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Foreign exchange reserves and its components in India: A comprehensive analysis

Appala Naidu Dhubireddi [1,*] and Rohit Yadav [2]

[1] *Assistant Professor, Department of Economics, Atma Ram Sanatan Dharma College, Dhaula Kuan, University of Delhi, New Delhi, India.*
[2] *Student, Delhi School of Economics, University of Delhi, New Delhi, India.*

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Abstract

The aim of this research paper is to analyse the impact of various components of foreign exchange reserves on foreign exchange reserves of 2023-24. Moreover, various statistical methods have been used to draw comparison and relationship between forex reserves and its components which are, correlation and regression analysis. This paper provides a robust understanding about the accumulation of forex reserves and composition of its various components ie., foreign currency assets, Gold, SDRs and Reserve Tranche Position in IMF. The major finding is that fall in the forex reserves in this financial year of 2023-24 due to valuation changes arising from appreciating U.S. dollar which was due to a major change in a component of forex reserves, foreign currency assets (FCA).

Keywords: Foreign Exchange Reserves; SDRs; Foreign Currency Assets and Correlation and Regression Analysis; Forex reserves

1. Introduction

Forex reserves are assets that are held by a nation's monetary authority. It is generally held in reserve currencies, usually the US Dollar, Euro, Japanese Yen, and Pound Sterling. It is used to back its liabilities like the native currency issued and also reserves deposited by financial institutions or the government with the central bank. India has a large foreign exchange reserves holdings of cash, bank deposits, bonds, and other financial assets denominated in currencies other than India's national currency., the Indian rupee. The reserves are managed by the Reserve bank of India for the Indian government and the main component is foreign currency assets. Foreign-exchange reserves act as the first line of defence for India in case of economic slowdown, but acquisition of reserves has its own costs. Foreign exchange reserves facilitate external trade and payment and promote orderly development and maintenance of foreign exchCreative Commons Attribution Liscense 4.0ange market in India.

1.1. History of Foreign Exchange Reserves

In 1960, forex reserves covered just 8.6 weeks of imports followed by 980, India had foreign exchange reserves of over U$7 billion, more than double the level (U$2.55 billion) of what China had at that time. In the year 1990, forex reserves covered just 4.8 weeks of imports., Foreign exchange reserves of India reached the $100 billion mark only in 2004. Moreover, India was forced to sell dollars to the extent of close to U$35 billion in the spot markets in Financial Year 2009 due to 22% depreciation in rupee (against the dollar) in the same financial year 2009. In 2009, India purchased 200 tonnes of gold from the International monetary fund, worth US$6.7bn (€4.57bn, £4.10bn). The year 2020, India crossed the 500 billion USD mark and also India crossed the 600 billion USD mark for the first time in 2021 i.e., total forex reserves touched an all time high of 642.453 billion US$ on 8 September 2021. Thereafter, the forex reserves rapidly declined to $573.9 billion by 29 July 2022 and followed by US$532.838 Billion on 07 Oct 2022, with

* Corresponding author: Appala Naidu Dhubireddi

the components of Foreign Currency Assets (FCA) at around US$471.496 Billion, Gold Reserves at around US$38.995 Billion, SDRs (Special Drawing Rights with the IMF) of around US$17.582 Billion and around US$4.836 Billion Reserve Position in the IMF.

According to Reserve Bank of India report weekly data 2023-24, India could target foreign exchange reserves of US$750 Billion-US$1 trillion, As on data 2023-24 India's total foreign exchange (Forex) reserves stand at around Rs.538.4201 Cr and its components of Foreign Currency Assets Rs.47,59,071 Cr, Gold Rs.4,35,024 Cr , SDRs is Rs.1,51,335 and Reserve Tranche Position in IMF is Rs 38,851 Cr. India's foreign exchange reserves are mainly composed of US dollar in the forms of US government bonds and institutional bonds with nearly 7.31% of forex reserves in gold. The FCAs also include investments in US Treasury bonds, bonds of other selected governments and deposits with foreign central and commercial banks.

2. Review of Literature

Y.V. Reddy (2002) highlighted that the subject of forex reserves may be broadly classified into two inter-linked areas, namely, the theory of reserves, and the management of reserves. The theory of reserves encompasses issues relating to institutional and legal arrangements for holding reserve assets, conceptual and definitional aspects, objectives for holding reserve assets, exchange rate regimes, and conceptualisation of the appropriate level of foreign reserves. In essence, a theoretical framework for reserves provides the rationale for holding forex reserves. Reserve management is mainly guided by the portfolio management consideration i.e., how best to deploy foreign reserve assets? The portfolio considerations take into account inter alia, safety, liquidity and yield on reserves as the principal objectives of reserve management. The institutional and legal arrangements are largely country specific and these differences should be recognised in approaching the critical issues relating to both reserve management practices and policy making 1.

