

## AN ANALYSIS OF VOLATILITY IN THE FOREIGN EXCHANGE RESERVES IN INDIA

**Dr. R. Rajanbabu<sup>1</sup> Dr. G. Monikanda Prasad<sup>2</sup> and Dr. K. Manoj<sup>3</sup>**

<sup>1&2</sup>Assistant Professor, Department of Economics, Manonmaniam Sundaranar University,  
Tirunelveli, Tamil Nadu, India

<sup>3</sup>Assistant Professor, Department of Statistics, Manonmaniam Sundaranar University,  
Tirunelveli, Tamil Nadu, India

<sup>1</sup>rajaneco@rediffmail.com

**Abstract** - This paper is primarily concerned with an analysis of the volatility and trends in the foreign exchange reserves of India. In order to achieve the objective, newer data available for India's forex reserves are utilised. Annual data for the sample period 2000-2001 to 2017-18, on SDR, Gold, Foreign Currency Assets and RTP in the Indian forex reserves are used. Hence, the present paper has attempted to extract the data from the prowess- rbi.org.in. For the purpose of detailed analysis and to make the inferences the conventional statistical tools i.e. coefficient of variation and instability index have been used in this paper. The analysis of the data reveals that foreign exchange reserves have significantly changed over the years. All the components noticed high volatility except foreign currency assets during the period under review. However, on the whole, it was observed that the degree of stability slightly increased for foreign exchange reserves in India over the periods and holds adequate level of foreign exchange reserves.

**Keywords:** Foreign Exchange Reserves, Forex Reserves, Gold, IMF, RTP, SDRs, Volatility

### INTRODUCTION

Foreign currency reserves are vital to a nation's economic well-being. Without adequate reserves, an economy can grind to a halt, and a country may be unable to pay for critical imports, such as crude oil, or service its external debt. Globally, there has been no exclusive definition of forex exchange reserve. Most central banks' differ among themselves in terms of coverage of items, ownership of assets and liquidity aspects. Globally central banks have accepted the definition suggested by the International Monetary Fund (Balance of Payments Manual, and Guidelines on Foreign Exchange Reserve Management, 2001). The International Monetary Fund (IMF) defines foreign reserves as external assets that a country's monetary authority can use to meet the balance of payments financing needs, affect currency exchange rates in currency exchange markets and other related purposes. Most nations hold the vast majority of their foreign currency reserves in U.S. dollars and a much smaller portion in euros.

## **Background**

In India, Reserve Bank of India (RBI) Act, 1934 gives power to RBI to act as the custodian of foreign exchange reserves and manage reserves with defined objectives. RBI Act, 1934 says 'to use the currency system to the country's advantage and with a view to securing monetary stability. This implies that maximum gains for the country as a whole or economy in general could be derived in the process of reserve management, which not only provides for considerable flexibility to reserve management practice, but also warrants a very dynamic view of what the country needs and how best to meet the requirements. The term 'forex reserves' refers to value of gold holding, Special Drawing Rights (SDRs), Foreign Currency Assets (FCAs) and Reserve Position in the IMF. The most understandable reason for holding foreign exchange reserve by any country's central bank is insurance against currency crisis (Russell Green and Tom Torgerson, 2013). RBI has the same motivation and holds foreign exchange reserves basically for three motives, viz. transaction, speculation and precautionary. Transaction means managing currency flows due to international trades. Speculative motive is due to individuals and corporate trading in currency market. Precautionary motive is guided by covering unpredictable flows due to global vulnerability, deficits, return from alternative assets, etc. Moreover, forex reserves are maintained to enhance confidence in country's monetary policy and exchange rate policy, enabling orderly absorption of international money and capital flows, enhancing capacity to intervene in forex market to curb excess volatility, to balance between demand and supply of foreign currency, to preserve and improve confidence in the market especially rating agencies about the country's ability to meet external obligations and to provide market participants confidence by backing domestic currency by external assets. However, foreign exchange reserves are not the only buffers against crisis. A few alternatives to foreign exchange reserves which are very close to reserves are currency swap line with other countries' central bank, precautionary credit line from IMF and commercial banks, sovereign wealth funds, etc.

