used sum of India's exports to the rest of the world and India's imports from the rest of the world. India's exports and imports are collected from DOT. India's GDP is collected from IFS. India's short term external debt is collected from Ministry of Finance.

According to our theoretical priors, exchange rate depreciation of a domestic currency has positive impact on foreign exchange reserves through export channel. The increase in nominal exchange rate (i.e. depreciation of the rupee) will make India's exports cheaper in the international markets (for which exports will be more) and will make India's imports costlier (for which imports will be less) in the domestic market. As a result it may increase foreign exchange reserves. So, we expect the coefficients of exchange rate to be positive sign. On the other hand, a decrease in nominal exchange rate (i.e. appreciation of rupee) will make India's exports costlier in the international market (for which exports will fall) and imports will be cheaper in the domestic market (for which imports will rise). So, we expect the coefficients of exchange rate to be negative sign. The coefficient of exchange rate can be +Ve /-Ve. Hence, it is an empirical examination. We believe inflation and foreign exchange reserves are negatively related. Because of inflation, the price level of a domestic country increases. Such increase in price level reduces export competitiveness of domestic products in the international market. For import driven economy like India, because of higher inflation, the country needs to pay more import bills and as a result foreign exchange reserves will reduce. Hence, we believe coefficient of inflation carries a negative sign. Analysts, economists and academicians focus more on current account balance since the state of the current account indicates the inherent strength or weakness of an economy. Current account is surplus when revenue receipts from exports of goods and services are more than the payments made for the imports of goods and services. If exports exceed imports, there would be an accumulation of foreign currency reserves. Hence, it is believed that higher the current account deficit (CAD), lower the foreign

exchange reserves. Hence, we expect the coefficient of CAD to be negative but current account deficit may work other direction also. Higher the current account deficit a country has, more foreign exchange reserve as a cushion to finance imports bills. In that context, higher the current account deficit higher the foreign exchange reserves. Hence sign of current account deficit can be +Ve/-Ve. Theoretically the coefficient of trade openness can go both directions. Higher trade openness may lead to lower foreign exchange reserves if imports are more in comparison to exports. Alternatively, trade openness may lead to more foreign exchange earnings if exports are more in comparison to imports. Hence, trade openness is an empirical issue. The study uses short term external debt to GDP ratio as a proxy to measure capital account vulnerability and balance of payments (BoP) instability. When the economy is exposed to capital account vulnerability, the economy needs more foreign exchange reserves as a cushion for any potential external shocks. Hence, they are positively correlated.

Methodology Used

Before proceeding for empirical estimation, each of the macro economic variables is initially tested for their stationarity properties and order of integration. The Augmented Dickey Fuller (ADF) and Phillips–Perron (PP) test are used for this purpose. Subsequently, the bound testing approach to ARDL model developed by Pesaran, Shin and Smith (2001) is used to check if the variables are co-integrated or not. The ARDL approach of co-integration is preferred over Johansen's approach for this empirical analysis because variable of interest are not purely integrated of order one I (1). Another significant advantage of ARDL approach over the co-integration technique is that different variables can be assigned different lag length in the ARDL model.

The following ARDL model is estimated to check for the presence of co-integration. ARDL model is used to investigate the determinants of foreign exchange reserves in India. The ARDL model specification is as follows:

$$\begin{aligned}\Delta \ln \mathrm{Re}\, serve_t &= \alpha_0 + \alpha_1 \ln \mathrm{Re}\, serve_{t-1} + \alpha_2 \ln Exchangerate_{t-1} + \alpha_3 Inflation_{t-1} + \alpha_4 CAD_{t-1} \\ &+ \alpha_5 Tradeopenness_{t-1} + \alpha_6 \ln Shorttermdebt/GDP_{t-1} + \sum_{i=1}^{p} \alpha_{7i} \Delta \ln \mathrm{Re}\, serve_{t-i} \\ &+ \sum_{i=0}^{p} \alpha_{8i} \Delta \ln Exchangerate_{t-i} + \sum_{i=0}^{p} \alpha_{9i} \Delta Inflation_{t-i} + \sum_{i=0}^{p} \alpha_{10i} \Delta CAD_{t-i} + \sum_{i=0}^{p} \alpha_{11i} \Delta Tradeopenness_{t-i} \\ &+ \sum_{i=0}^{p} \alpha_{12i} \Delta \ln Shorttermdebt/GDP_{t-i} + \varepsilon_t \end{aligned} \quad (1)$$