Shin-ichi Fukuda and Yoshifumi Kon, (2010) pointed out that the recent accumulation in foreign exchange reserves has reached record-breaking levels in many developing countries. This paper investigated the long-run macroeconomic impacts of this trend in developing countries. In the first part of the paper, they analyzed a simple open economy model where increased foreign exchange reserves reduce the costs of liquidity risk. An increase in foreign exchange reserves raises both liquid and total debt, while shortening debt maturity. It also leads to a decline in consumption, although investment and economic growth may improve when the tradable sector is capital intensive. In the second part of the paper, we attempted to provide empirical support for our theoretical analysis 2.

Bishwajit Bhattacharyya(2016) observed that pressure on the rupee is likely to continue and the Centre and the RBI are working in tandem, through both monetary and fiscal measures, to ease the conditions for the currency. Besides the recent hikes in policy rate, the RBI has also given banks the flexibility to solicit more NRI deposits, relaxed the rules for FPI investments in debt securities and for external commercial borrowings and allowed settlement of external trade in rupees. The Centre, on its part, has hiked import duty on gold in a bid to dis-incentivise imports and reduce the trade gap. Policymakers will have to use all the tools in their arsenal to control the volatility in the rupee. It will be good if the task of the regulator is not made harder through fear-mongering which can create panic in the currency market, exacerbating the volatility 3.

Hiro Ito and Robert N McCauley (2020), in their study emphasized on the share of the dollar in forex reserves is higher where the domestic currency varies less against the dollar than against other key currencies. Because If a currency varies less against the dollar than against other key currencies, then a reserve portfolio with a substantial dollar share poses less risk when returns are measured in domestic currency. If a larger share of trade is denominated in the USD, the USD share in FX reserves tends to be higher as well1 4.

Marshall Hargrave, (2024) Economists theorize that it is better to hold the foreign exchange reserves in a currency that is not directly connected to the country’s own currency in order to provide a barrier should there be a market shock. However, this practice has become more difficult as currencies have become increasingly intertwined as global trading has become easier 5.

3. Research Design

3.1. Objectives of the Study

- To evaluate the impact of components of foreign exchange reserves on it.
- To study the changes in India's foreign exchange reserves for the financial year 2023-24

- To study the direction and strength of the relationship between the foreign exchange reserves and its components.

3.2. Research Methodology

The study used the time series secondary data on foreign exchange reserves of India for the financial year weekly data 2023-24 released by the central bank of India at the end of every week collected from official website of Reserve Bank of India. The data consisted of the total value of foreign exchange reserves of India and the values of its components such as Foreign Currency Assets, Gold, SDRs and Reserve Tranche Position in IMF.

4. Data Interpretation

The data outlines the weekly trends in India's foreign exchange reserves (in million USD$) for 2023-24. Here's a detailed analysis based on the components and overall trends.

