Foreign Exchange Reserves in India

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Abstract

Foreign exchange reserves are important indicators of ability to repay foreign debt and for currency defence, and are used to determine credit ratings of nations. The quantity of foreign exchange reserves can change as a central bank implements monetary policy.Foreign exchange reserves are mainly held by a country to maintain the balance between the demand and supply of money, help the central bank to intervene in the market during crises and also to preserve confidence in the ability of an economy to meet its external obligations. The paper models estimates the quantity of reserves using monthly data from April 1999 to March 2008. The model has five explanatory variables: exchange rate volatility, log of export volatility, IIP, log of money share in GDP and interest rate. The size of the economy (for which the Index of Industrial Production serves as a proxy) and volatility of exports have positive coefficients and are significant predictors of foreign exchange reserves, as are share of broad money in GDP and the opportunity cost of reserves (captured by the T-Bill rate). On the other hand, reserve holdings should be negatively correlated with exchange-rate volatility since central banks no longer need a large reserve stockpile to manage a fixed exchange rate, but result seem to contradict the hypotheses.

Keywords: foreign exchange reserves, reserve holding, model, IIP, interest rate, volatility

INTRODUCTION

Foreign exchange reserves in a strict sense are only the foreign currency deposits and bonds held by central banks and monetary authorities. However, the term in popular usage commonly includes foreign exchange and gold, SDR's and IMF reserve positions. This broader figure is more readily available, but it is more accurately termed "official international reserves" or "international reserves". These are assets of the central bank held in different reserve currencies, mostly the dollar, and to a lesser extent the euro and yen, and used to back its liabilities, e.g. the local currency issued, and the various bank reserves deposited with the central bank, by the government. These reserves are important indicators of ability to repay foreign debt and for currency defence, and are used to determine credit ratings of nations. The quantity of foreign exchange reserves can change as a central bank implements monetary policy.

Foreign exchange reserves are mainly held by a country to maintain the balance between the demand and supply of money, help the central bank to intervene in the market during crises and also to preserve confidence in the ability of an economy to meet its external obligations. In order to perform all these functions, the economy requires a certain level of reserves and the thumb rule usually followed in the past is that the reserves should be adequate to meet the import bill of the country for a certain number of months.

The balance of payments crisis in 1991, with the depletion of foreign exchange reserves to tide over only two weeks' imports, was the prime motivation for initiation of economic liberalization in India. This episode underscored the importance of maintaining an adequate level of foreign exchange to ensure liquidity in the event of a crisis. With the integration of financial markets across the globe, capital flows into and out of a country assume even greater importance. As has been proved by the East Asian economic crisis, these capital flows can be taken out of the economy at very short notice and this can trigger a series of events, which can put the currency of a country at serious risk. Therefore, in order to avoid any such risk, some cushion in the form of reserves, over and above that required to meet the import bill should be set aside to prevent any volatility in the capital flows.