The existence of a co-integrated relationship between the variables in the above mentioned ARDL model specification is examined with the help of F or Wald test statistics. Wald test examines the joint null hypothesis of zero co-integration between the variables, against the alternative hypothesis of presence of co-integration. The calculated F-statistics is compared with two sets of critical values computed by Pesaran, Shin and Smith (2001) for a given level of significance in their bound testing approach to the analysis of long-run relationship. If the computed Wald/ F statistics exceeds/fall above the upper critical value, it implies that all the variables are co-integrated i.e I (1), and the null hypothesis of zero co-integration can be rejected. On the other hand, if the computed Wald/ F statistics falls below the lower bounds critical value, it implies that all the variables are not co-integrated, i.e. I(0), and in this context the null hypothesis of zero co-integration can't be rejected. However, if the calculated Wald/ F statistics falls between the lower and upper bound of critical values, the tests becomes inconclusive. If the null hypothesis of zero co-integration is rejected, error correction representation of ARDL model is estimated to study the short-run dynamics. The error correction term measures the speed with which the deviation from the long run equilibrium is corrected in each period and error correction term is expected to have a negative sign and statistically significant.

Finally, regression diagnostic tests are performed for the ARDL models estimated as per equation (1). Lagrange Multiplier (LM) test is used to check whether the estimated ARDL model suffer from residual serial correlation. Breusch-Pagan-Godfrey test is used to check the presence or absence of Heteroskedasticity problem in the data. Parameter stability tests play a pivotal role to ensure reliability of policy simulations based on the model. To test for parameter stability, we have applied the CUSUM (Cumulative Sum) and Cumulative Sum of Squires (CUSUMQ) tests developed by Brown, Durbin and Evans in1975. CUSUM and CUSUMQ test are carried out to check for parameter stability in the estimated ARDL model. This test plots the cumulative sum together with the 5% critical lines. Movement outside the 5% critical lines indicates parameter instability. The test finds no evidence of major parameter instability since the cumulative sum tests statistics do not cross the 5% critical lines. Stability of the estimated elasticities suggests that the model can be considered stable enough for forecasting and policy analysis.

EMPIRICAL RESULTS

Table 1 presents the results of ADF and PP tests for examining the stationarity properties of macroeconomic variables such as forex reserve, Exchange rate, Inflation, CAD, Trade openness, Short term debt/GDP. The optimal lag length for carrying out the ADF and PP test for each of the variables is chosen on the basis of Akaike Information Criteria (AIC). It is observed from the Table 1 that all the variables are non stationary at level. Hence, we can say that variables are integrated of order 0, i.e. I(0). However, all the variables become stationary only at first differences, that is, they are integrated of order 1 or I(1). Since, the macro economic variables are found to be I(1), the bound testing approach to ARDL model is implemented to check for the presence of any co-integrating relationship among the variables. The ARDL approach to co-integration cannot be applied if any of the variables is found to be I(2).

TABLE 1
UNIT ROOT TEST RESULTS

Variables	**ADF Test with Trend &Intercept in Level**	**ADF Test with Trend & Intercept in First Difference**	**PP Test with Trend & Intercept in Level**	**PP Test with Trend &Intercept in First Difference**
Ln Forex Reserve	-0.75468(1)	-5.15718(1)	-0.27769(1)	-5.18150(1)
Ln Exchange Rate	-1.43196(1)	-6.09953(1)	-1.14459(1)	-6.08364(1)
Inflation	-3.05683(1)	-6.05238(1)	-3.18220(1)	-5.17711(1)
CAD	-3.43261(1)	-9.79989(1)	-3.35421(1)	-9.85037(1)
Trade Openness	-3.84133(1)	-9.19138(1)	-3.13091(1)	-6.53735(1)
Ln Short-term debt/GDP	-1.97987(1)	-6.58285(1)	-2.04622(1)	-6.55654(1)

Note: ADF test with trend and intercept in levels are 4.11, 3.38, 3.17 at 1%, 5% and 10% level of significance. ADF test with trend and intercept in first difference are 4.11, 3.48 and 3.17 at 1%, 5% and 10% level of significance. PP test with trend and intercept in levels are 4.11, 3.48 and 3.16 at 1%, 5% and 10% level of significance and PP test with trend and intercept in first difference are 4.11, 3.48 and 3.17 at 1%, 5% and 10% level of significance.