Table 1 Foreign Exchange Reserves (Weekly) 2023-24

Year / Week Ended	1 Total Reserves		1.1 Foreign Currency Assets		1.2 Gold			1.3 SDRs			1.4 Reserve Tranche Position in IMF	
	₹ Crores	US $Millions	₹ Crores	US $Millions	₹ Crores	US $Millions	Volume (Metric Tonnes)	₹ Crores	SDRs Millions	US $Millions	₹ Crores	US $Millions
29-Mar-2024	53,84,281	6,45,583	47,59,071	5,70,618	4,35,024	52,160	822	1,51,335	13,694	18,145	38,851	4,660
22-Mar-2024	53,59,608	6,42,631	47,39,393	5,68,264	4,29,410	51,487	820	1,51,946	13,694	18,219	38,859	4,662
15-Mar-2024	53,25,702	6,42,492	47,11,435	5,68,386	4,23,910	51,140	818	1,51,493	13,694	18,276	38,864	4,689
08-Mar-2024	52,66,052	6,36,095	46,55,556	5,62,352	4,19,860	50,716	818	1,50,760	13,694	18,211	39,876	4,817
01-Mar-2024	51,87,144	6,25,626	45,95,222	5,54,231	4,01,430	48,417	817	1,50,733	13,694	18,180	39,760	4,798
23-Feb-2024	51,35,344	6,19,072	45,47,374	5,48,188	3,96,913	47,848	817	1,50,946	13,694	18,197	40,111	4,839
16-Feb-2024	51,14,732	6,16,097	45,30,988	5,45,783	3,93,310	47,376	817	1,50,322	13,688	18,107	40,111	4,831
09-Feb-2024	51,24,965	6,17,230	45,37,894	5,46,524	3,96,386	47,739	813	1,50,580	13,688	18,135	40,104	4,832
02-Feb-2024	51,61,947	6,22,469	45,72,053	5,51,331	3,98,786	48,088	812	1,50,849	13,688	18,190	40,260	4,860
26-Jan-2024	51,26,070	6,16,733	45,39,360	5,46,144	3,94,644	47,481	810	1,51,673	13,688	18,248	40,393	4,860
19-Jan-2024	51,18,229	6,16,143	45,34,331	5,45,855	3,92,185	47,212	810	1,51,361	13,688	18,221	40,353	4,854
12-Jan-2024	51,32,462	6,18,937	45,48,412	5,48,508	3,91,785	47,247	805	1,51,836	13,688	18,310	40,429	4,872
05-Jan-2024	51,33,694	6,17,303	45,46,115	5,46,650	3,94,932	47,489	805	1,52,173	13,688	18,298	40,474	4,866
29-Dec-2023	51,85,784	6,23,200	45,90,152	5,51,615	4,02,148	48,328	804	1,52,822	13,688	18,365	40,662	4,892
22-Dec-2023	51,58,895	6,20,441	45,71,034	5,49,747	3,94,739	47,474	804	1,52,383	13,688	18,327	40,739	4,894
15-Dec-2023	51,12,041	6,15,971	45,23,362	5,45,048	3,94,838	47,577	804	1,52,060	13,688	18,323	41,782	5,023
08-Dec-2023	50,60,326	6,06,859	44,75,303	5,36,699	3,92,998	47,130	804	1,51,658	13,688	18,188	40,368	4,842
01-Dec-2023	50,31,468	6,04,042	44,44,765	5,33,610	3,94,231	47,329	804	1,52,019	13,688	18,250	40,452	4,853
24-Nov-2023	49,85,457	5,97,935	44,06,784	5,28,531	3,86,360	46,338	804	1,51,898	13,688	18,218	40,415	4,848
17-Nov-2023	49,58,161	5,95,397	43,83,515	5,26,391	3,83,413	46,042	804	1,50,988	13,688	18,131	40,244	4,833
10-Nov-2023	49,20,560	5,90,321	43,51,110	5,22,004	3,79,388	45,515	804	1,50,127	13,681	18,011	39,935	4,791
03-Nov-2023	49,20,453	5,90,783	43,46,726	5,21,896	3,84,148	46,123	804	1,49,706	13,681	17,975	39,873	4,789
27-Oct-2023	48,79,087	5,86,111	43,07,970	5,17,504	3,82,289	45,923	804	1,49,095	13,681	17,910	39,733	4,773
20-Oct-2023	48,50,051	5,83,532	42,82,084	5,15,202	3,77,545	45,425	804	1,48,987	13,681	17,925	41,436	4,980
