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An Empirical and Analytical Study of the Factors Affecting the Exchange Rate Fluctuation in India

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Abstract: *The study gives an overview of the various determinants of the exchange rate movements in India. Out of the multiple factors affecting the Rupee-Dollar value; the impact of Interest rate differential, Trade deficit of India, Foreign Net investment inflows to India, Oil prices, and Gold prices (in the short term) on the exchange rate has been studied using Regression analysis. Besides, this paper also examines the role played by the above mentioned variables in determining the exchange rate during the Global Financial Crisis of 2008. The results indicate that Interest rate differential, Foreign Net Investment Inflows to India and Crude oil price proved to have a significant impact on the exchange rate in the short run. However during the period of crisis, the selected factors were able to explain the exchange rate value to a moderate extent only, as there were many other macro factors as well playing an important role.*

Keywords: *Exchange Rate, Interest rate differential, Trade deficit of India, Foreign Net Investment inflows to India, Regression analysis*

1. INTRODUCTION

The pursuit of economic and structural reforms in different areas of the Indian economy, has led to the integration of the economy with the rest of the world. With a Gross Domestic Product averaging six-eight percent since the reforms, the flow of goods and services from and into India has been increasing multi-fold. India's Foreign Exchange Reserves stood at 374.8 USD billion in Oct 2017 as compared to a record low of 1.1 USD billion in Jun 1991, giving a compounded annual growth rate (CAGR) of 25.14 percent over the last twenty six years (ceicdata.com). Owing to the growth of the forex reserves due to the opening up of the Indian economy and liberal rules for imports and exports, the stability of the Indian Rupee (INR) becomes important, so as to ensure that the current account and balance of payments do not get adversely affected as was the case in 1991. Till the beginning of the 90s, RBI would determine the exchange rate of Rupees in terms of a weighted basket of currencies of India's major trading partners. There were significant restrictions on the current account transactions. In 1992, the Indian Government started to make the Rupee convertible, and in 1993 a single floating Exchange Rate in the market of Foreign Exchange in India was implemented. Since the onset of liberalisation, the forex market has witnessed a significant evolution. The market has not remained confined to the traditional participants, which include tourists, importers, exporters and businessmen dealing in foreign currency. It has expanded to involve investors and speculators who simply participate to take advantage of future scope of profitability arising from the fluctuations in the exchange rates. The development of derivatives in the forex market has also added to the size of this market. In April 2016, the average volume traded daily in the forex market was $5.1 trillion (the Bank for International Settlements Reuters).

USD-INR Trend in the past decade

Chart 1 *(Source – Investing.com)*

The past decade has witnessed a volatile movement in the USD-INR exchange rate. In 2008, when the Lehman brothers filed for bankruptcy, the U.S. economy experienced the worst ever financial crisis. Investors lost confidence in the USD and started looking for safer economies to invest in. With three rounds of Quantitative easing in 2009 the Fed aimed to infuse cheap money and liquidity in the U.S. economy. The availability of easy and low cost funds lead to Investors churning their portfolio in emerging markets and other parts of Asia which was facing its own country specific economic challenges of rising Inflation and Central Bank dominated increasing Interest rates. This resulted in strengthening of the Asian currencies compared to the Dollar. Similarly, the Rupee which is highly correlated to the USD, kept strengthening till the end of 2011. The Financial Markets recovered from a low eight thousand Sensex points in January 2008 to seventeen thousand by 2010, which in turn strengthened the rupee. However, in August 2011, S&P downgraded USA's credit rating which led to a decline in major U.S. stock indexes and also in global stock markets. Thus Indian equities saw a decline. This also impacted trade flows and capital flows around the world. The rupee started to weaken in this scenario. In 2012, the Rupee continued to weaken against the Dollar. Domestic factors pertaining to current account deficit and slowdown in portfolio flows applied downward pressure on the Indian currency. This was further accompanied by political turmoil in Greece. The European countries, especially the Greek government faced threat of defaulting on payment of its debt. European Central Bank would bail Greece out on the condition that it would adopt its austerity measures. Risk aversion resulted in the Dollar appreciating against other currencies. Eurozone crisis impacted India's exports to Europe, a significant destination for Indian exports. Capital inflows into the Indian equity and debt markets were also affected. All this led to the Rupee weakening.

In 2013, there was news that the Fed will be withdrawing the stimulus and will be selling Treasuries and bonds to reverse the ongoing Quantitative Easing process. This re-instilled confidence in the US economy and country was believed to be doing well. There were expectations that the interest rates will be hiked. Due to this reason, the investors started withdrawing money from the Asian economy leading to the weakening of the Rupee. The recovery of the Rupee was witnessed post 2014, when the newly elected government started speeded up the economic reforms. The first half of 2014 saw the INR appreciating against the USD when the Bhartiya Janta Party won the Lok Sabha elections with a clear majority. For the next two years, as per a report in Financial Express, the Rupee depreciated by 16%. The currency plunged from 58.59 levels on May 26, 2014 to 67.71 levels on May 24, 2016, data available with the Reserve Bank of India showed. INR weakened mainly on account of global reasons. Concern over US Federal Reserve lifting US interest rates combined with pressure on emerging markets due to China devaluating its Yuan dampened market sentiments in the past two years. Also, there was a massive outflow of foreign funds from India as FIIs offloaded their investments from the equity markets.