## **Reserve Management Policy in India**

Prior to 1991 payment crisis, India's approach towards foreign exchange reserve management was to maintain foreign exchange reserves to cover few months import bill. The above approach came under severe pressure from the increase in trade deficit and net invisible deficit, which led the RBI to devalue Indian rupee twice on July 1 and July 3, 1991. This led to the introduction of Liberalized Exchange Rate Management System (LERMS) in March 1992 with twin objectives of building foreign exchange reserve and discouraging non-

essential imports. Under this a double exchange rate system was adopted. Under LERMS, exporters could sell 60 percent of their foreign exchange earnings to authorised dealers in the open market at market determined exchange rate, while remaining 40 percent was to be sold compulsorily to RBI at exchange rate decided by RBI. This approach of foreign exchange reserve management underwent a paradigm shift with the adoption of the recommendations of the High Level Committee on Balance of Payments (Chairman: Dr. C. Rangarajan). The Committee recommended introduction of market determined exchange rate regime within limits; liberalization of current account transactions (i.e. full current account convertibility); encouraging capital flows from debt market to equity market; strict regulation of external commercial borrowing, especially short term debt; placed current account deficit (CAD) at 1.6 percent of GDP as ceiling, etc. The Committee also said that while determining appropriate level of foreign exchange reserves attention should be paid to payment obligation arising out of other than those for imports. The factors to be considered while determining appropriate level of foreign exchange reserves are: the need to ensure confidence to international financial community about country's ability to meet.

### **Forex Reserves**

In simplest terms foreign exchange reserves are the foreign currencies which are held by the central bank to support liabilities on the issued currency and also a way to influence the monetary policies of the country. It includes government securities, bonds, bank notes, bank deposits and treasury bills.

Regardless of the size of the economy almost all countries in the economy hold significant foreign exchange reserves and most of them being held in U.S dollars which is the most traded currency. Other currencies in reserves are British pound sterling, euro, Chinese Yuan, and Japanese Yen. Theorists believe that holding reserves in currencies which is not immediately connected to its own is best policy. As of August 2018 China holds the largest foreign exchange reserves \$3210 billion.

The holding of forex is used to back the one's domestic currency. Countries who wish to have fixed exchange rate uses forex reserves as a tool of monetary policy. Central institution has ability to exert some control over exchange rates by retaining the option to shove reserves from another currency in to the market.

## **COMPONENTS OF FOREIGN EXCHANGE RESERVES**

### **(i) Special Drawing Rights**

“The SDR is an international reserve asset, created by the IMF in 1969 to supplement its member countries’ official reserves. SDRs can be exchanged for freely usable currencies. The value of the SDR is based on a basket of five major currencies— the U.S. dollar, euro, the Chinese renminbi (RMB), the Japanese yen, and pound sterling as of 2018” - IMF.

“The SDR was created by the IMF in 1969 as a supplementary international reserve asset, in the context of the Bretton Woods fixed exchange rate system. A country participating in this system needed official reserves government or central bank holdings of gold and widely accepted foreign currencies that could be used to purchase its domestic currency in foreign exchange markets, as required to maintaining its exchange rate. But the international supply of two key reserve assets gold and the U.S. dollar proved inadequate for supporting the expansion of world trade and financial flows that was taking place. Therefore, the international community decided to create a new international reserve asset under the auspices of the IMF”.

### **(ii) Gold Reserves**

“Gold played a central role in the international monetary system until the collapse of the Bretton Woods system of fixed exchange rates in 1973. Since then, its role has diminished. But it remains an important asset in the reserve holdings of several countries, and the IMF is still one of the world’s largest official holders of gold. In line with the new income model for the Fund agreed in April 2008, profits from limited gold sales were used to establish an endowment, and used to boost the IMF’s concessional lending capacity to eligible low-income countries (LICs).

The IMF holds around 90.5 million ounces (2,814.1 metric tons) of gold at designated depositories. On the basis of historical cost, the IMF’s total gold holdings are valued at SDR 3.2 billion (about \$4.5 billion), but at current market prices, their value is about SDR 80.1 billion (about \$112.7 billion). The IMF acquired its gold holdings through four main channels:

- a. When the IMF was founded in 1944 it was decided that 25 percent of initial quota subscriptions and subsequent quota increases were to be paid in gold. This represents the largest source of the IMF's gold.