13-Oct-2023	48,78,276	5,85,895	43,24,217	5,19,351	3,62,813	43,575	804	1,49,830	13,681	17,995	41,416	4,975
06-Oct-2023	48,67,956	5,84,742	43,25,067	5,19,529	3,52,200	42,306	804	1,49,212	13,681	17,923	41,477	4,983
29-Sep-2023	48,82,783	5,86,908	43,28,124	5,20,236	3,63,824	43,731	801	1,49,243	13,681	17,939	41,593	5,002
22-Sep-2023	48,98,336	5,90,702	43,39,928	5,23,363	3,67,410	44,307	800	1,49,366	13,681	18,012	41,633	5,019
15-Sep-2023	49,31,885	5,93,037	43,73,725	5,25,915	3,65,925	44,000	800	1,50,460	13,681	18,092	41,775	5,030
08-Sep-2023	49,25,911	5,93,904	43,66,137	5,26,426	3,68,121	44,384	800	1,49,790	13,681	18,060	41,863	5,034
01-Sep-2023	49,53,552	5,98,897	43,89,432	5,30,691	3,71,694	44,939	800	1,50,491	13,681	18,195	41,935	5,073
25-Aug-2023	49,16,873	5,94,858	43,58,044	5,27,249	3,66,616	44,354	800	1,50,383	13,681	18,194	41,828	5,061
18-Aug-2023	49,43,746	5,94,888	43,86,111	5,27,786	3,64,196	43,824	799	1,51,292	13,681	18,205	42,147	5,072
11-Aug-2023	49,88,363	6,02,161	44,27,048	5,34,399	3,67,317	44,340	798	1,51,801	13,681	18,324	42,198	5,098
04-Aug-2023	49,82,323	6,01,453	44,18,603	5,33,400	3,70,124	44,680	798	1,51,376	13,674	18,274	42,220	5,099
28-Jul-2023	49,67,138	6,03,870	44,03,421	5,35,337	3,69,359	44,904	798	1,51,715	13,674	18,444	42,642	5,185
21-Jul-2023	49,75,431	6,07,035	44,07,539	5,37,752	3,73,862	45,614	798	1,51,414	13,674	18,474	42,616	5,196
14-Jul-2023	50,04,017	6,09,022	44,38,291	5,40,166	3,71,364	45,197	798	1,51,878	13,674	18,484	42,484	5,175
07-Jul-2023	49,33,658	5,96,280	43,76,744	5,28,968	3,64,561	44,060	798	1,50,875	13,674	18,235	41,479	5,017
30-Jun-2023	48,81,602	5,95,051	43,31,357	5,27,979	3,59,585	43,832	797	1,49,626	13,674	18,239	41,035	5,002
23-Jun-2023	48,66,441	5,93,198	43,10,564	5,25,440	3,63,459	44,304	797	1,50,408	13,674	18,334	42,010	5,120
16-Jun-2023	48,84,306	5,96,098	43,23,489	5,27,651	3,69,128	45,049	797	1,49,531	13,674	18,249	42,159	5,149
09-Jun-2023	48,96,139	5,93,749	43,29,845	5,25,073	3,74,159	45,374	797	1,49,974	13,674	18,187	42,160	5,115
02-Jun-2023	48,97,289	5,95,067	43,30,529	5,26,201	3,74,926	45,557	797	1,49,664	13,674	18,186	42,170	5,123
26-May-2023	48,64,556	5,89,138	43,01,298	5,20,931	3,70,756	44,902	797	1,50,207	13,674	18,192	42,295	5,113
19-May-2023	49,05,462	5,93,477	43,38,981	5,24,945	3,73,000	45,127	796	1,51,059	13,674	18,276	42,422	5,130
12-May-2023	49,26,121	5,99,529	43,51,530	5,29,598	3,80,870	46,353	795	1,51,290	13,674	18,413	42,431	5,164
05-May-2023	48,75,737	5,95,976	43,03,465	5,26,021	3,78,914	46,315	795	1,50,918	13,667	18,447	42,439	5,192
28-Apr-2023	48,18,457	5,88,780	42,51,387	5,19,485	3,73,648	45,657	795	1,51,122	13,667	18,466	42,300	5,172
21-Apr-2023	47,97,026	5,84,248	42,24,244	5,14,489	3,78,926	46,151	795	1,51,329	13,667	18,431	42,526	5,176
14-Apr-2023	48,00,370	5,86,412	42,29,121	5,16,635	3,77,986	46,175	795	1,50,716	13,667	18,412	42,546	5,190
07-Apr-2023	47,89,256	5,84,755	42,13,256	5,14,431	3,82,447	46,696	795	1,51,107	13,667	18,450	42,446	5,178