Table 2 shows the results of ARDL model which includes both lags and current variables. The ARDL (1, 4, 0, 1, 0, 3) model is chosen based on Akaike Information Criteria (AIC). In ARDL (1, 4, 0, 1, 0, 3) model for lag 1 corresponds to the variable LnForex Reserve, Lag 4, corresponds to LnExchange rate, Lag 0, corresponds to Inflation, Lag 1, corresponds to CAD, Lag 0, corresponds to Trade openness and Lag 3, corresponds to LnShort term debt/GDP. From Table 2, we infer that the past 1 and 3 lag of nominal exchange rate, current values of inflation, 1 lag of CAD, 3 lag of short term debt/GDP have a negative and statistically significant effects on foreign exchange reserves.

TABLE 2
AUTOREGRESSIVE DISTRIBUTED LAG ESTIMATES

Regressor	Coefficient	Standard Error	T-Ratio	Probability
Ln Forex Reserve(-1)	0.942123	0.024772	38.03141	0.0000
Ln Exchange Rate	-0.775741	0.178325	-4.350157	0.0001
Ln Exchange Rate (-1)	0.717849	0.280950	2.555082	0.0141
Ln Exchange Rate (-2)	0.122063	0.273077	0.446992	0.6570
Ln Exchange Rate (-3)	-0.549162	0.313876	-1.749616	0.0870
Ln Exchange Rate (-4)	0.528843	0.256284	2.063504	0.0449
Inflation	-0.007359	0.003078	-2.390897	0.0211
CAD	-2.61E-06	1.82E-06	-1.433387	0.1587
CAD (-1)	-3.82E-06	1.26E-06	-3.030602	0.0040
Trade Openness	-0.006485	0.094706	-0.068472	0.9457
Ln Short Term Debt/GDP	-0.006303	0.047332	-0.133161	0.8947
Ln Short Term Debt/GDP (-1)	0.093107	0.066739	1.395091	0.1698
Ln Short Term Debt/GDP (-2)	0.044003	0.062237	0.707017	0.4832
Ln Short Term Debt/GDP (-3)	-0.103724	0.046128	-2.248635	0.0295
C	0.343232	0.377169	0.910021	0.3677

Source: Authors calculations.

The bound testing approach to co-integration is reported in Table 3. When Wald test is performed for ARDL (1, 4, 0, 1, 0, 3) model, the F-statistic is found to be 5.08. Since the computed F-statistics exceeds the critical upper bound at 1% significance level, the null hypothesis of zero co-integration can be rejected in this case. This implies that there exists a long- run equilibrium relationship between forex reserve, exchange rate, inflation, CAD, trade openness and short term debt/GDP.

TABLE 3
BOUNDS TESTING TO COINTEGRATION

Estimated Model		
Optimal Lag Length	(1, 4, 0, 1, 0, 3)	
F-Statistics(WALD Test)	5.083180	
	Critical values ($T = 60$)[#]	
	Lower bounds *I*(0)	**Upper bounds *I*(1)**
10 per cent level	2.26	3.35
5 per cent level	2.62	3.79
2.5 per cent level	2.96	4.18
1 per cent level	3.41	4.68

Source: Authors calculations.

The long run coefficient estimated from ARDL (1, 4, 0, 1, 0, 3) model is reported in Table 4. The inflation carries a negative sign and statistically significant which implies a 1% increase in inflation in India reduces the foreign exchange reserves by 0.12%. On the other hand, short term debt to GDP carries a positive sign and statistically significant. A 1% increase in short term external debt/GDP in India, increases the foreign exchange reserves by 0.46%. When the economy is exposed to capital account vulnerability, the economy needs more foreign exchange reserves as a cushion for any potential external shocks. Trade openness carries a negative sign but not statistically significant.

TABLE 4
ESTIMATED LONG RUN COEFFICIENTS USING THE ARDL APPROACH

Regressor	**Coefficient**	**Standard Error**	**T-Ratio**	**Probability**
Ln Exchange Rate	0.757674	1.429292	0.530105	0.5986
Trade Openness	-0.112042	1.644568	-0.068129	0.9460
Ln Short Term Debt/GDP	**0.467929**	0.258959	**1.806964**	0.0775
CAD	0.000021	0.000029	0.723996	0.4728
Inflation	**-0.127143**	0.064147	**-1.982046**	0.0536
C	5.930331	5.260963	1.127233	0.2656

Source: Authors calculations.