- b. All payments of charges (interest on member countries' use of IMF credit) were normally made in gold.
- c. A member wishing to acquire the currency of another member could do so by selling gold to the IMF. The major use of this provision was sales of gold to the IMF by South Africa in 1970–71.
- d. Member countries could use gold to repay the IMF for credit previously extended.

The Second Amendment to the Articles of Agreement in April 1978 fundamentally changed the role of gold in the international monetary system by eliminating its use as the common denominator of the post-World War II exchange rate system and as the basis of the value of the Special Drawing Right (SDR). It also abolished the official price of gold and ended its obligatory use in transactions between the IMF and its member countries. It furthermore required the IMF, when dealing in gold, to avoid managing the price of gold, or establishing a fixed price.”

### **(iii) Foreign Currency Assets**

Foreign Currency Assets (FCA) that is the most important component of the RBI's foreign exchange reserve is the assets like US Treasury Bills bought by the RBI using foreign currencies. The FCA is the largest component of the forex reserve.

### **(iv) Reserve Tranche Position**

International Monetary fund is financed by member's quota. Each member of the IMF is assigned a quota part of which is payable in SDR's or specified useable currencies (Reserve Assets) and part in member's own currency. The difference between a member's quota and the IMF's holding of its currency is a country's Reserve Tranche Position (RTP). The reserve tranche position of the quota can be accessed by the member at any time, whereas the rest of the member's is typically inaccessible.

### **Major Countries with the Biggest Forex Reserves**

Here are the 10 countries with the largest foreign currency reserve assets as of August 2018. All reserve assets are given in billions of U.S. dollars.

TABLE I: TEN COUNTRIES WITH THE LARGEST FOREIGN CURRENCY RESERVE

Rank	Country	Foreign Currency Reserves (in billions of U.S. dollars)
1	China	\$3,210.0
2	Japan	\$1,259.3
3	Switzerland	\$804.3
4	Saudi Arabia	\$501.3
5	Russia	\$460.6
6	Taiwan	\$459.9*
7	Hong Kong	\$424.8
8	India	\$403.7
9	South Korea	\$402.4
10	Brazil	\$379.4

Source: IMF, 2018; \*Central Bank of the Republic of China)

The above table lists China's and Hong Kong's reserves separately. China has by far the largest foreign currency reserves with over two and a half times more than the second largest reserve holder, Japan. When China and Hong Kong reserves are considered together, the total is \$3.6 trillion. Asian nations dominate foreign currency reserves, accounting for six of the top 10. As of August 2018, India had foreign currency reserves of \$403.7 billion and witnessed eighth position in the world.

The United States had foreign currency reserves of \$123.5 billion as of August 2018. The United Kingdom, which did not make the list, had \$187.4 billion in foreign reserves as of August 2018. Maintaining foreign currency reserves is vital to the economic health of a nation. The top 10 nations in terms of foreign currency reserves had combined reserve assets of \$8.3 trillion as of March 2018, over half of which was accounted for by China and Hong Kong.

### EARLIER STUDIES

Charansingh (2006) India's foreign exchange reserves increased during the 1990s as a result of measures introduced to liberalize capital inflows under the financial sector reforms undertaken since 1991. The Reserve Bank of India, in consultation with the government, currently manages foreign exchange reserves. As the objectives of reserve management are liquidity and safety, attention is paid to the currency composition and duration of investment so that a significant proportion can be converted into cash at short notice. The government of India intended to use a part of its foreign exchange reserves to finance infrastructure. There is

no evidence that any other country has used foreign exchange reserves to finance infrastructure. The amount of foreign exchange reserves in India is modest when compared to some of the other countries in the region and it can be argued that the proposed plan may lead to more economic difficulties than anticipated benefits.

Arunachalam (2010) research work done on development over two centuries. In this research an attempt has been made to study the two booming economies of the globe with respect to their foreign exchange reserves. This study mainly based on secondary data published by respective governments and various studies done on this area. One of the paradoxes of India's hugely successful efforts since 1991 to shore up its reserves is that they are mostly in a basket of foreign currencies that are subject to volatility and disruptions.