1.1 Determinants of exchange rate:

Multiple factors impact Exchange rates. The present study aims to understand the correlation between selected macro-economic factors and Forex rates.

Inflation:

As per the Purchasing Power Parity theory, the exchange rates of two currencies will be adjusted in such a way so as to make them at par with the purchasing power of each other. When the rate of inflation is relatively high in India, India's competitiveness and ability to trade with global markets will reduce. This in turn will reduce the demand of India currency in the international markets, thus affecting the exchange rate adversely. Holding this theory, lower inflation is preferred for a stronger exchange rate (rupee).

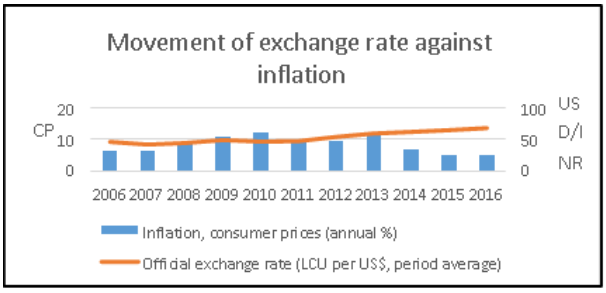

Chart 2 *(Source – World Bank and Investing.com)*

Gross domestic product (GDP)

GDP is the final value of goods and services produced within the geographic boundaries of a country during a specified period of time, normally a year. GDP is an important indicator of the economic performance of a country. A booming economy, will have relatively high levels of consumer spending and demand. Countries with strong economic growth will be able to attract foreign investments which in turn will improve the valuation of the home currency. On the other hand, investors tend to lose confidence in the currencies of countries that witness slow economic growth.

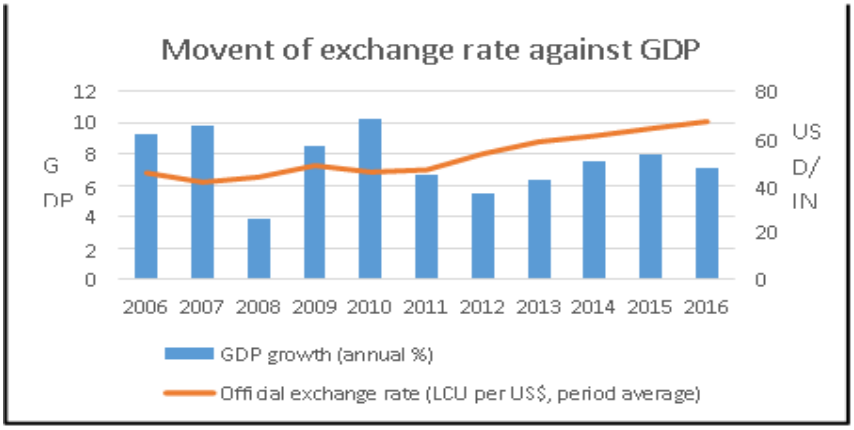

Chart 3 *(Source – World Bank and Investing.com)*

Differential interest rates and monetary policy outlook

Interest rates is one of the most important factor affecting the Economy in India. An increase in the interest rate or a hawkish stance will attract foreign investors to park their funds in Indian bonds to yield higher returns. This will lead to inflow of foreign capital and lead to appreciation of the rupee. When the Central Bank takes a dovish stance or reduces the interest rates, the foreign investors will look for better options to invest in as the Indian bonds are no longer attractive to them. This will lead to capital flight and lowering of the rupee.

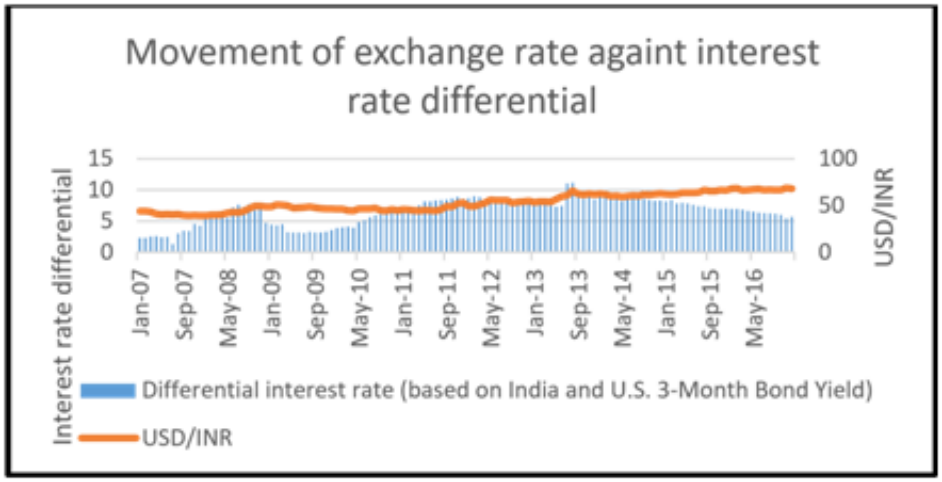

Chart 4 *(Source – Investing.com)*

Commodity prices

Imports of oil, petroleum products, gold, and silver accounted for more than 45% of India's total imports as of May 2017 .Also India comes within the top five importers of gold and oil. High oil prices and gold prices inflate India's import bill and result in wider current account deficit. The demand for USD increases to finance the import bills and the deficit. This causes depreciation of the rupee against the dollar. Thus lower prices of import commodities are favourable for the rupee.