The foreign exchange reserves of India show an upward trend since the reforms. An analysis of the sources of reserves accretion during the entire reform period from 1991 onwards reveals that the increase in foreign exchange reserves has been facilitated by an increase in the annual quantum of foreign direct investment (FDI). In addition, an opening up of the economy provided exposure to a variety of financial instruments such as derivatives that increased depth as well as variability in the market. The current balance of payments position, where the level of foreign exchange reserves has escalated to over USD 250 Billion as on January 2009, has also engendered debate regarding the benefits and costs of maintaining such a large fund.
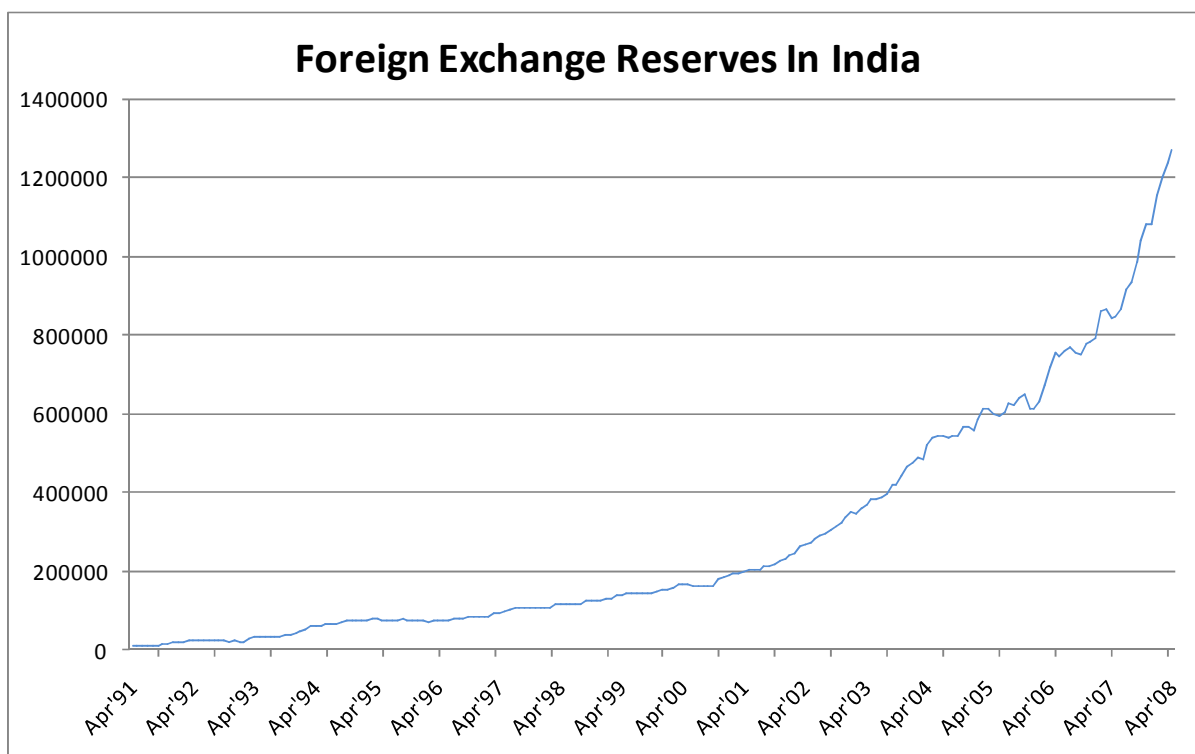
This crucial variable serves as an indicator and determinant of the fiscal stability of a nation and influences international capital flows, which in turn determines growth. Hence, an accurate forecast of trends and fluctuations in the level of foreign exchange reserves will enable a more precise assessment of the future growth trajectory of the nation.

This study attempts to construct a model to forecast trends in the level of foreign exchange reserves in India by analysing the underlying factors that influence their

accumulation or depletion.

LITERATURE REVIEW

PAPER: **INTERNATIONAL RESERVES MANAGEMENT AND CAPITAL MOBILITY IN A VOLATILE WORLD: POLICY CONSIDERATIONS AND A CASE STUDY OF KOREA – JOSHUA AIZENMAN, YEONHO LEE AND YOUNGSEOP RHEE**

This paper characterizes the precautionary demand for international reserves driven by the attempt to reduce the incidence of costly output decline induced by sudden reversal of short-term capital flows. Such observations are validated by empirical investigations that reveal that in the aftermath of the 1997-98 Asian crisis, the international reserves/GDP ratio increased sizably, reaching the ratio of the total external debt/GDP. In addition, the financial crises afflicting countries with limited access to international borrowing suggest another aspect of international reserves— they serve as an asset affecting the developing country's exposure to sovereign risk and costly adjustment. These considerations suggest that international reserves may be viewed as a form of precautionary saving for economies with conditional access to global capital markets and costly domestic tax collection. The study concludes that real GDP, trade openness, and volatility of exports are significant at the conventional confidence levels and have positive coefficients in accordance with the traditional theory of the demand for international reserves.

PAPER: **THE HIGH DEMAND FOR INTERNATIONAL RESERVES IN THE FAR EAST: WHAT IS GOING ON? – JOSHUA AIZENMAN AND NANCY MARION**

This paper explores econometric and theoretical interpretations for the relatively high demand for international reserves by countries in the Far East and the relatively low demand by some other developing countries. It uses a sample of 125 developing countries to show that reserve holdings over 1980–1996 can be predicted a few key factors, such as the size of international transactions, their volatility, the exchange-rate arrangement, and political considerations.Further the regression model adds some political measures since political uncertainty and political corruption are expected to act as a tax on the return to reserves and hence reduce optimal holdings. An increase in an index of political corruption significantly reduces reserve holdings, as does an increase in the probability of a government leadership change by constitutional means.