Vanlalramsanga and Ramesh Golait (2012) found that an increase in India's foreign exchange reserve is driven mainly by the foreign-currency assets' component, while the corresponding increase in the gold reserve component did not occur for a fairly long time. Furthermore, the gold holdings in India, in terms of percentage, are relatively lower compared with increasingly sizable holdings in most of the advanced countries and even some EMEs. In general for all countries, percentage of gold holdings is seen to have been showing an increase.

Mayuresh and Ramana Raju (2013) used a time series data of the variables between 1980 and 2010 the study tries to establish a causal relationship between exchange rate and foreign exchange reserves in the Indian context. Emphasis has been laid on understanding the impact of foreign exchange reserves on the exchange rate. India has accumulated unprecedented foreign exchange reserves and synchronously has been experiencing a large depreciation in its Rupee vis a vis US dollar. Saba Abid and Neelam Jhawar (2017) analysed the trend in foreign exchange reserves and its components in India. The period of the study was defined from 2011 to 2016. The analysis of the data revealed that foreign exchange reserves have significantly changed over the years.

## **THEORETICAL FRAMEWORK**

The theory and practice of foreign exchange reserves is as complex as any other contemporary economic issue. While it is not easy to provide answers to all the questions raised in the recent debate on foreign exchange reserves management policy, in India have had such a long journey from the agony of 1991 to the comfort of today and this has come about only by dint of hard work and implementation of prudent policies which has made India, a respected model in the emerging world.

## STATEMENT OF RESEARCH

Foreign exchange reserves increases the confidence in the monetary policies as well as exchange rate policies of the government. The capacity of the central bank to intervene in foreign exchange market and to control any adverse movement is enhanced. Also the capacity to stabilize the forex rates to provide more favourable economic environment for the country is also enhanced.

During the crises forex reserves come to the rescue of any country and absorb the distress or shocks. Domestic currency gets backed by external assets and is good for equity market since the forex reserves are strong then people from different countries wants to invest in the country. In this light of its importance, an attempt on foreign exchange reserves has been undertaken with the following specific objectives are:

## OBJECTIVES OF THE STUDY

1. To examine the foreign exchange reserves in India.
2. To estimate the volatility of forex reserves in India with reference to selected components.
3. To analyse the trends in the foreign exchange reserves of India.

## Hypothesis

*H<sub>1</sub>*: India's foreign exchange reserves are expected to be stable during the period of study.

## METHODOLOGY

### Data Source

In order to achieve the above objective, newer data available for India's forex reserves are utilised. Annual data for the sample period 2000-2001 to 2017-18, on SDR, Gold, Foreign Currency Assets and RTP in the Indian forex reserves are used. Although various journals, magazines, websites likes i.e. rbi.org.in, Central Statistical Organization (CSO), Handbook of Statistics on Indian economy provide the secondary information on forex reserves. Hence, the present study has attempted to extract the data from the prowess-rbi.org.in.

## Data Analysis

For the purpose of detailed analysis and to make the inferences the conventional statistical tools i.e. coefficient of variation and instability index have been used in this study.

### *Coefficient of Variation*

The coefficient of variation in gold, RTP, SDR and foreign currency assets were computed by using the following exponential functional form for the period 2000-2001 to 2017-18.

The formula for the coefficient of variation is:

$$\text{Coefficient of Variation} = (\text{Standard Deviation} / \text{Mean}) \times 100.$$

In symbols:

$$CV = \frac{\sigma}{\bar{x}} \times 100$$

### *Instability Model*

Foreign exchange reserves like other economic variables do not have a fixed trend over time. This volatility has some costly effect on the economic system of any country. This fluctuation is called instability. As cannot find just one clear definition for instability, here some comparative research on that. The first economist to define instability was Coppock. He believes that, sometimes fluctuations of variables are not unutilized or unwanted changes, but the aim of economic activities is to find the best usage of variable volatility.

So he had a comparative research between useful fluctuation and some another kind of fluctuation that make problems for economic system (Coppock, 1962; 29).