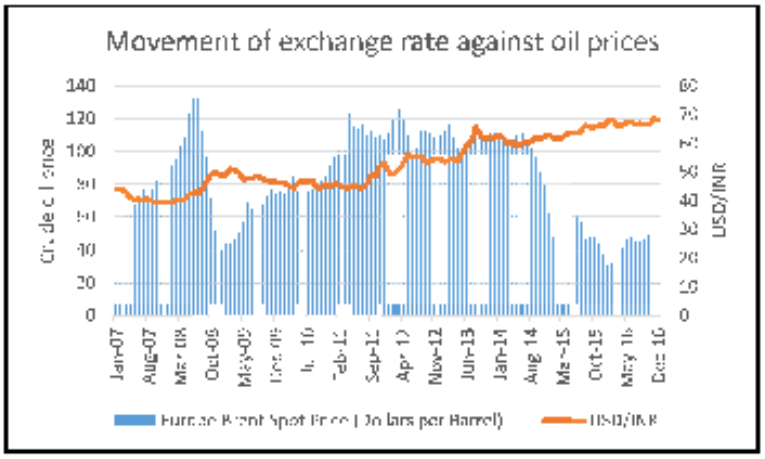

Chart 5 *(Source –U.S. Energy Information Administration and Investing.com)*

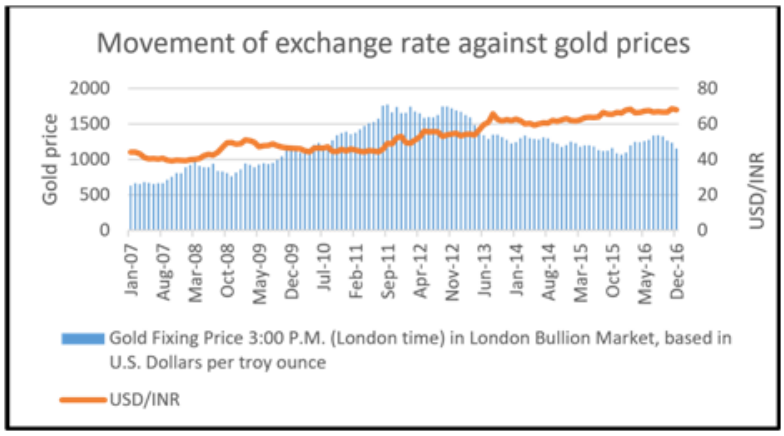

Chart 6 *(Source – Federal Reserve Bank of St. Louis and Investing.com)*

Trade deficit, Balance of payment, Foreign Direct Investment (FDI) and Foreign Institutional Investment (FII)

When a country imports more than it exports, it will require additional foreign currency to fund the trade deficit arising from the surplus of import over export. This increases the demand of the foreign currency and leads to its appreciation. Similarly economies lucrative for FDI and offering asset classes with relatively higher rates of return for the FIIs, as compared to those of other economies, will be able to attract foreign capital. As the demand for the home currency goes up, it will appreciate in value. Thus countries with a positive balance are in a better position than that with a negative balance.

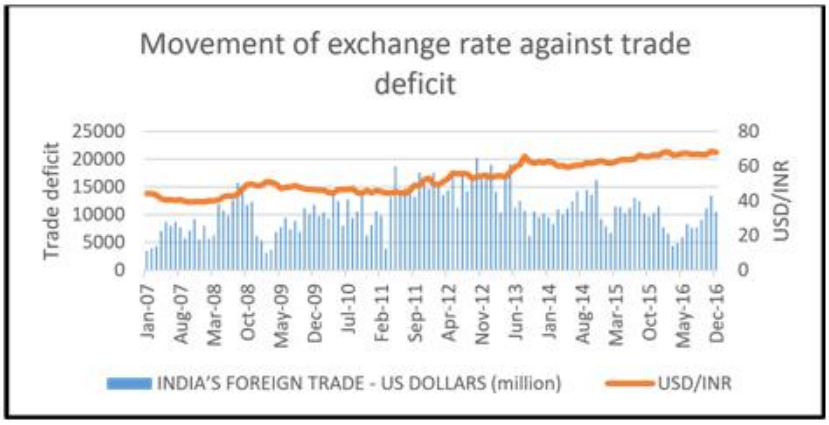

Chart 7 *(Source – Reserve Bank of India and Investing.com)*

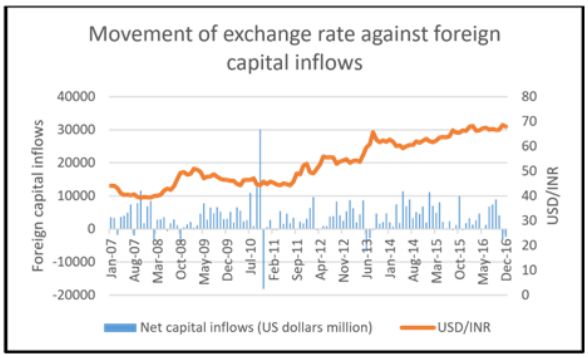

Chart 8 (Source – Reserve Bank of India and Investing.com)

Forex reserve

For currencies like the Yuan, foreign exchange reserves play the most important role in determining its value against the dollar. Being a manufacturing and export oriented nation, is sitting on a large value of foreign exchange reserves. Given an option, China is in a position to sell its dollar reserves in the foreign exchange market and therefore uplift the value of Yuan. However to ensure the competiveness of its goods and services in the foreign exchange markets, it has deliberately held on to its dollar reserves and ensured that the Yuan remains weak.