The error correction representation of ARDL (1, 4, 0, 1, 0, 3) model gives the short run dynamics which is reported in Table 5. The error correction term is found to be negative and statistically significant, providing further empirical evidence in support of presence of co-integration between the variables. ECT values of -0.19 implies that about 19% of the short-run disequilibrium between these variables is corrected every quarter. Exchange rate carries a negative sign and statistically significant. One percent depreciation in nominal exchange rate promotes the foreign exchange reserves 0.05%. Exchange rate depreciation will solve the problem of current account deficit. In short run, exchange rate is the only macroeconomic variable which affects foreign exchange reserves whereas; in long run inflation and short term external debt/GDP affects the foreign exchange reserves. Figure 2 plots the results of CUSUM tests for ARDL (1, 4, 0, 1, 0, 3) model and Figure 3 plots the results of CUSUMQ tests for ARDL (1, 4, 0, 1, 0,

3) model. Both CUSUM and CUSUMQ tests is found to lie well within the 5% critical lines, indicating parameter stability.

TABLE 5
ERROR CORRECTION REPRESENTATION FOR THE SELECTED ARDL MODEL

Regressor	Coefficient	Standard Error	T-Ratio
D(Ln Reserve(-1))	0.487079	0.13739	3.54513
D(LnExchange Rate(-1))	0. 0.05961	0.03110	1.91672
D(Trade Openness(-1))	-0.031141	0.16826	-0.18508
D(LnShort Term Debt/GDP(-1))	0.014086	0.04979	0.28293
D(CAD(-1))	1.97E-06	1.5E-06	1.29187
D(Inflation(-1))	-0.003995	0.00409	-0.97768
dC	0.019005	0.00930	2.04456
ecm(-1)	**-0.19554**	**0.10128**	**-1.93069**

Source: Authors calculations.

FIGURE 2
CUMULATIVE SUM OF RECURSIVE RESIDUALS

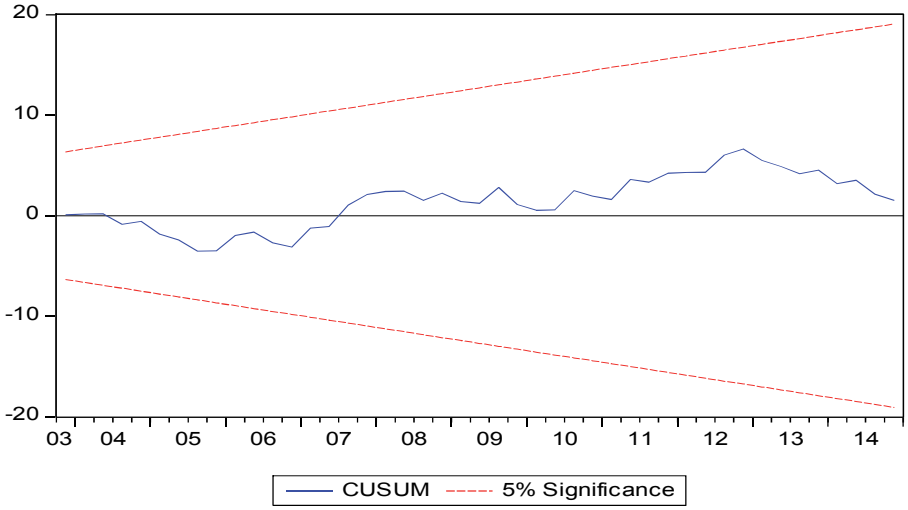
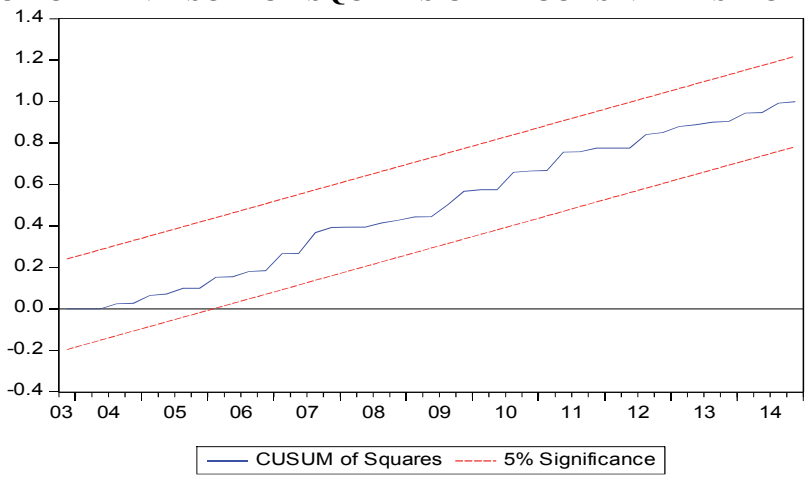