The study concludes that political-economy considerations are useful in improving the explanatory power of econometric models of international reserves. In addition, a generalized precautionary saving model, allowing for limited integration with international capital markets, costly tax collection, and relatively inelastic fiscal outlays, can explain the demand for international reserves by emerging markets.

PAPER:**THE OPTIMAL LEVEL OF INTERNATIONAL RESERVES: EVIDENCE FOR INDIA – M. RAMACHANDRAN**

The demand for international reserves for the purpose of serving as a cushion to

absorb fluctuations in external payment imbalances rises with an increase in the volatility of external payment gaps, defined as macroeconomic adjustment cost. However, reserves yield negligible return; therefore, reserve holding incurs an opportunity cost, which is the difference between what the reserve could have earned and what it actually earns. Therefore, reserve demand increases with a fall in their opportunity cost. Ramachandran's study claims that in India, reserve demand is predominantly determined by the opportunity cost rather than reserve volatility, in stark contrast to the overall evidence for other emerging market economies. This may be attributed to the relatively free inflow of capital in India.

PAPER: THE DEMAND FOR INTERNATIONAL RESERVES AND EXCHANGE RATE ADJUSTMENTS: THE CASE OF LDCS, 1964-1972 -- SEBASTIAN EDWARDS

In this paper, the demand for international reserves by less developed countries is analyzed for a group of 23 LDCs that maintained a fixed exchange rate during 1964-1972 and for a group of 18 LDCs that devalued their currencies by over 10% at least once during this period. With respect to external disturbances, most authors have assumed that, the higher the variability of a country's external payments, the higher the level of reserves it would desire to hold.According to the hypothesis that countries willing to use exchange rate adjustments have a different demand function than fixed exchange rate countries, it is expected that at least some of the regression coefficients would be significantly different for these two groups of countries which is tested using dummy variable procedure. The study suggests that, while fixed-rate countries demand reserves for both transactions and precautionary motives, devaluation countries tend to neglect the precautionary motive in their holding of international reserves.

PAPER:DEMAND FOR INTERNATIONAL RESERVES: A QUANTILE REGRESSION APPROACH – OZAN SULA

Most empirical studies that examine the determinants of demand for reserves rely on the 'buffer stock' model. A common empirical approach used to test the buffer stock model is to estimate a constant demand elasticity model by including the aforementioned factors as the right hand side variables in an ordinary least squares (OLS) regression. Recent examples of this approach, however, present mixed results when applied to a large sample of developing nations.

There are number of possible reasons for non-constant demand elasticities such as differences in the structure of the financial or real sector, government's preferences, specific macro conditions facing the economy, or institutional and political factors imply that no single demand function characterizes all nations. The study concludes that the behavior of emerging markets is significantly different from other developing nations since the largest reserve holders in the sample are emerging markets. . Furthermore, the results show that there are significant differences in elasticities.

MODEL SPECIFICATION and IDENTIFICATION

The paper uses monthly data from April 1999 to March 2008 for identification of the

model.

TABLE 1: VARIABLE DESCRIPTION

Abbreviation	Definition	Variable name
Forex	The foreign exchange reserves of the country consist of (i) foreign currency assets held by the RBI, (ii) gold holdings of the RBI and (iii) Special Drawing Rights (SDRs).	Foreign exchange reserves in India (Rs. billion)
Iip	Base: 1993-94=100	Index of industrial production
Impshare	Share of imports in GDP	Import share
tradeopen	(Exports-Imports) as proportion of GDP	Trade openness
exportvol	Volatility of exports is defined as standard deviation of previous 12-month export receipts	Export volatility
Finopen	Financial openness defined as net capital flows to GDP	Financial openness
Exvol	Volatility of exchange rate (Rs./$) is defined a standard deviation of previous 24-months exchange rate	Exchange rate volatility
moneyshare	Share of broad money in GDP	Money share (Rs. billion)
Intdif	Nominal interest rate differential in 91days government treasury bill rate between India and US.	Interest rate differential (percentages)
Impvol	Defined as standard deviation of previous 12 months imports receipts	Import volatility

Source: Reserve Bank of India – Handbook of Statistics on Indian Economy

Expected signs of coefficients of independent variables in the regression

Foreign exchange reserves of an economy, an indicator of its fiscal stability depend on a number of factors such as the size of international transactions, their volatility, the exchange-rate arrangement, and political considerations.