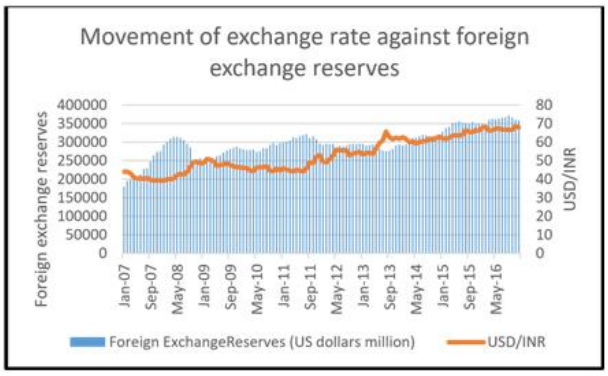

Chart 9 (Source – Reserve Bank of India and Investing.com)

Debt of the country

National debt in itself has no direct impact on the currency value of a country. But from an indirect perspective, high debt on an economy's balance sheet indicates high interest expenditure. If the debt is denominated in foreign currency, high interest expenditures will deplete the foreign currency reserves of that country. Huge amounts of debts will also lead to inflation in the economy. Not only this, it will also affect the sovereign rating given to the country by agencies like Moody's and S&P and in case the country defaults on the debt austerity measures will be imposed on the country before it is bailed out. Thus countries with large amounts of debt will fail to have a strong currency value.

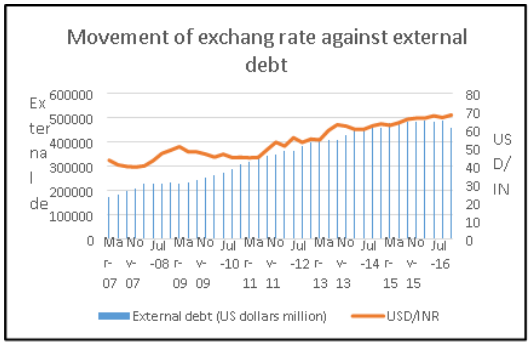

Chart 10 (Source – Reserve Bank of India and Investing.com)

Others:

Domestic factors that include political stability, new tax reforms, stock market performance, economic data releases and macroeconomic factors that include geopolitical events, war, global financial or economic crisis and recessions, among many other factors, will also influence the rupee value.

2. LITERATURE REVIEW

Mirchandani (2013) carried out research in order to investigate various macroeconomic variables leading to acute variations in the exchange rate of a currency. The variables studied are interest rate, inflation rate, GDP, current account, foreign direct investment and USDINR. His findings indicated that there was a strong correlation between the exchange rate and variables such as interest rate, inflation rate, and foreign direct investment and GDP Growth rate in either direct or indirect manner. No relationship was found between current account and the exchange rate as the correlation value was insignificant. Sahu et al (2014) undertook a study to investigate the dynamic relationships between oil price, exchange rate and Indian stock market from 1993 to 2013. The variables studied were the monthly closing values of S&P BSE Sensex, WTI crude oil price per barrel (in $) and the USD INR exchange rates. Using Co-Integration Test, Vector Error Correction Model (VECM), Variance Decomposition Test and Impulse Response Analysis to establish the long and short-run dynamic relationship between the variables and Granger Causality Test to identify the direction of causality, the results indicated that there exists a long run co-integrating relation between crude oil price, exchange rate and Indian stock market, but crude oil price or exchange rate is not observed to affect the Indian stock prices significantly. Kamble & Honrao (2014) empirically investigated the nature of exchange rate volatility. The study made use of monthly data on Rupee-US Dollar bilateral exchange rate. The empirical analysis was carried out for the period between Jan 2011 and Sep 2013. The foreign exchange rate volatility of Indian rupee against US Dollar was investigated by using GARCH (1, 1) model. Almost all the parameter estimates of the ARCH and GARCH models were significant at 5% level. The volatile nature of the foreign exchange market is attributed to an increase in capital flows and domestic and international issues impacting U.S.A. as well as India. Kanika & Singh (2015) aimed to identify those macro-economic factors that affect the price of Indian currency (Rupee) and their inter-relationship. The variables include inflation rate, lending interest rate, foreign direct investment, gross domestic product growth rate and current account deficit. The nature of research is Exploratory & Analytical that generates a posteriori hypothesis by analyzing a data-set and looking for potential relations between variables. Regression and Correlation has been run with SPSS. The findings suggest that exchange rate is highly dependent on the five select independent variables taken up for this study. Lodha (2017) examined the long-run and short-run interdependence between USD/INR exchange rates, gold prices and crude oil prices. The long-run relationship was tested using Johansen Cointegration test. However, the results indicated that there was no long-run interdependence between the variables. The study also examines the shortrun relationship using Granger causality test and VAR model. The results reveal that a bidirectional Granger causality exists between crude oil and USD/INR exchange rate, whereas unidirectional Granger causality runs from crude oil to gold price series.