Source: Reserve Bank of India (Varies weekly data) 2023-24

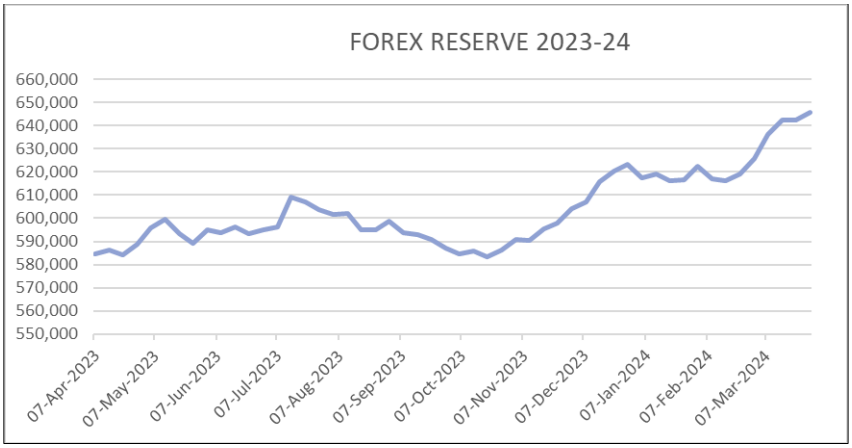

Figure 1 Foreign Exchange Reserves (Weekly) 2023-24

The table 1 depicts that the total reserves fluctuated throughout the year, the total reserves increased from $584,248 million 21-Apr-2023 to $645,583 million 29-Mar-2024 and net increase of $61,335 million from 07-Apr-2023 ($584,755 million) to 29-Mar-2024 ($645,583 million). The following key observations on the reserves generally showed an upward trend in the latter half of the financial year. Sharp increases occurred during certain weeks, possibly indicating interventions by the RBI or favourable market conditions and significant declines from15-Dec-2023 to 08-Dec-2023 **.**

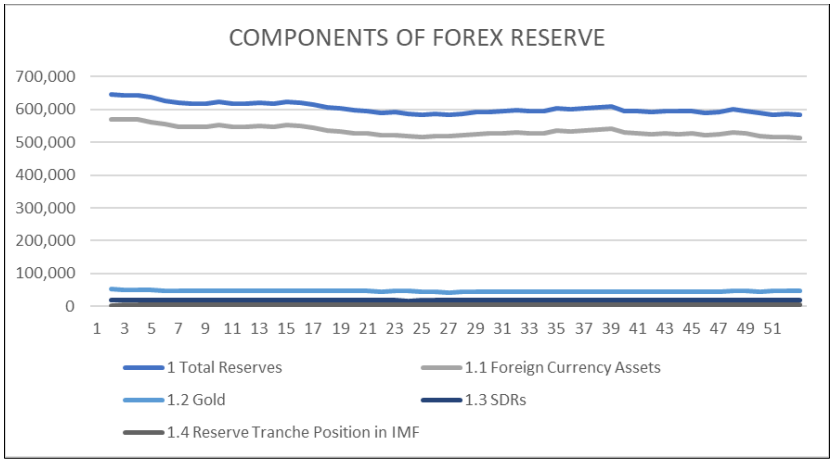

Figure 2 Components of Foreign Exchange Reserves (Weekly) 2023-24

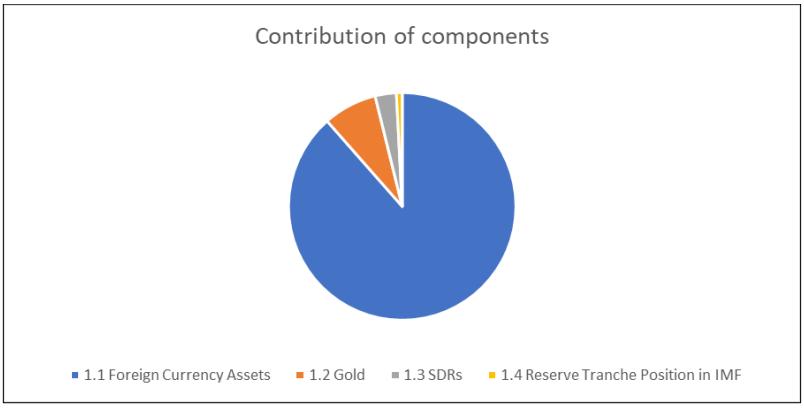

Figure 3 Components of Foreign Exchange Reserves (Weekly) 2023-24

The following data which is revealed that the Foreign Currency Assets (FCA), which constitutes the largest component of reserves, followed the general trend of total reserves being highest on $570,618 million 29-Mar-2024 compared to $514,431 million 07-Apr-2023. The data shows a net increase of $56,187 million over the financial year and also increases in FCA were consistent with overall growth in reserves, especially in the final quarter of the year.

Moreover, Gold reserves showed periodic increases and decreases but remained relatively stable ie., $42,306 million 06 October,2023, and rapidly increasing after some months $52,160 million 29 March,2024. The net increase of $5,464 million from 07 April , 2023 to 29 March 2024. The major observation is that gold reserves saw a significant increase in the last quarter of FY 2023-24, indicating possible additions to gold holdings.

Special Drawing Rights (SDRs) holdings remained relatively stable, with minor fluctuations from $17,910 million (27-Oct-2023) to $18,450 million (07-Apr-2023) and marginal decrease of $305 million over the financial year, major observation is that SDR is not contribute significantly to the overall trend in reserves.

