Vol 7 Issue 5 June 2017

ISSN No : 2230-7850

International Multidisciplinary Research Journal

Indian Streams Research Journal

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RNI MAHMUL/2011/38595 **ISSN No.2230-7850**

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ISSN: 2230-7850 IMPACT FACTOR : 5.1651(UIF)

INDIAN STREAMS RESEARCH JOURNAL

VOLUME - 7 | ISSUE - 5 | JUNE - 2017

"DETERMINANTS OF FOREIGN EXCHANGE RESERVES A LITERATURE REVIEW"

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ABSTRACT

Many studies have suggested that it is important for a developing economy to accumulate a good amount of reserves to attain growth and maintain stability in an economy. So, this raises the issue of examining what determines the adequate level of foreign exchange reserves. In this study, we build up our literature review based on models developed by researchers to determine the factors and indicators that leads to accumulation of foreign exchange reserves. In the last section we have critically reviewed the various studies and concluded that there is still a lot of research has to be done on this topic.

KEYWORDS: *developing economy , foreign exchange reserves , various studies and concluded .*

INTRODUCTION

The expansion in the volume of trade activities and capital inflows in the form of investments and commercial borrowing has led to the emergence of importance of managing the foreign exchange reserves. Globally there has been no unique definition of foreign exchange reserves, however, most countries in the world have adopted the definition suggested by International Monetary Fund (Balance of Payments Manual, and Guidelines on Foreign Exchange Reserve Management, 2001), which defines reserves as "external assets that are readily available to and controlled by monetary authorities for direct financing of external payments imbalances, for indirectly regulating the magnitudes of such imbalances through intervention in exchange markets to affect the currency exchange rate, and/or for other purposes." Reserves are held in one or more reserve currencies, mostly United States dollar and to a lesser extent the EU's euro, the British pound sterling and the Japanese yen. Historically under the Bretton –Woods system, the foreign exchange reserves were used by the central bank across the world to maintain the external value of their respective currencies at a fixed level. With the breakdown of Bretton -Woods system in the early 1970s, countries started adopting a relatively flexible exchange rate system, under which the reserves play only a less important role. Yet, the global exchange reserves have increased from 1.75 to 7.8 percent of world GDP between 1960 and 2002(Flood and Marion, 2002).

The traditional approaches to reserve determination are considered to be pure trade based models comprising mainly measures of import cover, opportunity cost and foreign exchange market intervention. Unlikely, the contemporary reserve demand models incorporate features like free capital mobility, inflation targeting, return-risk trade-off and complications arising from intermediate exchange rate regimes.Earlier studies on optimum reserves mainly identify three primary motives for accumulating reserves, namely, transaction motive, precautionary motive and speculative motive (Reddy, 2002). While transaction motive

applies to reserve demand by the commercial banks, precautionary motive dominates the central bank reserve accumulation behavior. Besides keeping reserves for meeting the balance of payments deficits, countries also keep certain amount of reserves for meeting unforeseen contingencies. In other words, official reserves are necessary for crises prevention and for the central bank lender of resort function.

The structure of the paper includes the following sections, the conceptual framework, wherein we will discuss about the various concepts and definitions of foreign exchange reserves and also about some related terms to it. Then we have the section of literature review, wherein we review the work of various academicians and economists, followed by a section of critical review, wherein we critically review and compare the various literatures.

CONCEPTUAL FRAMEWORK

This section contains various concepts and terms related to foreign exchange reserves. These are as follows:

Motives for holding foreign exchange reserves

Basically, a country holds reserves for 'maintaining liquidity and safety'. By liquidity and safety, we mean a country should possess certain enough amounts of foreign reserves to meet their day to day operations like trading and also to ensure their safety in times of crises. Holding enough or what we call is optimum level of reserves helps a country to be self-reliant and have a self-sufficiency to meet their payment obligations, side by side creating a vulnerability which means sensitivity to the stock of reserves, i.e., if reserve level falls beyond optimum level, a country should become alert on accumulation of reserves otherwise their currency would appreciate and their GDP would be affected which may lead to a situation of crises.

Apart from self-reliance, self-sufficiency and vulnerability, there is one more thing called 'buffer', which acts a shock absorber in times of crises and helps in bringing economic stability in the country for which certain costs are to be paid which will be discussed later on.

For meeting with the requirements of a country in 'times of crises' like for food import, petroleum import etc. for example, let say suddenly OPEC countries might decide to raise the prices. So, as petroleum products are a necessity and we cannot give up on its consumption, we have to finance it through our holdings of foreign reserves.

The quantum and timing of export earnings do not coincide with the inflow of foreign exchange reserves from various times of exports. Moreover, all international transactions are credit transactions. So, in order to 'finance our imports', we need to sacrifice some of our reserve holdings.

There is a cost of holding foreign exchange reserves, so, the management of foreign exchange reserves requires that there may be a shift in the portfolio of reserves. Central bank is not a profit making entity and its objective is of national interest. Also, Central bank holds reserves for maintaining sovereignty and to control the money supply in a country.

Determinants of foreign exchange reserves

Country circumstances vary and there is no precise level of reserves that are universally considered either sufficient or optimal. Advanced economies with highly liquid, floating currencies and stable financial market access in domestic currency tend to derive very insignificant value from holding precautionary reserves. On the other hand, countries where currencies are less liquid and having very unstable financial markets tend to hold high level of reserves as it may reduce both the risk and impact of current account shocks and capital account crises. Efforts have been made by economists to present an optimizing framework for maintaining appropriate level of foreign exchange reserves. There are various viewpoints regarding this, like one view point suggests that optimum level of reserves is that level where marginal social costs equal marginal social benefit. Another viewpoint suggests, the level of reserves where marginal productivity of reserves plus interest earned on reserve assets equals the marginal productivity of real resources. In simple terms, foreign exchange reserves are said to be adequate when the level of foreign exchange reserves ensures sustainable balance of payments and macroeconomic adjustment resulting from external price shocks or reversals in short term foreign capital

flows.