3. DATA ANALYSIS

3.1 Purpose of undertaking the study

Multiple stakeholders including exporters, importers, companies, government bodies and individual investors amongst others with huge foreign currency exposures face the threat of adverse currency movements, and consequently the possibility of losses on their investments. The foreign investments might have performed well in operational terms but simply because of the exchange rate fluctuations, the investment might depreciate in value. This not only affects individual businesses but in fact tends to have a negative impact on the entire economy. Thus it becomes necessary to study the factors that impact the exchange rate fluctuations. An understanding of the factors impacting the exchange rate, can help the businessmen dealing in transactions involving foreign currency, to take better economic decisions and curtail losses arising out of adverse currency movements, to the extent possible.

The study will address the following objective:

- To give an overview of the factors affecting the exchange rate, in general
- To statistically test the impact of certain factors on the exchange rate, in the short term

- To test the significance of the impact of these selected relevant factors on the exchange rate during the period of financial crisis (2008-2010)

3.2 Data collection

For the purpose of data collection, secondary sources were used. The relevant data to conduct the research was collected from the website of RBI, Federal Reserve Bank of St. Louis and Investing.com. The period covered for the study was taken to be three years (short term) and monthly data was extracted from January 2014 to December 2016. To study the period of financial crisis 2008 three years monthly data was extracted from January 2008 to December 2010.

3.3 Nature of Research

The nature of the research is descriptive and causal as it involves description of factors affecting the exchange rate and analysis of the impact of certain variables and the extent of that impact on the exchange rate movement.

3.4 Sample

Out of the various factors impacting the exchange rate, the following factors were selected for the statistical testing in the research study:

- Gold prices (in USD terms)
- Crude oil prices (Brent - in USD terms)
- Interest rate differential based on US and India 3-month bond yields.
- Trade deficit of India (in USD terms)
- Foreign investment inflows in India (FDI, FII - in USD terms)

3.5Hypothesis

From the factors selected above, the null hypothesis formed will be:

$1H_0$: Gold price does not have any significant impact on the rupee dollar exchange rate in the short term.

$2H_0$: Crude oil price does not have any significant impact on the rupee dollar exchange rate in the short term.

$3H_0$: Interest rate differential does not have any significant impact on the rupee dollar exchange rate in the short term.

$4H_0$: Trade deficit of India does not have any significant impact on the rupee dollar exchange rate in the short term.

$5H_0$: Foreign investment inflows in India does not have any significant impact on the rupee dollar exchange rate in the short term.

The corresponding alternative hypothesis formed will be:

$1H_a$: Gold price has a significant impact on the rupee dollar exchange rate in the short term.

$2H_a$: Crude oil price has a significant impact on the rupee dollar exchange rate in the short term.

$3H_a$: Interest rate differential has a significant impact on the rupee dollar exchange rate in the short term.

$4H_a$: Trade deficit of India has a significant impact on the rupee dollar exchange rate in the short term.

$5H_a$: Net (foreign) investment inflows in India has a significant impact on the rupee dollar exchange rate in the short term.

3.6 Methodology and Procedure

The dependent and independent variables selected for the research study were extracted from various websites for the period January 2014 to December 2016 and the period January 2008 to December 2010 and the data for the same is as follows:

Table 1: *Dependent and independent variables used for data analysis period 2014-16*

Period	USD/INR	Gold Price based in U.S. $ per troy ounce	Spot Crude Oil Price: Brent, Dollars per barrel	Interest rate differential (%)	Net investment inflows (US $ million)	Trade deficit (US $ million)
Jan-14	62.685	1244.795	108.12	0	1969	9454.7
Feb14	61.795	1300.975	108.9	9.089	755	8312.3
Mar14	60.015	1336.083	107.48	8.504	7442	10953.4
Apr14	60.345	1299	107.76	8.865	1808	9968.1
May14	59.195	1287.525	109.54	8.19	11409	11039.6
Jun14	60.06	1279.095	111.8	8.534	6815	12425.8
Jul-14	60.555	1310.967	106.77	8.585	8925	14252.3
Aug14	60.52	1295.988	101.61	8.605	3231	10647.5
Sep14	61.94	1238.818	97.09	8.537	5081	14452.1
Oct-14	61.405	1222.489	87.43	8.392	4506	13554
Nov14	62.21	1176.3	79.44	8.287	6760	16219.4
Dec14	63.035	1202.289	62.34	8.289	1929	9160.5
Jan-15	62.02	1251.845	47.76	8.167	11108	7850.2
Feb15	61.659	1227.188	58.1	8.365	6989	6717.3
Mar15	62.291	1178.63	55.89	7.844	4897	11394.5
Apr15	63.529	1197.91	59.52	7.945	8064	11369.3
May15	63.743	1199.053	64.08	7.847	2153	10308.7
Jun15	63.604	1181.505	61.48	7.59	9	11212.5
Jul-15	63.988	1130.037	56.56	7.376	2348	13090.9
Aug15	66.412	1117.475	46.52	7.4	-381	12399.1
Sep15	65.517	1124.532	47.62	7.042	1183	10166
Oct15	65.423	1159.245	48.43	7.031	9907	9692.2
Nov15	66.462	1085.702	44.27	6.959	-373	10335.5
Dec15	66.208	1068.253	38.01	6.992	1722	11503.1
Jan-16	67.878	1097.375	30.7	6.935	3274	7667.5
Feb16	68.208	1199.912	32.18	6.947	1346	6573.3
Mar16	66.255	1246.338	38.21	6.867	2638	4398.5
Apr16	66.425	1242.262	41.58	6.625	4685	4825.7
May16	67.209	1259.398	46.74	6.518	31	5879.2
Jun-16	67.504	1276.405	48.25	6.324	1269	8261.4
Jul-16	66.655	1337.326	44.95	6.271	6758	7613
Aug16	66.973	1341.089	45.84	6.23	7374	7706.1
Sep16	66.556	1326.03	46.57	6.166	8918	9070.7
Oct16	66.686	1266.569	49.52	6.041	4118	11134.5
Nov16	68.598	1235.98	44.73	5.435	-3333	13421
Dec16	67.955	1151.403	53.31	5.718	-2391	10455.9