5. Correlation between the Variables

The table 2 represents the correlation between the Foreign Exchange Reserves and its components. The data reveals that the Foreign Exchange Reserves(X) and its Components such as Foreign Currency Assets(Y1), Gold(Y2), SDRs(Y3) and Reserve Tranche Position in IMF(Y4) are positively correlated except SDRs (Y). SDRs(Y) is very low correlated over the year. The trend in growth of Reserve Tranche Position (RTP) in IMF remained stable with minor weekly changes from $5,196 million 21-July-2023 to $4,773 million 27-Oct-2023 and a slight increase of $18 million over the financial year.

Table 2 Correlation between Foreign Exchange Reserves and It's Components

Correlation	X and Y1	X and Y2	X and Y3	X and Y4
X and Y1	0.997451245			
X and Y2		0.863461987		
X and Y3			0.190609168	
X and Y4				0.62839955

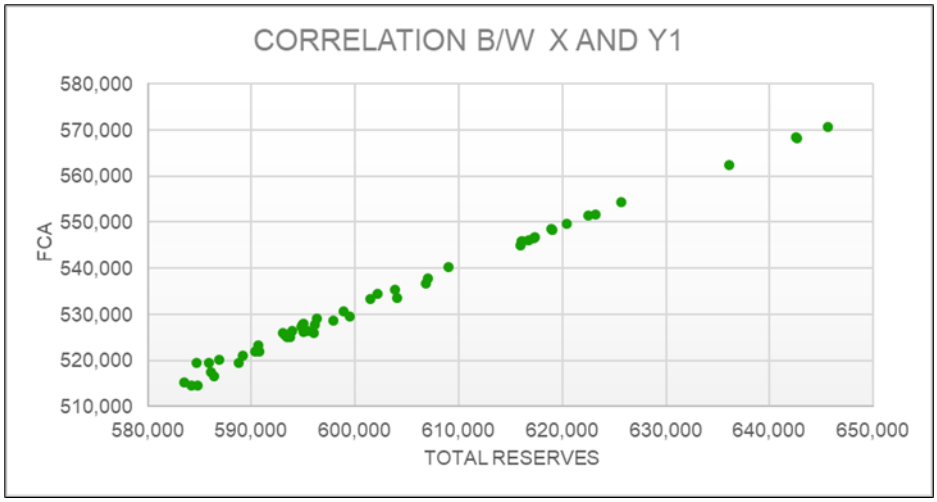

Figure 4 Correlation Between Foreign Exchange Reserves(X) and Foreign Currency Assets(Y1)

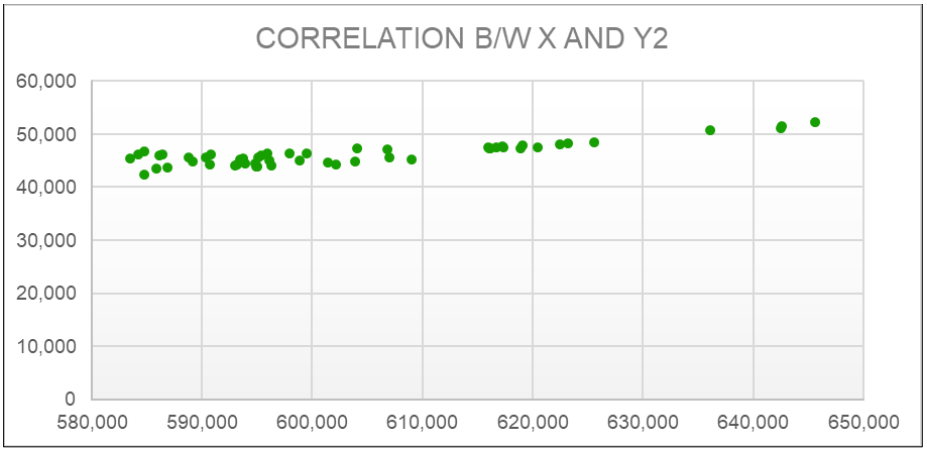

Figure 5 Correlation Between Foreign Exchange Reserves(X) and Gold(Y2)