In order to determine the appropriate or optimal level of reserves, certain determinants or indicators that have been suggested by economists and academicians. These are as follows:

Trade based indicator- These indicators are also known as import based indicators or it can also be termed as ratio of non-gold foreign exchange reserves to imports. These indicators basically got popularity after the World War II and it was suggested by Keynes and Triffin (1947) and IMF (1953). Under this measure certain months of import bills is covered by reserves, i.e., a number of months a country can continue to support its current level of imports if all other inflows and outflows cease. Reserves covering three months of imports has been conventionally regarded as adequate and considered as a useful indicator for predicting future international payments obligations. While three month of import cover is assumed as the minimum threshold, six months of import cover could be deemed as safe and viable for developing countries. This measure is suitable for low income countries that are vulnerable to current account shocks and do not have significant access to capital markets.

$$AFR=FR\div IM$$

Where, AFR is Adequate Foreign Exchange Reserves, FR is Foreign Reserves and IM is Import bill (Suresh Sahu, Adequacy of India's Foreign Exchange Reserves, 2015). Despite its popular use as a reserve adequacy indicator, import cover has got some serious practical limitations like it is purely based on merchandise trade and does not include other components of current account such as services, transfers and invisibles. In order to overcome such limitations, reserves covering six months of merchandise trade as well as one year invisible payments may be considered optimal for an emerging economy. Also, the adequacy of reserves is influenced by the economic situation of a country. Sudden and sharp capital outflows may arise because of short term debts, which are not considered in this method.

Debt-based indicator- The famous Greenspan-Guidotti rule, named after Alan Greenspan and Pablo Guidotti, is a debt based indicator of determining the adequate level of reserves. It measures the extent of external drain that a country is exposed to at a particular point of time. They said that developing countries should amass their reserves equal to all external debt coming due within the next year, i.e., all short term debts. According to this rule, reserves equal to one year short term debt is considered healthy and in simpler way it means to maintain a level of reserves that meets the short term debt with remaining maturity. However, this rule does not take into account the main source of reserve demand, i.e., imports. Without trade element, debt based rules are believed to underestimate the ideal reserve requirements of a country.

$$AFR=FR\div SFD$$

Where, AFR is Adequate foreign exchange reserves, FR is foreign exchange reserves and SFD is short term foreign debt (Suresh Sahu, Adequacy of India's Foreign Exchange Reserves).

Money-based indicator- Kamnisky (1999) employed the monetary aggregates and he measured foreign exchange reserve adequacy level as the ratio of foreign exchange reserves to broad money or what we call as base money (M2). The Net Foreign Exchange Assets (NFEA) to currency ratio is also a money based indicator and it helps in predicting the sustainability of reserve flows in a country. Money based indicators are useful for countries that face a high risk of capital flight, i.e., it is a good predictor of crises. These indicators are deemed to be better predictors of reserves in countries with fuller capital account convertibility. Under fuller capital account convertibility, citizens possess the freedom to convert their domestic currency into foreign currencies and vice versa. However, this measure suffers from certain limitations like in countries, mostly developed, where demand for money is stable and confidence in domestic currency is high, there is no requirement of holding high level of reserves and on the other hand, countries, mostly developing and emerging, where demand for money is unstable and confidence in domestic currency tends to be low, maintaining a high level of reserves could provide a cushion to them in situation of crises.

$$AFR=FR\div M2$$

Where, AFR is Adequate foreign exchange reserves, FR is Foreign exchange reserves and M2 is Broad money or base money. The Reserve Bank of India Act, 1934 stipulates a minimum of 40 percent net foreign assets backing of domestic currency in India. However, give current realities, the committee recommends a minimum 70 percent coverage of foreign currency assets for domestic currency in circulation.

Reserve Drainer Approach- Apart from all the indicators mentioned above, there's one more which was suggested by Shcherbakov in 2002 after he examined the Russian foreign exchange outflows experience. He combined all the above explained determinants of reserves which are import bills, short term foreign debt and broad money to measure foreign exchange reserve holdings. Shcherbakov opined that once these variables are matched by available external reserves, then external shocks would be cushioned in any economy.

$$AFR=FR\div(IM+SFD+M2)$$

Where, AFR is Adequate foreign exchange reserves, IM is Import bills, SFD is Short term foreign debt and M2 is broad or base money.

Costs and risks of holding foreign exchange reserves

Reserves are often an expensive insurance mechanism, with its cost coming from many different sources and it is often very difficult to quantify their sources. The costs that may arise because of holding excess reserves are as follows:

Sterilization costs- Sterilization basically neutralizes the inflationary monetary impact of reserve accumulation by offsetting the associated increase in money supply with a domestic money market operation, typically domestic debt issuance (Russell Green and Tom Toregerson, Are High Foreign Exchange Reserves in emerging markets a blessing or a burden?). Sterilization involves controlling domestic currency appreciation which may result in inflationary pressures and can hamper a country's growth. Sterilizing reserve accumulation can be quite regarded as a good tool for controlling inflation in a country, however fully sterilizing reserve accumulation can be challenging. There are basically three challenges which can limit or hamper the usefulness produced by sterilization.

These are:

The fiscal costs of intervention- It represents the difference between what the central bank earns on international reserves and what it pays on the domestic debt issued to sterilize the reserves.