Table2: *Dependent and independent variables used for data analysis period 2008-10*

Date	USD/INR	Gold Price based in U.S. Dollars per troy ounce	Spot Crude Oil Price: Brent, Dollars per barrel	Interest rate differential (%)	Net investment inflows (US $ million)	Trade deficit (US $ million)
Jan08	39.28	889.595	92.18	5.331	8506	7955.3
Feb08	39.92	922.298	94.99	5.614	-3234	5688.2
Mar08	40.03	968.434	103.64	5.866	2838	6319.6
Apr08	40.46	909.705	109.07	5.948	2869	11856.5
May08	42.16	888.663	122.8	5.515	3644	10757
Jun08	42.93	889.488	132.32	7.18	-618	9769.7
Jul08	42.483	939.772	132.72	7.58	1755	12595
Aug08	43.87	839.025	113.24	7.274	2921	15763.9
Sep08	46.815	829.932	97.23	7.74	1159	15346.6
Oct08	49.325	806.62	71.58	6.708	-3746	11738.4
Nov08	49.575	760.863	52.45	7.014	509	12324.9
Dec08	48.62	816.092	39.95	4.723	1392	6088.1
Jan09	48.85	858.69	43.44	4.457	2119	5359.1
Feb09	51.005	943.163	43.32	4.346	403	3121.3
Mar09	50.57	924.273	46.54	4.492	1067	3680.3
Apr09	49.725	890.2	50.18	3.218	4617	6865

May09	47.12	928.645	57.3	3.163	7734	7719.9
Jun09	47.75	945.67	68.61	3.157	2824	9448.7
Jul09	47.825	934.228	64.44	3.065	6508	7382.2
Aug09	48.69	949.375	72.51	3.288	4748	8862.3
Sep09	47.735	996.591	67.65	3.173	6607	6903
Oct09	46.925	1043.159	72.77	3.189	5254	11129.8
Nov09	46.535	1127.036	76.66	3.285	2974	10063.8
Dec09	46.41	1134.724	74.46	3.589	3075	11758
Jan10	46.125	1117.963	76.17	3.902	5181	9709.9
Feb10	46.105	1095.413	73.75	4.026	1947	10406.1
Mar10	44.825	1113.337	78.83	4.093	6515	9372.8
Apr10	44.275	1148.688	84.82	3.935	5494	13535.8
May10	46.365	1205.434	75.95	4.838	2301	12465.2
Jun10	46.445	1232.92	74.76	5.173	2630	7981.6
Jul10	46.405	1192.966	75.58	5.653	10899	12715.4
Aug10	47.065	1215.81	77.04	5.958	890	9357.2
Sep10	44.57	1270.977	77.84	6.138	12695	10527.6
Oct10	44.325	1342.024	82.67	6.731	30096	13380.9
Nov10	45.8	1369.886	85.28	6.733	-18183	6267.3
Dec10	44.713	1390.553	91.45	7.073	512	8161.7

For the purpose of analysing this data, regression was run using Ms-Excel. The ANOVA output is used to check significance of the impact of the selected independent variables on the dependent variable in totality. The model summary provides the R square, which signifies the extent to which the exchange rate depends on the factors selected, as per the sample taken. The regression analysis also provides the significance of the impact of each individual independent variable on the dependent variable in the model created. To ensure absence of multicollinearity among the independent variables having significant impact on the dependent variable, the variance inflation factor (VIF) is checked for those variables using Real Statistics. Finally the regression is run on the data extracted for the period January 2008 to December 2010. The R square of the sample data representing the period 2008-10 is compared to the R square of the sample data representing the period 2014-16. This provides an insight on the extent to which the selected factors played a role in determining the exchange rate during the global financial crisis of 2008.

Following is the output of the regression analysis:

Regression Statistics					
Multiple R	0.961142				
R Square	0.923794				
Adjusted R Square	0.911093				
Standard Error	0.841125				
Observations	36				
ANOVA	Alpha 0.05				
	df	SS	MS	F	Significance F

Dec2016 (model 1).