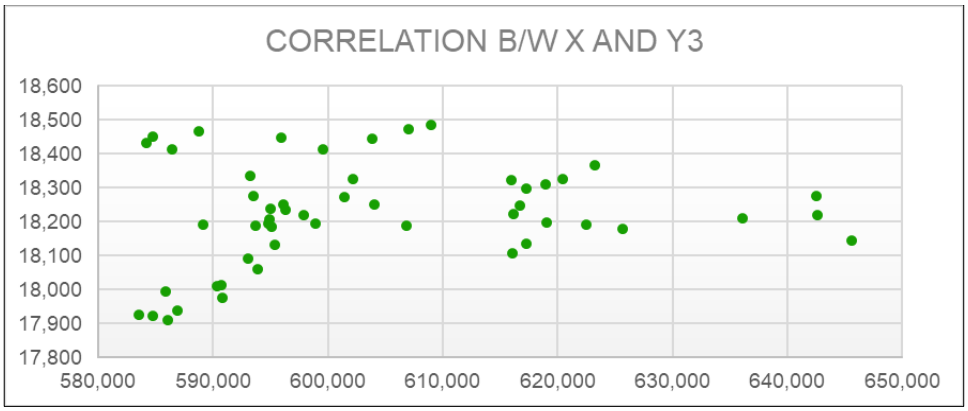

Figure 6 Correlation Between Foreign Exchange Reserves(X) and SDRs(Y3)

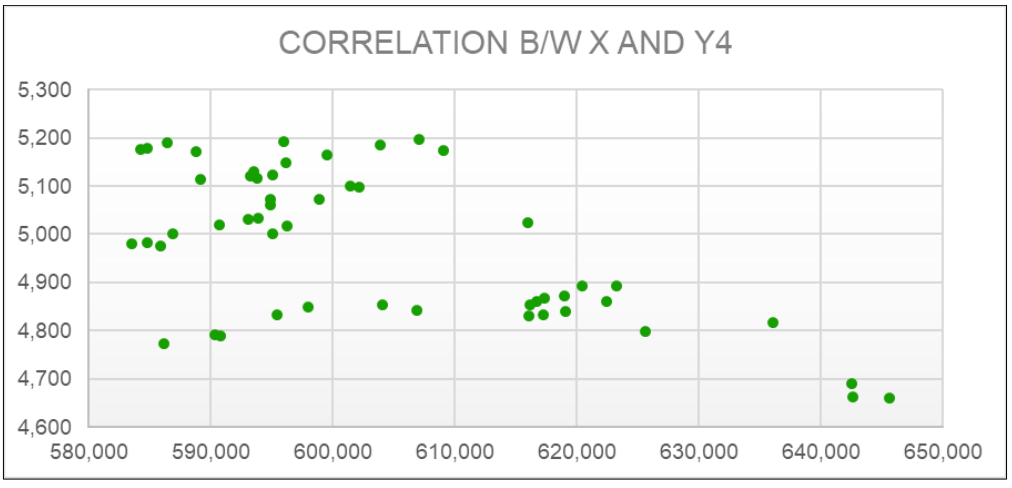

Figure 7 Correlation Between Foreign Exchange Reserves(X) and Reserve Tranche Position in IMF(Y4)

6. Regression Analysis

The regression model for foreign exchange reserves and its components has been specified as follows

$$Y = \beta 0 + \beta 1X + e$$

Where
Y = Foreign exchange Reserves ,
X1 = Foreign Currency Assets
X2 = Gold
X3 = SDR's
X4 = Reserve Tranche Position (RTP) in IMF
β0 = Y-Intercept,
β1= Slope coefficient of Y w.r.t. X
e = Error term

Table 3 Regression results for Foreign Exchange Reserves and it Components Weekly)2023-24

Variables	**Co-efficient**	**Standard Error**	**t-Statistics**	**Sig-t**	**R Square**	**P Value**
Foreign Currency Assets (FCA)	9666.4837	6011.2545	1.60806	5.2657154	0.9949*	0.1141
Gold(G)	288613.4379	26052.9023	11.0779	1.7806832	0.7455*	4.5892
SDR's(SDR)	232205.1264	270552.6236	0.8582	0.1758843	0.0363	0.3948
Reserve Tranche Position (RTP) in IMF(RTPIMF)	931728.2331	57461.3327	16.2148	6.109119	0.3948***	1.4957

Source : Calculate by researcher; Note: *1 Percent level of Significant; **5 Percent level of Significant; * **10 Percent level of Significant

The regression result depicts that Foreign Exchange Reserves primarily depends on Foreign Currency Asset, Gold and Reserve Tranche Position in IMF. Hence, Foreign Currency Asset is positive impact and statistically significant at 1 percent level of significant. Gold and Reserve Tranche Position in IMF are positive impact and statistically significant at 5 percent level of significant. Since P value is significantly greater than the value of **β0**, hence we accept the Null hypothesis.