Coppock (1977; 4) discussed that instability is not only residual, but also more than normal from this trend. Therefore, he believes that it is different in meaning from wasteful or excessive or normal. Most of economists think about one fixed trend and residual as a definition of instability. In this way, just found a normal trend of variable and instability that is a kind of volatility from this trend.

In order to analyse the stability in gold, RTP, SDR and foreign currency assets, the Coppock's Instability Index was constructed using the formula:

$$V \log = \sum \frac{\left[ \left( \log \frac{X_t + 1}{X_t} - m \right) \right]^2}{N - 1}$$

$$\text{Instability Index} = (\text{Antilog } \sqrt{V \log - 1}) \times 100$$

Where,

$X_t$  = Gold/RTP/SDR/Foreign Currency Assets in year t;

N = Number of years;

m = Arithmetic mean of the differences between the logs of  $X_t$  and  $X_{t-1}$ ;  $X_{t+1}$  and  $X_{t+2}$  and so on; and

V log = Logarithmic variance of the series.

## LIMITATIONS OF THE STUDY

The major limitations of the study are

1. The study is made only in consideration with India and not applicable to any part of the globe.
2. Only annual data is used for the analysis and not daily, weekly, monthly or quarterly.
3. The study fully depends on the secondary data, which has its own limitations.

## RESULTS AND DISCUSSION

### Volatility Analysis of Foreign Exchange Reserves in India

The table II presents data on the foreign exchange reserves in Indian currency during the period from 2000-01 to 2017-18. The total foreign exchange reserves in India has increased from Rs.1,972.04 billion in 2000-01 to a maximum of Rs.27,608 billion in 2017-2018, which reflects the total foreign exchange reserves in India in terms of value has been increased 14 times within 18 years period. The instability index (11.87) was found to be fairly stable over the periods for the total foreign exchange reserves. The magnitude of instability of index was also relatively less than in the case of components of total reserve studied.

TABLE II: FOREIGN EXCHANGE RESERVES IN INDIAN CURRENCY FROM  
2000-01 TO 2017-18 (IN BILLION)

Year (End of Fiscal)	SDR##	Gold#	Foreign Currency Assets*	RTP	Forex Reserves
2000-01	0.11	127.11	1844.82	-	1972.04
2001-02	0.50	148.68	2491.18	-	2640.36
2002-03	0.19	167.85	3414.76	31.90	3614.70
2003-04	0.10	182.16	4662.15	56.88	4901.29
2004-05	0.20	196.86	5931.21	62.89	6191.16
2005-06	0.12	256.74	6473.27	33.74	6763.87
2006-07	0.08	295.73	8365.97	20.44	8682.22
2007-08	0.74	401.24	11960.23	17.44	12379.65
2008-09	0.06	487.93	12300.66	50.00	12838.65
2009-10	225.96	811.88	11496.50	62.31	12596.65
2010-11	204.01	1025.72	12248.83	131.58	13610.13
2011-12	228.60	1382.50	13305.11	145.11	15061.30
2012-13	235.40	1397.40	14126.30	125.10	15884.20
2013-14	268.30	1296.20	16609.10	110.20	18283.80
2014-15	249.40	1191.60	19854.60	80.80	21376.40
2015-16	99.60	1334.30	22190.60	162.90	23787.40
2016-17	93.80	1288.30	22449.40	150.50	23982.00
2017-18	100.20	1397.40	25975.70	135.20	27608.50
CV	114.70	71.42	60.70	63.62	60.88
II	796.33	15.95	12.78	54.78	11.87

Source: Reserve Bank of India

Note: CV% = Coefficient of variance, II = Instability Index  
- : Negligible.

\*: Foreign Currency Assets exclude investment in foreign currency denominated bonds issued by IIFC (UK), SDRs transferred by Government of India to RBI and foreign currency received under SAARC SWAP arrangement. Foreign currency assets in US dollar take into account appreciation/depreciation of non-US currencies (such as Euro, Sterling, Yen, Australian Dollar, etc.) held in reserves. Foreign exchange holdings are converted into rupees at rupee-US dollar RBI holding rates.