Intercept	78.78386	1.33648	58.94890	0.00000	76.06154	81.50617	
Spot Crude Oil Price: Brent, Dollars per barrel	-0.03983	0.00867	-4.59460	0.00006	-0.05749	-0.02217	2.69533
Interest rate differential (%	-1.51455	0.23370	-6.48075	0.00000	-1.99058	-1.03852	2.78494
Net investment inflows (US $ million)	-0.00016	0.00004	-4.14237	0.000234	-0.00025	-0.00008	1.098977

Regression Statistics							
Multiple R	0.95898						
R Square	0.91968						
Adjusted R Square	0.91216						
Standard Error	0.83621						
Observations	36						
ANOVA	Alpha 0.05						
	df	SS	MS	F	Significance F		
Regression	3	256.1405	85.38015	122.0996	0.0000		
Residual	32	22.37652	0.699266				
Total	35	278.517					
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	vif

Regression	5	257.292	51.45845	72.7336	0.0000	
Residual	30	21.22474	0.707491			
Total	35	278.517				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	81.2106	5.4074	15.0183	0.0000	70.1671	92.2540
Gold Price based in U.S. Dollars per troy ounce	-0.0012	0.0034	-0.3403	0.7360	-0.0081	0.0058
Spot Crude Oil Price: Brent, Dollars per barrel	-0.0319	0.0147	-2.1761	0.0376	-0.0619	-0.0020
Interest rate differential (%	-1.6027	0.3025	-5.2974	0.0000	-2.2205	-0.9848
Net investment inflows (US $ million)	-0.0002	0.0000	-3.3738	0.0021	-0.0003	-0.0001
Trade deficit (US $ million)	-0.0001	0.0001	-1.1716	0.2506	-0.0002	0.0001

Table3: Regression analysis of the independent variable on the dependent variable for the period Jan2014 to

Table 4: *Regression analysis model 2 of only the significant independent variables having impact on the dependent variable and the VIF of those factors for the period Jan2014 to Dec2016 (model 2).*

Regression Statistics						
Multiple R	0.851734					
R Square	0.725451					
Adjusted R Square	0.679692					
Standard Error	1.711464					
Observations	36					
ANOVA				Alpha	0.05	
	df	SS	MS	F	Significance F	
Regression	5	232.1903	46.43806	15.85399	0.00	
Residual	30	87.87328	2.929109			
Total	35	320.0636				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	54.0321	2.0632	26.1881	0.0000	49.8184	58.2458
Gold Price based in U.S. Dollars per troy ounce	-0.0008	0.0017	-0.4736	0.6392	-0.0043	0.0027
Spot Crude Oil Price: Brent, Dollars per barrel	-0.1247	0.0162	-7.7202	0.0000	-0.1577	-0.0917
Interest rate differential	0.0478	0.2422	0.1975	0.8447	-0.4467	0.5424

Table 5: *Regression analysis of the independent variable on the dependent variable for the period Jan2008 to Dec2010 (model 3).*

(%						
Net investment inflows (US $ million)	-0.0001	0.0000	-2.0998	0.0443	-0.0002	0.0000
Trade deficit (US $ million)	0.0003	0.0001	2.3848	0.0236	0.0000	0.0005

Table 6: *Regression statistics of the independent variables – Crude oil, Interest rate differential and Net investment inflows on the dependent variable exchange rate for the period Jan2008 to Dec2010 (model 4).*

Regression Statistics	
Multiple R	0.819261
R Square	0.671189
Adjusted R Square	0.640363
Standard Error	1.813495
Observations	36
Anova Fstatistic	15.85399
Significance F	0.00

Table 7: *Regression statistics of the independent variables –Interest rate differential, Net investment inflows and Trade deficit on the dependent variable exchange rate for the period Jan2008 to Dec2010 (model 5).*

Regression Statistics	
Multiple R	0.850341
R Square	0.723079
Adjusted R Square	0.697118
Standard Error	1.664259
Observations	36
Anova F statistic	27.85219
Significance F	0.00

4. FINDINGS AND INTERPRETATION

Regression analysis-

Table 8: *Inference of regression analysis of the independent variable on the dependent variables for the period Jan2014 to Dec2016.*

Sr.no	Null hypothesis	Alternative hypothesis	P-value (level of significance is taken to be 0.05)	Decision	Inference
1.	Gold price does not have any significant impact on the rupee dollar exchange rate in the short term.	Gold price has a significant impact on the rupee dollar exchange rate in the short term.	0.7360	Fail to reject the null hypothesis.	As per the sample taken, gold prices don't impact the exchange rate in the short term, at 5% level of significance.
2.	Crude oil price does not have any significant impact on the rupee dollar exchange rate in the short term.	Crude oil price has a significant impact on the rupee dollar exchange rate in the short term.	0.0376	Reject the null hypothesis.	As per the sample taken, crude oil prices impact the exchange rate in the short term, at 5% level of significance.
3.	Interest rate differential does not have any significant impact on the rupee dollar exchange rate in the short term.	Interest rate differential has a significant impact on the rupee dollar exchange rate in the short term.	0.0000	Reject the null hypothesis.	As per the sample taken, the interest rate differential impacts the exchange rate in the short term, at 5% level of significance.
5.	Net investment inflows in India does not have any significant impact on the rupee dollar exchange rate in the short term.	Foreign investment inflows in India has a significant impact on the rupee dollar exchange rate in the short term.	0.0021	Reject the null hypothesis.	As per the sample taken, foreign investment inflows impact the exchange rate in the short term, at 5% level of significance.
4.	Trade deficit of India does not have any significant impact on the rupee dollar exchange rate in the short term.	Trade deficit of India has a significant impact on the rupee dollar exchange rate in the short term.	0.2506	Fail to reject the null hypothesis.	As per the sample taken, the trade deficit does not impact the exchange rate in the short term, at 5% level of significance.