Future monetary imbalances- The long term effectiveness of sterilized intervention depends upon the tools used for sterilization and on which sector it ends up. Large scale reserve accumulation typically raises the underlying liquidity position of the banking system and this can be partly neutralized by selling long term government bonds to banks which in turn will be sold by banks to non-banks usually households and corporates. This will reasonably complete sterilization.

Financial sector imbalances- Sterilized intervention to prevent a rise in exchange rate can affect macroeconomic and financial imbalances like increased bank lending resulting from partial or ineffective sterilization could finance excessive investment in certain sectors such as property markets and may lead to the formation of property bubbles.

Opportunity costs- The resources or funds that are used to purchase foreign exchange reserves could be used for several other purposes, like a government could pay off its sovereign short term external debt, since the interest cost of a given amount of short term external debt likely exceeds the earnings on an equivalent amount of reserves. Another purpose for utilizing the resources instead of acquiring reserves could be reserves spend by government on investment projects, with the constraint that reserves cannot be converted back into local currency if authorities wish to avoid an impact on the exchange rate. For example, reserves could be used to purchase medical supplies and equipment from a foreign country.

Central bank balance sheet risk- Foreign exchange reserves are just like any other foreign currency asset, which can lose its value in local terms if the exchange rate appreciates. As long as interest margins and cash flows remain positive, it may be feasible for central banks to operate with negative capital for a considerable period. However, leaving itself undercapitalized could in time jeopardize the central bank's credibility and ability to target price stability, to intermediate government foreign borrowing, to act as lender of last resort, or to maintain a domestic payments system (Russell Green and Tom Torgerson, Are High Foreign Exchange Reserves in emerging markets a blessing or a burden?).

Other costs- Reserve accumulation may render a false sense of security, delaying necessary reforms. While reserves may provide some protection against external crises, otherwise unsustainable policies cause undesirable distortions even when they do not end in crises. Large fiscal deficits, for instance, may crowd out private sector investments or create debt overhang problems. And these vulnerabilities, if allowed to grow too large, may overwhelm the insulating effect of reserves and surprise a country previously considered secure (Russell Green and Tom Torgerson, Are High Foreign Exchange Reserves in emerging markets a blessing or a burden?).

REVIEW OF LITERATURE

This section comprises the review of various literatures and these are as follows:

Green and Torgerson (2007) in their occasional paper examined the motivations and costs of foreign exchange reserve accumulation among the world's largest emerging market holders of reserves. They found that the top seven emerging market reserve holders exceeded the standard reserve adequacy measures. Their analysis mainly suggests that net marginal return to additional reserves is low, if not extremely negative, yielding scant support for the proposition that the largest reserve holders were holding foreign exchange reserves exclusively for precautionary purposes and their policy is not about the allocation of existing reserves, but about further reserve accumulation.

Apart from holding reserves for precautionary purposes, i.e., for currency crises, economies also hold reserves for day to day operations which are called transaction motives and also for speculative activities, these motives basically denotes for hedging against non-currency crises. So, Green and Toregerson emphasized that fairly minimal reserve levels may be adequate for these sources of demand outside a currency crises and non-currency crises reserve demand will not exceed demand for reserves to insure against a currency crises. In other words, the marginal benefit of additional reserve holdings for non-crises purposes already approached zero by the time reserves reach levels sufficient to insure against a currency crises. Intervention to respond to terms of trade shocks, to fight deflation, or to support export led growth may result in stocks of reserves, however, once acquired, these resources have very limited use.

They also found that at the end of 2005, eight of the largest reserve stockpiles were located in East Asia, with the other two held by major oil exporters (Table 1a). Theyfocused on the seven economies given in Table 1a as emerging market economies considering them on the basis of determinants of foreign exchange reserves or finding out how adequately they maintained reserves based on the determinants. Figure 1a shows how the seven economies in the list match up to the Greenspan Guidotti threshold for reserves/short term debt. All hold several multiples of their short term debt in reserves, with China far ahead of the rest at more than eleven times short term debt.

TOP 7 RESERVE HOLDERS

Rank	Country	Gross Reserves minus Gold 2005 (USD Billions)	Change in Reserves 2004-5 (USD Billions)	Rate of Increase
1	Japan	834	0	0.0%
2	China	822	207	25%
3	Taiwan	257	29	11%
4	S. Korea	210	11	5%
5	Russia	176	55	31%
6	India	132	5	4%
7	Hong Kong	124	1	1%
8	Singapore	116	4	3%
9	Mexico	74	10	13%
10	Malaysia	70	4	5%

Table 1a, Source: IMF

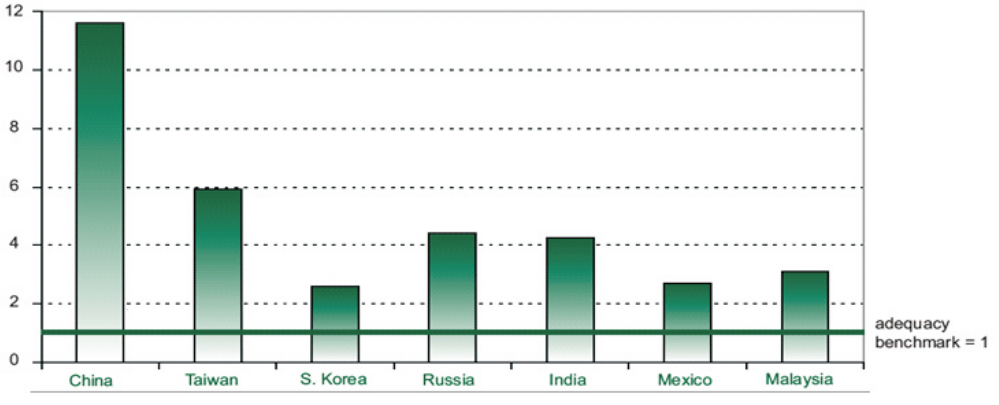

Figure 1a, Source: IMF and BIS

• Coverage of money supply, M2, in Figure 1b shows a similar picture. On this measure all economies are adequately reserved. India and Russia approach coverage of their entire broad money supply. It was emphasized by them that China was liberalizing controls on outward investment while facing a large, weak banking sector; India was consideringliberalizing its capital account and had large budget deficit; and Mexico had a history of capital flight into dollars. Indeed it was advised that India, Mexico and Russia should perhaps be measured against the low end of the 5-20% benchmark range as countries with the flexible exchange rate.