#: Includes 314.63 Billion (US \$ 6699 million) reflecting the purchase of 200 metric tonnes of gold from IMF on November 3, 2009.

##: Includes SDRs 3082.5 million allocated under general allocation and SDRs 214.6 million allocated under special allocation by the IMF done on August 28, 2009 and September 9, 2009, respectively.

In the beginning of year special drawing rights was merely Rs.0.11 billion and it fluctuated over the years. Maximum of Rs.268.30 billion was witnessed in 2013-14 and subsequently it has decreased to Rs.100.20 billion. Thus, the coefficient of variation was found to be very high (114.70 percent). The instability index too reflects the incredible volatility trend as pointed out by the coefficient of variation. The main reason for this inconceivable result due to the sudden hike occurred in the year 2009-10. Because it includes SDRs 3082.5 million allocated under general allocation and SDRs 214.6 million allocated under special allocation by the IMF done on August 28, 2009 and September 9, 2009, respectively. Consequently it shows that the special drawing rights became drastically volatility with the passage of time.

The total gold reserves has increased from Rs.127.11 billion in 2000-01 to the highest of Rs.1397.40 billion in end of the study period. The coefficient of variation for gold reserves was found to be high (71.42 percent). The instability index (15.95) for gold reserves not reflects as much the same trend as indicated by the coefficient of variation. It was observed that the degree of volatility increased for gold reserves over the periods particularly for last decade.

The foreign currency assets in India increased from Rs.1844.82 billion to a maximum of Rs.25975.70 billion in the end year of the study period. It shows that the value of foreign currency assets has been increased fourteen times within 18 years period. The coefficient of variation for foreign currency assets was found to be the far above the ground (60.70 percent). For the foreign currency assets, the instability index was found to be quite stable (12.78) over the periods.

In the starting of year, the reserve tranche position was Rs.31.90 billion and it has increased to Rs.162.90 billion in 2015-16. The coefficient of variation for reserve tranche position was found to be high (63.62 percent). The instability index (54.78) also reflects the same trend as indicated by the coefficient of variation. It shows that the reserve tranche position became unstable with the passage of time.

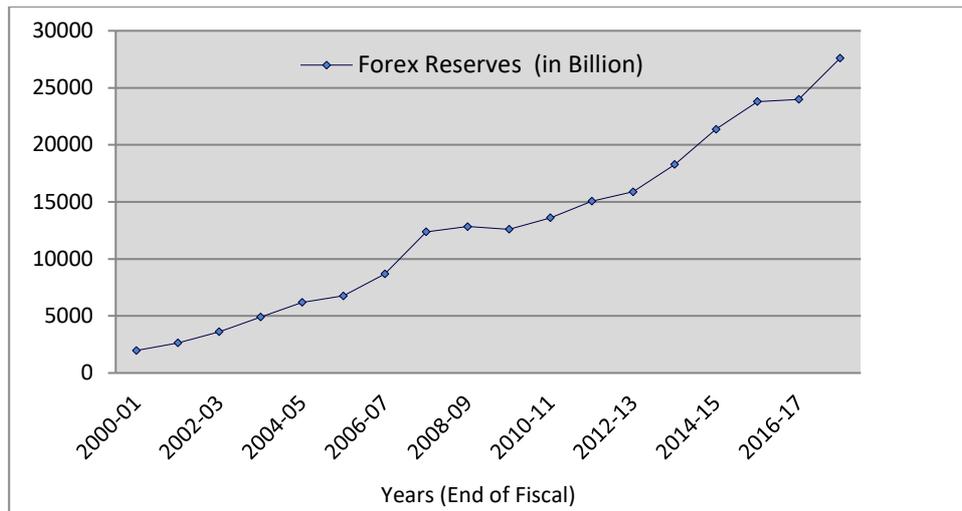


Fig. 1: Foreign Exchange Reserves in Indian Currency

**Ratio of Reserves**

TABLE III: RATIO OF RESERVES TO TOTAL FOREX RESERVES FROM 2000-01 TO 2017-18 (IN PERCENT)