FIGURE 3
CUMULATIVE SUM OF SQUIRES OF RECURSIVE RESIDUALS



Regression diagnostic tests performed for the estimated ARDL model are reported in Table 6 and Table 7. Table 6 confirms the absence of serial correlation and Table 7 Breusch-Pagan-Godfrey test shows that there is absence of heteroskedasticity in the model.

TABLE 6
BREUSCH-GODFREY SERIAL CORRELATION LM TEST

F-statistic	0.038650	Prob. F(2,43)	0.9621
Obs*R-squared	0.107668	Prob. Chi-Square(2)	0.9476

Source: *Authors calculations.*

TABLE 7
HETEROSKEDASTICITY TEST: BREUSCH-PAGAN-GODFREY

F-statistic	0.980842	Prob. F(14,45)	0.4872
Obs*R-squared	14.02831	Prob. Chi-Square(14)	0.4476
Scaled explained SS	5.798850	Prob. Chi-Square(14)	0.9713

Source: *Authors calculations.*

CONCLUSIONS and POLICY IMPLICATIONS

This paper investigates the determinants of foreign exchange reserves in India by using Auto Regressive Distributed Lag (ARDL) model during 2000:Q1 to 2014: Q4 by using the macro economic variables such as foreign exchange reserve, nominal exchange rate, inflation, current account deficit, trade openness and short term debt/GDP. Empirical results of ARDL model suggest that in the long run variables such as inflation and short term external debt/GDP affect the foreign exchange reserves in India. One percent increase in inflation reduces the foreign exchange reserves by 0.12%. Short term external debt/GDP has a positive impact on reserves. One percent increase in short term external debt/GDP in

India increases the foreign exchange reserves by 0.46%. This supports the precautionary motive for holding reserves. When the economy is exposed to capital account vulnerability or sudden capital flight, the economy needs more foreign exchange reserves as a cushion for any potential external shocks or currency crisis like South Asian Currency crisis during 1997-98. In India, there has been deterioration in the key external sector vulnerability indicators like the ratio of short term debt to total external debt. From 2004-2005, the short-term external debt as a percent of total external debt has been increasing. While it was around 13 % in 2004-05, it increased to around 25 % in 2012-13. Hence, holding of foreign exchange reserves becomes necessary as a precaution to avoid external sector shocks.

In the short run, exchange rate affects foreign exchange reserves of India. One percent depreciation in exchange rate increases the foreign exchange reserves by 0.05%. That might be the reason that RBI gives emphasis on exchange rate depreciation to promote exports and hence reduce imports for which significant amount of foreign exchange reserve can be maintained. Hence, in order to boost more foreign exchange reserves, policy authorities should focus on inflation control and RBI intervention in the foreign exchange market.

ENDNOTES

1. Although both US dollar and Euro are intervention currencies and the Foreign Currency Assets (FCA) are maintained in major currencies, the foreign exchange reserves are denominated and expressed in US dollar only. As at end-March 2016 out of the total foreign currency assets of USD 336.1 billion, USD 224.8 billion was invested in securities, USD 91.6 billion was deposited with other central banks, the BIS and the International Monetary Fund (IMF) and remaining USD 19.7 billion comprised deposits with overseas branches of commercial bank. The Reserve Bank holds 557.77 tonnes of gold; of which, 265.49 tonnes are held overseas in safe custody with the Bank of England and the Bank for International Settlements (BIS). Gold as a share of the total foreign exchange reserves in value terms (USD) stood at about 5.6 per cent as at end-March, 2016.Movements in the FCA occur mainly on account of purchases and sales of foreign exchange by the RBI, income arising out of the deployment of the foreign exchange reserves, external aid receipts of the Central Government and changes on account of revaluation of the assets (RBI, July 2016).

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