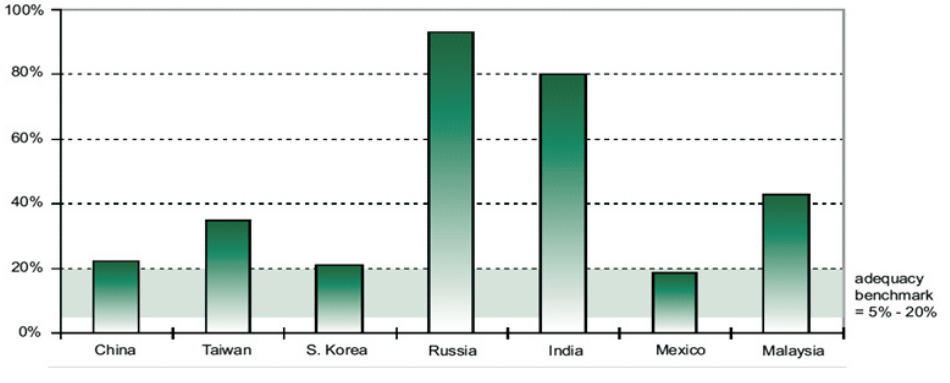

Figure 1b, Source: IMF and National Sources

• The third determinant which is trade based, i.e., import coverage was regarded as less relevant for economies with capital market access. Even so, none of the top reserve holders demonstrate vulnerability in Figure 1c. Mexico had the lowest import coverage ratio at 3.8 months. Every other economy was well beyond four months of import coverage.

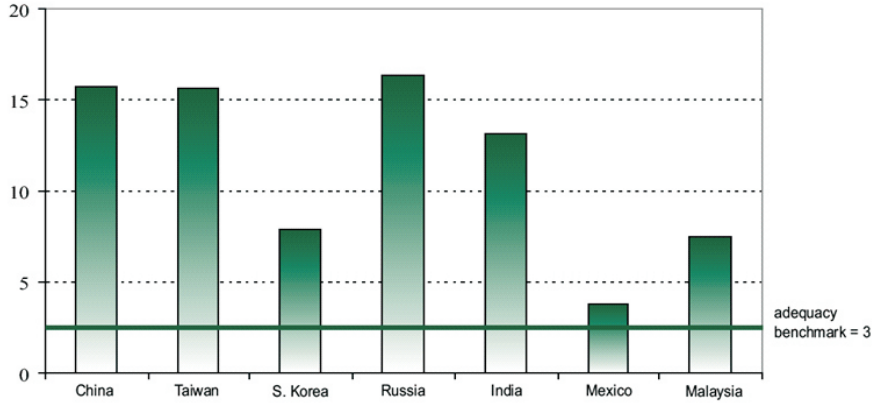

Figure 1c, Source: IMF and National Sources

• The comparisons presented thus far involve benchmarks against single statistics. Green and Torgerson considered a different approach wherein they included a full range of fundamentals by estimating the demand for reserves in multivariate setting. Their estimate of such a measure captures the relative weight put on various sources of vulnerability. This approach does not indicate divergence from appropriate levels of reserves, as countries may have followed suboptimal reserve policies in the past. However, under the assumption that countries generally hold adequate reserves relative to the fundamentals, the estimates can be used to determine whether out of sample reserve levels are adequate.

2. Polterovich and Popov (2003) reported for 1969-99 period and basically suggested that the accumulation of foreign exchange reserves (FER) contributes to the economic growth of a developing economy by increasing both the Investment/GDP ratio and capital productivity. It is widely known that devaluation of a currency can increase output in the short run, bringing actual output above the potential level, it is generally assumed that in the long run growth rates of output do not depend on the exchange rate, rather the exchange rate itself in the long run is considered as an endogenous variable determined by the growth rates of prices and outputs in two countries. There has been a strong empirical evidence that accumulation of foreign exchange reserves (FER) leads to a lower exchange rate, which in turn stimulates export led growth and countries with rapidly growing FER/GDP ratios, other things being equal, exhibit higher investment/GDP ratios, higher trade/GDP ratios, higher capital productivity and higher rates of economic growth. Now we will going to review the literature of findings and evidences presented by Poterovich and Popov in their paper, and these are as follows:

• Polterovich and Popov took all the data from the site of World Bank and they did an observation of about 100 countries for the period of 1960-99. It was seen that the average ratio of FER to GDP for 1960-99 ranged from several percent of GDP to several dozen percent (Hong-Kong- over 40%, Singapore- over 60%, Botswana- 60%; by the end of 1999 Botswana had reserves over 100% of GDP). In East Asian countries also the ratio of reserves to GDP in general increased, whereas in African and Latin American countries foreign exchange reserves grew lee rapidly than GDP. The theory suggests that smaller countries with higher foreign trade would have relatively (as a % of GDP) higher reserves, however, in practice this is not the case, there is practically no relationship between FER/GDP ratios and the GDP itself, no matter whether it is measured at PPP (Purchasing Power Parity) or official exchange rates.