Year (End of Fiscal)	SDR	Gold	Foreign Currency Assets	RTP
2000-01	0.006	6.446	93.549	1.471
2001-02	0.019	5.631	94.350	1.136
2002-03	0.005	4.644	94.469	0.883
2003-04	0.002	3.717	95.121	1.161
2004-05	0.003	3.180	95.801	1.016
2005-06	0.002	3.796	95.704	0.499
2006-07	0.001	3.406	96.357	0.235
2007-08	0.006	3.241	96.612	0.141
2008-09	0.001	3.800	95.810	0.389
2009-10	1.794	6.445	91.266	0.495
2010-11	1.499	7.536	89.998	0.967
2011-12	1.518	9.179	88.340	0.963
2012-13	1.482	8.797	88.933	0.788
2013-14	1.467	7.089	90.841	0.603
2014-15	1.167	5.574	92.881	0.378
2015-16	0.419	5.609	93.287	0.685
2016-17	0.391	5.372	93.609	0.628
2017-18	0.363	5.061	94.086	0.49

Source: Reserve bank of India

Foreign Currency Assets (FCA) that is the most important component of the RBI's foreign exchange reserve is the assets like US Treasury Bills bought by the RBI using foreign currencies. The FCA is the largest component of the forex reserve. Foreign currency assets constantly contribute the major shares to the total reserves was 94.086 percent in 2017-18.

The gold reserves were increased between 2009-10 and 2013-14 because 314.63 billion reflecting the purchase of 200 metric tonnes of gold from IMF on November 3, 2009; however the total share of gold in foreign exchange reserves has fallen recent years. Its percentage share to the total reserves was 5.061 percent in 2017-18. Both reserve tranche position and special drawing rights have showed fluctuation trend till 2017-18 and often lower shares in total reserves (i.e. less than 2 percent only) over the years.

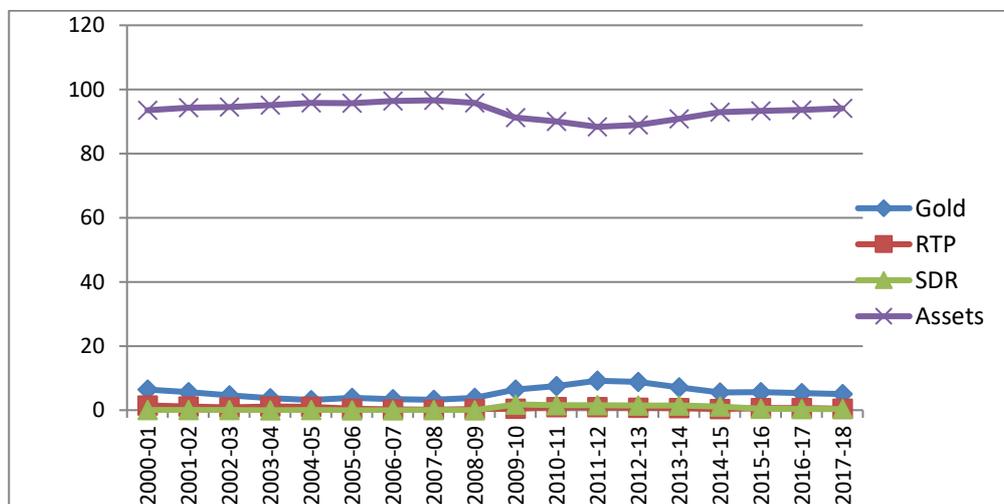


Fig. 2: Ratio of Reserves (in percent)

**CONCLUSION**

From the analysis, the coefficient of variation of special drawing rights, gold, foreign currency assets, reserve tranche position, and total foreign exchange reserves were order of 114.7 percent, 71.42 percent, 60.70 percent, 63.62 percent and 60.88 percent respectively. The instability index of special drawing rights, gold, foreign currency assets, reserve tranche position, and total foreign exchange reserves were order of 796.33, 15.95, 12.78, 54.78 and 11.87 respectively.

The analysis of the data reveals that foreign exchange reserves have significantly changed over the years. All the components noticed high volatility except foreign currency assets during the period under review. However, on the whole, it was observed that the degree of stability slightly increased for foreign exchange reserves in India over the periods and holds adequate level of foreign exchange reserves.

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