Real reserve holdings should increase with the size of international transactions, so reserve holdings should be positively correlated with the country's GDP and standard of living. Index of industrial production (IIP) has been taken in lieu of the size of the economy (GDP).

Reserve holdings should increase with the volatility of international receipts and payments if they are intended to cushion the economy, so reserve holdings should be positively correlated with the volatility of a country's export receipts.

Reserve holdings should also increase with the vulnerability to external shocks. So, reserve holdings should be positively correlated with the average propensity to import, a measure of the economy's openness and vulnerability to external shocks. Financial openness and trade openness have been taken to illustrate the extent of international dependence

Finally, since greater exchange-rate flexibility should reduce the demand for reserves because central banks no longer need a large reserve stockpile to manage a fixed exchange rate, reserve holdings should be negatively correlated with exchange-rate volatility.

Political stability and index of corruption are other factors that influence the demand for foreign exchange reserves. Higher the instability and higher the corruption the lower is the accumulation of these reserves. But due to lack of data availability, this variable is not considered.

There is a cost associated with holding of reserves, the higher the opportunity cost the lower is the level of reserve holding. Domestic interest rates have been assumed to depict this opportunity cost. Treasury bill rate has been taken as a measure of opportunity cost of holding reserves

In addition to this, a measure of Reserve Adequacy Ratio has been taken in the form money supply as a proportion of IIP (Money Share). This has been done in light of the precautionary demand argument, which advocates a higher level of reserves to be maintained by developing countries due to the possibility of a sudden withdrawal of foreign capital such as the one faced by South Korea. Limited access to foreign capital and high tax collection costs faced by developing countries like India further intensify this precautionary need for reserves

In the light of above analysis, attempt is made estimate a multiple regression model taking the logarithm of foreign exchange reserves (the dependent variable) and a list of independent variables.

For arriving at the regression model, several variables were used and finally using the Hendry/LSE Approach of modeling from "general to simple", the following model was arrived at:

$$Y_t = ß_1 + ß_2 X_{2t} + ß_3 X_{3t} + ß_4 X_{4t} + ß_5 X_{5t} + ß_6 X_{6t} + ß_7 X_{7t} + u_t$$

Where Y = ln (forex)
X_2 = exchange rate volatility
X_3 = ln (export volatility)
X_4 = iip
X_5 = ln (money share)
X_6 = T-Bill rate

**TABLE 2: LOG (FOREIGN EXCHANGE), 1999.04-2008.03**

Explanatory Variable	Coefficient	t-value
Exchange rate volatility	0.016	1.344
Ln (export volatility)	0.154	7.168*
IIP	0.008	23.50*
Ln (money share)	1.045	14.84*
T-Bill rate	- 0.070	-15.27*
Constant	1.863	6.778*

*significance at 1% los

Our final regression model has five explanatory variables and four of them turn out to be significant. Export volatility and 'iip' have a positive influence on the level of reserves as expected from the structural model. Also, the coefficient of 'moneyshare' has a positive sign indicating that higher adequacy ratios have a positive impact on the level of reserves. The opportunity cost of holding these reserves proxied here by the treasurybill rate also confirms the expectation based on theory. However, the sign of coefficients of exchange rate volatility do not confirm our structural model. The model doesn't include import volatility, interest rate differential, import share, financial openness and trade openness because their coefficients are insignificant except financial openness whose observed sign is opposite to the underlying theory.

The R-squared of our final model suggests that the model explains approximately 98% of the variations in the dependent variable. The model initially depicted heteroscedasticity but the use of robust standard errors has now rendered the model free from this feature. The absence of autocorrelation in the final model is confirmed by the Lagrange Multiplier test. The errors are normally distributed as required for the validity of the model. The above model therefore is free from heteroscedasticity, autocorrelation and multi-collinearity and is a good fit as shown below.