• They found that FER were correlated with imports (with exports as well, but the correlation was much weaker, adjusted R2 was 26% and 13% respectively but were not correlated with many other variables that were supposed to explain the level of reserves. They basically tried the volatility of external trade, terms of trade, net

fuel imports, the current account, private capital flows, total debt and short-term debt, debt service payments, international and domestic interest rates - neither of the indicators was statistically significant. GDP per capita and the indicator of investment climate acquired the negative sign - the worse is the investment climate, other things being equal, poor countries with poor investment climate were advised to increase FER faster (probably using them as a collateral) than others. The average level of FER to GDP ratio for the long term period (1960-99) had a negative impact on the change of FER in 1975-99, which was in line with the intuition that countries with high level of FER did not need to increase it.

For the period 1975-99, the best equation explaining changes if FER is shown as below:

$?R = 39 - 0.4(R/Y_{60-99}) - 6.21gY - 0.3ICI_{84-90} + 0.2(T/Y) + 0.3([T/Y]'),$ (1)

R^2=50%, N=72, all coefficients significant at 3% level or less, where:

?R- the increase in the reserve/GDP ratio in 1975-99 p.p. Y- initial (1975) GDP per capita, T/Y- average ratio of foreign trade to GDP over the period, [T/Y]'- the increase in the same ratio over the period, (R/Y60 – 99)- average ratio of FER to GDP in 1960-99, ICI_{84-90} –average investment climate index in 1984-90 (ranges from 0-100, the higher, the better)

Then they considered the residual from this equation, ?Rpol, as the policy induced change in foreign exchange reserve, the logic behind this was to net out changes in FER/GDP ratio caused by objective circumstances, such as level of development and investment climate. Afterwards, they used policy induced change in foreign exchange reserves as one of the explanatory variables in growth regressions.

• It was observed for different periods that for different measures of FER- average for the period, as well as the increment for the period, as a proportion of GDP and in months of import. It was not observed however for developed countries. But fast growing developing countries more often than not appear to have high and rapidly growing reserves. It was quiet difficult to argue that the successful growth leads to rapid accumulation of reserves because the accumulation of reserves is a policy variable. Facts provide that countries with high reserves had better record of macroeconomic stability than the others. In any case, if successful growth is somehow accompanied by the rapid accumulation of FER, the appropriate question to ask was whether this reserve build up is a necessary pre-condition for growth, or whether this growth could continue without the reserve build up?

• They used standard growth regressions to show that the accumulation of reserves and policy-induced accumulation of FER matters for economic growth even after other factors are taken into account. Regression resultsshowed the link between investment/GDP ratios and growth, but also suggested that the accumulation of reserves creates stimuli for growth through greater involvement into foreign trade. It was suggested that the accumulation of FER is associated with greater involvement into the international trade that in turn produces externalities - higher capital productivity. The results for developing countries only were very similar.

• The data suggested that the impact of policies on monetary authorities on the exchange rate was by no means negligible, i.e., there was a negative relationship between the increase in FER and the exchange rate undervaluation as measured by the ratio of PPP exchange rate of local currency in US$ to the official exchange rate. It was argued that countries that pursue this kind of policy appear to experience some appreciation of real exchange rate, although even with this appreciation it remained lower than in countries with no reserve build up.

• It also appeared that the inflow of foreign direct investment (FDI) depends on the accumulation of foreign exchange reserves. There was surprisingly strong correlation between the increase in FER in 1960-99 and the net inflow of FDI in 1980s and 1990s. This was because, FER buildup underprices the exchange rate and thus makes domestic assets looked cheap in foreign currencies. China in recent 25 years may be a case in point where the inflow of FDI was miniscule for the whole period of 1980s, although the openness policy was enacted from the very start of reforms (1979) and the growth rates in 1980s were close to 10% a year. Only in 1990s, FDI was poured into China. It was seenthat inflows of FDI in 1980-99 were not correlated with the investment climate index, but was strongly correlated with buildup of FER in 1960-99. However, it was also seen that for some countries, the net inflow of FDI was larger than the increase in FER. Chile, Egypt, India, Malaysia, Mauritius, Singapore and Sri-Lanka were having a larger net inflow of FDI more than their FER, but was smaller than the FDI

inflow for Botswana and Korea.

• In the end, it was finally concluded by Poltrovich and Popov that accumulation of foreign exchange reserves is neither a necessary nor a sufficient condition of economic growth, it was found that countries that did not accumulated reserves grew faster than others because of better investment climate, better institutions, greater involvement in international trade achieved through the openness of their economies. It can also be said that countries experiencing low investment/GDP ratios despite accumulating ample amount of reserves was because of a poor investment climate that may result into high capital flights. On the other hand, they also tried to show us that accumulation of FER is a powerful macroeconomic mechanism of raising long term growth rates. This can be evidenced from, when a country has nothing else to do in a country with numerous government failures, poverty trap and institutional traps, there is at least a chance to provide an efficient 'big push' to economic development via accumulation of reserves by a central bank. The main difficulty that was pointed out by them was of the tradeoff between the rate of growth and current consumption.

3. Sahu (2015) basically placed his work on determining and maintaining the adequate level of reserves. He measured the level of India's foreign exchange reserves in terms of certain determinants of foreign exchange reserves (discussed in conceptual framework). The study period of his research was from 2001-02 to 2014-15 (December). The estimation and analysis of his findings are as follows:

• He emphasized on the level of foreign exchange reserves that India maintained during the period of study and it revealed that import coverage ratio far exceeds the international benchmark of 3 months. This measure of import coverage showed that India's yearly import coverage ratio was highest in 2003-04 and lowest in 2012-13. In terms of monthly import coverage in 2003-04 was 16.5 months, whereas in 2012-13 it was 6.5 months. India's ratio of foreign exchange reserve to import in all years was higher than 25% (standard benchmark) and in the first seven years forex reserves were higher than imports. This measure showed that India's forex reserves were adequate, but import is not the only factor determining the adequate level of forex reserves.