As per statistical methods, since gold prices and trade deficit did not prove to be impacting the exchange rate significantly, the two variables were dropped out and regression analysis was run again to obtain a better estimate of the model.

According to the model including only the independent variables that had significant impact on the exchange rate – i.e. Crude oil, Interest rate differential and Trade deficit of India – the R square is 91.96%. This means that the exchange rate is 91.96% dependent on the three independent variables mentioned above and 8.04% dependent on other factors.

The variance inflation factor is a simple test to assess multicollinearity in the regression model. It identifies correlation and the strength of that correlation between independent variables. VIFs between 1 and 5 suggest the presence of moderate multicollinearity, not critical enough to take corrective measures. Since the VIF of the independent variables are as low as 2.69, 2.78 and 1.09, we reject the possibility of presence of multicollinearity.

The regression equation derived from the model will predict the exchange rate significantly well as the p value of the F statistic is less than our level of significance of 5%.

To test the role played by the selected factors in determining the exchange rate during the global financial crisis of 2008, regression was run on the sample data representing the period January 2008 to December 2010.

From the model it was found that gold price and interest rate differential did not have a significant impact on determination of the exchange rate. Therefore crude oil prices, net investment inflows to India and trade deficit of India played a critical role in determining the exchange rate during the period affected by the crisis.

The regression model inclusive of only the significant factors selected from model 3 gave an R square of 72.31% in model 5.

To find out the impact of the factors selected in model 2 on the exchange rate during the period of 2008-2010, regression was run using the exchange rates of 2008-2010 as the dependent variable and crude oil prices, interest rate differential and net investment inflows to India as the independent variables. The regression analysis inclusive of these factors gave an R square of 67.12% in model 4. This is less than the R square in model 5 as interest rate differential was not a critical factor in determining exchange rate during the crisis period while trade deficit was.

Both, model 4 and model 5 as a whole are significant as the p value of the F statistic is less than our confidence level of 5%. However in both these cases, the R square is much less than that in model 2, which has an R square of 91.96%. This means that the factors selected in the study failed to explain the exchange rate during the crisis period, when compared to the extent to which those factors were successful in explaining the exchange rate during the recent period of 2014-2016.

The tremors of the Financial Crisis of 2008 were felt globally. It lead to the Great Depression of 2008 which spread to Asia rapidly and affected much of the region. Economic growth slowed down in India during the recession and global investors flocked to Japanese Yen and Swiss Franc, which were perceived to be safe havens during that time. Therefore the value of foreign currencies depended much on their relative performance against these currencies. Also the quantitative easing by the U.S. Federal Reserve to revive the economy from the recession played a major role in determining the dollar rate against the other currencies. The crisis and recession eventually hampered the global trade, which in turn affected the balance of payment. Affected economies had to resort to foreign trade to correct any negative balance. Since factors like - capital inflow to safe haven options involving foreign currencies besides the dollar; money supply in India, U.S.A. and the rest of the world; foreign exchange reserves; external debt; economic growth measured in terms of inflation and GDP - among other factors are not covered in the model it fails to give a high R square for the sample data representing the crisis period 2008-2010. Since our model is testing for exchange rate determinants in the short term, these factors have not been included as they have a long run effect on the exchange rate.

5. CONCLUSION

As per the sample taken, the research study conducted was able to prove that Crude oil price, Interest rate differential and Net investment inflows to India have an impact on the exchange rate in the short term. Gold prices do not have an impact on the exchange rate (Lodha, A Cointegration and Causation Study of Gold Prices, Crude Oil Prices and Exchange Rates, 2017). Also the analysis shows that there is no relationship between the trade deficit and exchange rate (Mirchandani, Analysis of Macroeconomic Determinants of Exchange Rate Volatility in India, 2013). Also statistically it was found that during the financial crisis of 2008 the selected variables - Crude oil price, Interest rate differential and net investment inflows to India – had lesser importance in determining the exchange rate.

Considering that India is a net importing nation, a depreciating rupee is harmful for the economy. While the depreciating rupee is favourable for exports, imports become more expensive, consequently leading to wider trade deficits for India. There is utmost need to manage the rising import bills caused mainly by surging crude prices. Also the monetary policies implemented by RBI, regulating the interest rates and money supply in the economy, will be crucial in maintaining the value of rupee against the greenback. As observed, the foreign investment inflows

influence the rupee value. The government should thus take initiatives to encourage FIIs and investment through the route of FDI. Several sectors remained untapped by the FDI as in the year 2016, according to a report by World Bank, India didn't even come among the top 100 countries ranked on the basis of ease of doing business. The recent political scenario and government in the U.S.A. along with the pro-growth economic strategies of the Modi government, including demonetization and implementation of the long awaited Goods and Service Tax Act, have led to short term volatility in the rupee-dollar movement. However temporary fluctuations that lead to rupee appreciation in the short term will not help anymore, what is needed at this stage that the Indian Government, with RBI's support and consultation, implements strong economic reforms and monetary policies that will help the rupee sustain its value in the long run.

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