7. Conclusion

The fall in the forex reserves in the financial year of 2023-24 is due to valuation changes arising from appreciating U.S. dollar. As a result the composition of forex reserves has witnessed major change. Further, a change in one variable of forex reserves impacts the other variables too, which was earlier shown by different statistical methods.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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Appendix

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.997451244 7
R Square	0.994908985 6
Adjusted R Square	0.994807165 3
Standard Error	1178.661348 2
Observations	52

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	13574602434.07	13574602434.07	9771.225480 152	5.265715481E-59
Residual	50	69462128.68	1389371.389242.573682		
Total	51	13644064562.75	67		

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	9666.483767	16011.25453265	1031.608064	2925 05	0.114118167	32-2407.476299	5955 21740.44383	38 -2407.476299	6 21740.44383
Y1	1.111839005	1 0.011247794	8903	98.84950925	65.26571548	1E-59 1.089247	1442004 1.13443	086604 1.089247	1442 1.13443086

Equation of regression line is: y = 9666.48 + 1.1118 X

P value > the value of **β0**, hence we accept the Null hypothesis

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SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.190609168 23
R Square	0.036331855013
Adjusted R Square	0.017058492114
Standard Error	16216.25751354
Observations	52

ANOVA

	df	SS	MS	F	Significance F
Regression	1	495714175.48748	495714175.4875	1.885081249308 11	0.175884313634774
Residual	50	13148350387.269	262967007.7454		
Total	51	13644064562.757			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	232205.12645432	70552.623607 41	0.858262334914	0.394843332170298	-311215.810995157	775626.0639037	-311215.811	775626.063904
Y3	20.385890657491	4.847887000531	1.372982610709	0.175884313634777	-9.436968072864 13	50.20874938785	-9.436968072 9	50.2087493879

Equation of regression line is: y = 232205.12 +20.38589 X

P value > the value of β0, hence we accept the Null hypothesis

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.628399551 02
R Square	0.394885995 73
Adjusted R Square	0.382783715 64
Standard Error	12850.06968 24
Observations	52

ANOVA

	df	SS	MS	F	Significance F
Regression	1	5387850020.6408	5387850020.643	32.62905774284 8	6.109119242 6E-07
Residual	50	8256214542.1158	165124290.842		
Total	51	13644064562.757			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	931728.233197	57461.33275075	16.21487335211	1.495744004E-21	###	1047142.71669	816313.7497072	1047142.7166871
Y4	-111.54014853583 4	-5.712185023 51	6.109119243E-07	-89.09853413215 6	-42.74039313 9	-89.09853413216	-42.74039313 8864	

Equation of regression line is: y = 931728.23 - 65.91946X

P value > the value of β0, hence we accept the Null hypothesis

t-Test: Paired Two Sample for Means

	X	Y1
Mean	603656.342115385	534240.888846154
Variance	267530677.701111	215314427.542637
Observations	52	52
Pearson Correlation	0.99745124474088	
Hypothesized Mean Difference	0	
df	51	
t Stat	248.573319248946	
P(T<=t) one-tail	1.29089510695E-80	
t Critical one-tail	1.67528495042491	
P(T<=t) two-tail	2.58179021 39E-80	
t Critical two-tail	2.00758377031584	

t-Test: Paired Two Sample for Means

	X	Y2
Mean	603656.342115385	546217.582115385
Variance	267530677.701111	4292744.8322209
Observations	52	52
Pearson Correlation	0.86346198700834	
Hypothesized Mean Difference	0	
df	51	
t Stat	275.234651543776	
P(T<=t) one-tail	7.17570437417E-83	
t Critical one-tail	1.67528495042491	
P(T<=t) two-tail	1.43514087483E-82	
t Critical two-tail	2.00758377031584	

t-Test: Paired Two Sample for Means

	X	Y3
Mean	603656.342115385	518220.995192307
Variance	267530677.701111	23388.4683078055
Observations	52	52
Pearson Correlation	0.190609168230164	
Hypothesized Mean Difference	0	
df	51	
t Stat	258.553339418 75	
P(T<=t) one-tail	1.736567908471E-81	
t Critical one-tail	1.675284950424 91	
P(T<=t) two-tail	3.473135816942E-81	
t Critical two-tail	2.00758377031584	

t-Test: Paired Two Sample for Means

	X	Y4
Mean	###	4976.85923076 92
Variance	###	24311.8491209 65
Observations	52	52
Pearson Correlation	-0.628399551024 6	
Hypothesized Mean Difference	0	
df	51	
t Stat	###	
P(T<=t) one-tail	8.23957030 97E-82	
t Critical one-tail	###	
P(T<=t) two-tail	1.64791406 19E-81	
t Critical two-tail	###	