• The universally accepted ratio for covering short term external debt is 1, meaning that foreign exchange reserve should cover 100% of the country's short term debt and it should not fall below 100%. In India, it was found that this ratio was always more than 1, meaning India's forex reserve was always sufficient during the study period. It was argued that this could be the reason that India was not much affected by Lehman Crises 2007. It was found that not only India covered its 100% short term external debt, but India covered more than 50% of total external debt (TED) as against globally accepted norm of at least 40% coverage.

• Kapteyn (2001), suggested reserves equivalent to 5%-20% of M2, depending on the exchange rate regime, as an appropriate buffer. India maintains market determined exchange rate and it was found that ratio of foreign exchange reserve to broad money (M2) was always more than 10%.

• Countering evidence was found when Sahu combined all the three determinants and it showed the trend of foreign exchange reserve gap. Gap was estimated by taking the difference between estimated foreign exchange reserves by taking sum of year end imports, short term external debt and broad money and actual foreign exchange reserve holdings excluding gold reserves. This gap gradually increased from financial year 2001-01 till 2012-13, afterwards the trend reversed and gap started declining.

• The analysis of Mr. Sahu showed that it is not appropriate to cover only import coverage ratio as the determinant of optimum level of foreign exchange reserves, rather other factors like broad money and short term external debt should also be considered. Analysis showed that India holds more than adequate reserves when taken individually with all the three factors but when all the factors are take aggregately, the difference between actual forex reserves and estimated required reserves widened.

4. Dash and Narayanan (2011) attempted to identify the key determinants of foreign exchange reserves in India using Johansen (1995) Maximum Likelihood Vector Error Correction Model (VECM) on monthly as well as annual data for reserves, imports and nominal exchange rate. The methodology and findings of their literature are as follows:

• Dash and Narayanan intended to capture the short term dynamics and their approach began with a careful understanding of time series properties of the data. The variables included in their empirical model were imports, rupee-dollar bilateral nominal exchange rate, opportunity cost (call-money rate) and capital flows in

levels. While monthly frequencies were considered to allow for sufficient variability in data, annual figures were used for robustness check to monthly data estimates. For annual data, instead of reserves and exchange rate in levels, reserve volatility and exchange rate volatility were used. Monthly data covered the period 1994:5 to 2008:9 and annual data span over the period 1974-2008. Except imports and reserves, all data were drawn from the Reserve Bank of India Handbook of Statistics on Indian Economy 2008 and for imports and reserves, data were extracted from IMF International Financial Statistics.

• They emphasized that monthly data showed that all three series were moving together and had a stochastic trends signaling the possibility of a long run cointegrating relationship among these variables. It was found that an OLS (Ordinary Least Square) model failed to generate consistent estimates and cointegration technique was considered most suitable for analysis of non-stationary data. Accordingly Johansen (1988, 1991 and 1995) maximum likelihood (ML) method of multivariate conitegrating VECM (Vector Error Correction Model) was employed for the empirical estimation of the reserve demand function. The VECM representation of the Johansen approach with two and four lags was expressed as following:

$$\Delta X_t = \alpha\,(\beta X_{t-1} + \mu + \rho t) + \sum_{i=1}^{2} \Delta Xt - 1 + \square + \varepsilon_t$$

$$\Delta X_t = \alpha\,(\beta X_{t-1} + \mu + \rho t) + \sum_{i=1}^{4} \Delta Xt - 1 + \square + \varepsilon_t$$

Where 'X' represents the vectors of I(1) endogenous variables. For monthly data, reserves (LOGR), imports (LOGNM) and exchange rate (LOGEX) were endogenous variables whereas reserve volatility (LOGRVOL), exchange rate volatility (LOGEXVOL), imports (LOGNM), net capital account balance (LOGNK) and call money rate (CI) were endogenous variables for annual data estimates. The term 'ϒ' was the linear deterministic trend term in the model. The model assumes that the trends in the data are linear but not quadratic and allows the cointegrating variables to be trend stationary. The individual VAR equations in the VECM estimation provides the short run dynamics and 'α' measures the speed of adjustment in the error correction process.

• Augmented Dicky- Fuller (ADF) and Philips- Perron (PP) tests were used by the authors and it suggested that all the three variables were non stationary in levels and I (1) with or without trend (Table 4(i)). Final Predictor Error (FPE), Akaike's Information Criterion (AIC), Schwartz's Bayesian Information (SBIC) and Hanan and Quinn Information Criterion (HQIC) identified two information lags for the VECM estimation and it was found that two period lag was considered as too short to adequately capture short run dynamics and the auto regressive structure in monthly data, so empirical estimations were carried out at both two and four lags. The significant values of trace statistic, maximum Eigenvalue and minimum information criterion identified one cointegrating vector among reserves, imports and exchange rate at two lags and two cointegrating vectors at four lags.

• Like monthly data, the unit root test showed that model variables were first difference stationary, with or without trend and the number of cointegrating variables were identified by the test statistics varies depending upon the inclusion or exclusion of variables. As the study period covered only 35 years, the asymptotic properties of the annual data estimates were not entirely satisfied, however, according the model satisfied the post estimation diagnostics. It was found that the coefficients of imports and exchange rate volatility were significant at 1% level of significance and indicated a long run relationship among reserve volatility, exchange rate volatility and imports. It was also found that large volatility in exchange rate implies less use of reserves for adjustment and the expected sign of the exchange rate volatility should be negative in the reserve volatility equation.