GRAPH 1: ACTUAL AND FTTED VALUES OF DEPENDENT VARIABLE

Actual and fitted logforex
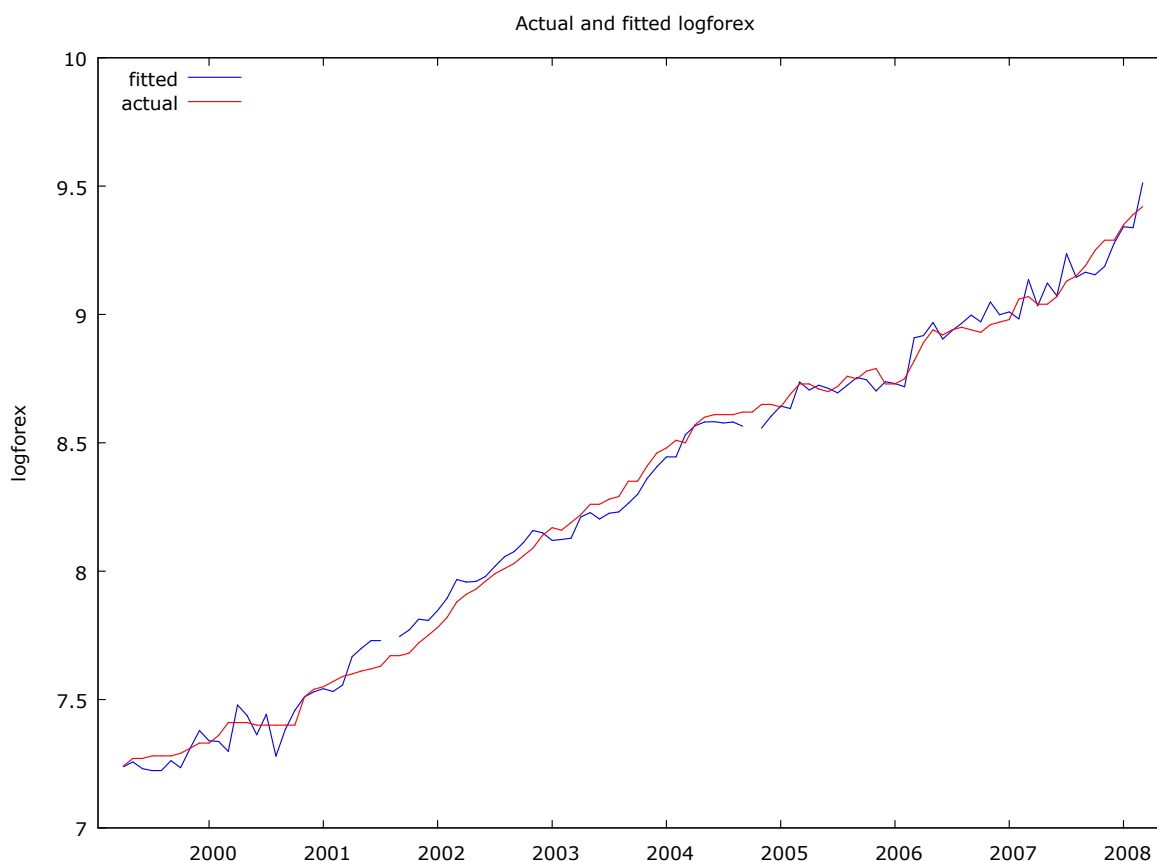
CONCLUSION

A comparison of the model espoused by this study and previous research in the domain re-affirms its theoretical foundation. As confirmed by the results of the Aizenman, Lee, & Rhee study, the size of the economy (for which the Index of Industrial Production serves as a proxy) and volatility of exports have positive coefficients and are significant predictors of foreign exchange reserves, as are share of broad money in GDP and the opportunity cost of reserves (captured by the T-Bill rate).

On the other hand, according to the Aizenman & Marion paper, reserve holdings should be negatively correlated with exchange-rate volatility since central banks no longer need a large reserve stockpile to manage a fixed exchange rate, but the results seem to contradict the hypotheses.

In any case, it has been established that our model is robust and has significant explanatory power, as evidenced by the R-squared which suggests that the model explains approximately 98% of the variation in the dependent variable. The final model incorporated in the study is free from heteroscedasticity, autocorrelation, & multicollinearity, and is a good fit.

As the level and trends of foreign exchange reserves can be an important factor in determining a nation's fiscal stability and overall economic growth, this paper reflects a modest effort in understanding this crucial variable.

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