• So, at last it was suggested that there exists a long run relationship among imports, reserves and exchange rate and the monthly data estimations showed that the exchange rate shock exerts a permanent effect on reserves, both on level and volatility. The results from estimations using annual data broadly replicated the results from estimation based on monthly data.

5. Chowdhury, et. al. basically placed their work on the determinants of foreign exchange reserves in Bangladesh. Their paper attempted to identify the key determinants of foreign exchange reserves in Bangladesh

using Augmented Dicky Fuller (ADF) unit root test to examine the stationarity, Engle Granger residual based co-integration approach to show the co-integrating relationship among variables, and diagnostic tests for better modeling. The findings of their work is as follows:

• They used annual time series data for the period of 1972-2011 for the ten variables, remittance (% of GDP) and exchange rate. Inflation rate differential, unit price index of imports, unit price index of exports, home interest rate, broad money M2 (% of GDP), foreign aid (% of GDP) and per capita GDP in PPP dollar. Data in this study has been used extensively from the secondary sources.

• They took a regression analysis to determine the factors affecting the foreign exchange reserves. A total of three regression models were tested. The three models are as follows:

Model A: measures the effects of exchange rate, home interest rate, foreign aid, remittance, broad money (M2), inflation rate differential, UPI of import and export, and per capita GDP on the foreign exchange reserves.

Model B: measures the effects of exchange rate, home interest rate, foreign aid, remittance, broad money (M2), UPI of import and export, and per capita GDP on the foreign exchange reserves.

Model C: measures the effects of exchange rate, home interest rate, remittance, broad money (M2), UPI of import and export, and per capita GDP on the foreign exchange reserves.

Model A

In linear Model A, foreign exchange reserves(% of GDP) has been assumed to be a linear function of exchange rate, home interest rate, foreign aid(% of GDP), remittance(% of GDP), broad money M2(%), inflation rate differential, UPI of import and export, and per capita GDP(PPP).

The linear model A is defined as follows:

$$Y_t = \beta_1 + \beta_2 EXC + \beta_3 EXO + \beta_4 FOA + \beta_5 GDP + \beta_6 HOI + \beta_7 IMP + \beta_8 INF + \beta_9 M2 + \beta_{10} REM + U_t$$

Where, Y_t is foreign currency reserves in % of GDP (excluded gold) for period t; where t = sample year 1 to 39 over the period from July 1973 to July2011. EXC is the exchange rate, FOA is the % of GDP of foreign aid , HOI is the bank rate that is called home interest rate, IMP is the Unit price index of imports (IMP) that is obtained on the base year of 1988-89, EXO is the Unit price index of exports that is obtained on the base year of 1988-89, REM is the % of GDP of remittance ,INF is the inflation rate differentials which are calculated by subtracting the US inflation from Bangladesh inflation, M2 is the broad money (M2) as % of GDP, GDP is the per capita gross domestic product , PPP (current international US dollar).

Model B

In linear Model B, the inflation rate (INF) is excluded from the model A and the model is defined as follows:

$$Y_t = \beta_1 + \beta_2 EXC + \beta_3 EXO + \beta_4 FOA + \beta_5 GDP + \beta_6 HOI + \beta_7 IMP + \beta_9 M2 + \beta_{10} REM + U_t$$

Model C

They have excluded foreign aid from linear model B and the model C is characterized as follows:

$$Y_t = \beta_1 + \beta_2 EXC + \beta_3 EXO + \beta_5 GDP + \beta_6 HOI + \beta_7 IMP + \beta_9 M2 + \beta_{10} REM + U_t$$

• After applying the ordinary least square method, the applied the ADF test to the exchange rate, home interest rate, foreign aid, remittance, broad money (M2), inflation rate, UPI of import and exports, per capita GDP and foreign exchange reserves series separately for checking the stationarity of data, as this is a time series data and generally time series data tend to be non-stationary. They carried out the estimation of models using

econometric software E-Views and tested the presence of unit roots using the systematic procedure described in Enders (1995). The results of the Augmented Dickey-Fuller (ADF) test for the stationarity of the ten original series are presented in Table 5.1. it was found that each time series have at least one unit root except inflation rate differential and hence are non-stationary in their original form.

They then tested the stationarity of the first difference of these series by applying the ADF test on the first difference series. As can be seen, the results showed that these series are stationary in their first difference form. This means all series are I(1) except inflation rate differential that is I(0).

Table 5.1

Variable	ADF test at level			ADF test at first difference			Status
	t-statistic	Critical value at 5%	Decision	t-statistic	Critical value at 5%	Decision	
EXC	-0.811570	-2.967767	Non-stationary	-6.363493	-2.967767	stationary	I(1)
EXO	2.504925	-2.941145	Non-stationary	-4.515393	-2.943427	stationary	I(1)
FOA	-1.218695	-2.941145	Non-stationary	-9.007575	-2.943427	stationary	I(1)
GDP	9.616029	-2.943427	Non-stationary	-3.721247	-2.943427	stationary	I(1)
HOI	-0.990202	-2.943427	Non-stationary	-5.879651	-2.943427	stationary	I(1)
IMP	0.968335	-2.941145	Non-stationary	-6.082325	-2.943427	stationary	I(1)
M2	1.406313	-2.945842	Non-stationary	-3.965535	-2.945842	stationary	I(1)
REM	1.507945	-2.941145	Non-stationary	-5.160532	-2.943427	stationary	I(1)
YT	-0329.645	-2.941145	Non-stationary	-5.431964	-2.943427	stationary	I(1)
INF	-5.86466	-2.941145	stationary				I(0)

• Results of their study are presented in Table-5.2 which showed that exchange rate,home interest rate, exports, money supply and GDPsignificantly affect the foreign exchange reserves, but thesign of coefficient of imports and home interest rate are inopposite to what were expected by them. The linearmodel B shows that these eight variables could independently explain about 85.76 percent of the foreignexchange reserves movements. With the exclusion of foreign aid, the linear model C could explain approximately 85.58percent of the foreign exchange reserves movements, but theeffect of remittance becomes significant, and six variableswithin seven variables become significant.

Table 5.2

Variables	Model B			Model C		
	Coefficient	Std. Error	Pro.	Coefficient	Std. Error	Pro.
CONSTANT	12.00241	3.008518	*0.0004*	14.04276	2.471971	*0.00000*
EXC	-51.34161	12.51909	*0.0003*	-52.04222	12.58147	*0.0002*
EXO	-0.031019	0.010122	*0.0046*	-0.036584	0.009000	*0.0003*
FOA	0.261609	0.222624	*0.2492*			
GDP	0.026051	0.004427	*0.00000*	0.025316	0.004410	*0.0000*
HOI	-1.055174	0.186320	*0.00000*	-1.071851	0.186917	*0.0000*
IMP	-0.016035	0.012492	*0.2091*	-0.012506	0.012200	*0.3132*
M2	-0.358321	0.071658	*0.00000*	-0.367896	0.071629	*0.0000*
REM	0.411960	0.322247	*0.2109*	0.627100	0.266813	*0.0253*
F-Value	29.60582			33.22965		
Adjusted R^2	0.857596			0.855846		

They got negative co-efficient of exchange rate which implied that as exchange rate decreases forex reserves will increase, as export will increase and import will decrease. This was because as there is a direct relation between exchange rate and imports while there is an inverse relation between exchange rate and exports. They got the following as a final model.

$$Y_t = 14.042 - 52.04EXC - 0.037EXO + 0.025GDP - 1.0719HOI - .0125MP - 0.368M2 + 0.6271REM$$

If EXC reduces 1 unit, foreign exchange reserves will increase 52.04% as a percentage of GDP. Again, if UPI ofexport increases 1 unit, foreign exchange reserves decrease 0.037% as a percentage of GDP. To sum up the analysis, it can be concluded that exchange rate and remittance are the major determinants to determine forex

reserves that are statistically and economically significant too.

• Finally after testing, it was found that exchange rate, home interest rate, foreign aid, remittance, broad money supply (M2), inflation rate differential, import, export and GDP as candidates for the threshold variables, they identified that exchange rate, home interest rate, remittance, broad money supply (M2), UPI of import and export and per capita GDP as threshold variables that may determine the foreign exchange reserves. The major findings of the paper states that foreign currency reserves linearly depend on exchange rate, home interest rate, remittance, broad money supply (M2), UPI of import and export and per capita GDP. It was also found that foreign aid is not a significant determinant of foreign reserves for the sample data. It was so because, in recent years, many developed and international organizations have reduced their considerable amount of aid due to various causes such as the global economic recession, various unfeasible condition by donor countries, unwanted existing corruption of the country, and so on. As a result, the amount of aid has been anchored by less than 1% of GDP in year of 2012.

CRITICAL REVIEW

• From reviewing the various studies, we found that Green and Torgerson (2007) emphasized on the fact that foreign exchange reserves are also used for speculative purposes apart from transaction and precautionary purposes to use them for non-currency crises purposes. Speculative motive basically purports to the motive of profit making which is not the objective of Central Banks of the countries. Central Bank is not a profit making organization, its main purpose is to serve the economy and therefore we cannot say that a Central Bank uses foreign exchange reserves for speculative purposes. However, private players in the foreign exchange market like foreign exchange brokers, dealers, etc. may indulge in speculative activities with the use certain currency futures and swaps, but the proportion of their holdings in the total holdings of foreign exchange reserves would be very small.

• As reviewed through various studies, it was found that there are basically three motives for holding foreign exchange reserves, which ultimately helps in determining foreign exchange reserves. These motives are transaction motives, precautionary motives and speculative motives. These three motives are the motive for holding money and not foreign exchange reserves. Motives for holding money is a concept in household economics, whereas the motives for holding foreign exchange reserves are primarily broad macro level decisions taken by Central banks. Therefore the factors for holding foreign exchange reserves are quite different and these were explained in the conceptual framework.

• Green and Torgerson (2007), Sahu (2015) identified almost the same determinants of foreign exchange reserves, but the study of Sahu was fully based on Indian economy whereas that of Green and Torgerson focused on the emerging market economies. They identified four determinants of foreign exchange reserves, namely, import based trade indicators, the famous Greenspan Giudotti rule of covering short term external debt, coverage of broad or base money and a reserve drainer approach. These determinants have been explained in the conceptual framework. Dash and Naraynan (2011) also identified these deteminants as the key factors for determining the foreign exchange reserves. On the other hand, it was found that Polterovich and Popov (2003) basically focused on trade as the key factor in determining the foreign exchange reserves. They found that foreign exchange reserves are more responsive to imports as compared to exports as the adjusted R2 for imports was higher that adjusted R2 for exports. They mainly stressed on the international trade as the major determining factors of foreign exchange reserves. Polterovich and Popov(2003) also found one more factor which is foreign direct investment (FDI).

• So at last, after reviewing various studies, it can be concluded that there are basically four determinants of foreign exchange reserves, which are import coverage ratio or trade based indicators, the Greenspan Guidotti rule or debt based indicators, the coverage of broad or base money (M2) and a composite approach wherein all the three components are used in determining the adequate level of foreign exchange reserves. However, it has not been concluded that which factor from among the four alternatives is the most suitable for determining the adequate level of foreign exchange reserves. This study can be further utilized for an empirical analysis in determining the factors which helps in determination of adequate level of foreign exchange reserves.

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