A comprehensive study on the performance of Indian rupee against the US dollar in the foreign exchange market as an indicator of economic performance vis-à-vis the GDP, trade balances and others since 2005

by

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Abstract

India has been noted to be a perennially Current Account Deficit country since independence, questioning the extent of positive macroeconomic impact from the fluctuations in exchange rate on the same. The hypothesis here would be that there is no relationship between the performance of the exchange rate vis-à-vis the performance of the GDP, trade balances and others as for majority of her time, India has seen the Rupee depreciate consistently against the US dollar yet it persistently attracts high FDI and FPI flows in the Capital Account and maintains a high GDP growth rate.

Major foreign exchange market indicators such as foreign reserves, foreign investments, the current account, were observed on a quarterly basis since 2005 and the impact of the exchange rate was mapped on all. The effect of the exchange rate bounded by inflationary pressures was also tested on the GDP-an important indicator of economic performance.

The results brought about interesting observations amongst the interplay of the aforementioned variables where in the current account was seen to be majorly affected whilst GDP, not so much. It indirectly highlighted the fact that there are a lot more factors that are crucial players in this game whether it is structural and cyclical factors affecting the trade imbalance and gap between import and exports or even the dampening of international competitiveness owing to inflationary pressures.

The research conducted in this paper opens up a door of possibilities in understanding the underlying factors that can be further explored and questioning the history in order to seek answers for the future.

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1.0 Introduction

Over the years, India has had several regulatory changes; since the country's independence by the Reserve Bank of India in controlling and later liberalizing the control over the exchange rate. One may argue that strong inflow of foreign direct and portfolio investments has had significant impact on the exchange rate and the reserves. India's excessive dependence on crude oil and gold imports have undoubtedly continued to create a dent in the forex reserves and exerted pressure on the domestic currency to depreciate against the greenback.

However, with the introduction of forex derivatives in India's secondary markets, the determination of exchange rate has become more transparent and efficient. The increase in trading volumes of forex derivatives over the years adds testimony to this assertion. At a macro level, the GDP as a variable has several factors which goes into valuations. Academically, it is a variable which can be thought of as a composition of the services, agricultural and the industrial sector. In the same academic tone, one may define the GDP as summation of investment, consumption, government expenditures, in addition to the difference between exports and imports. Since FDI and FPI flows add significant value to the GDP, to what significance have exchange rate been an influencing factor to the GDP remains to be established.

Through major parts of her history, India has had considerable imbalance in its balance of trade having considerable deficit in its current account. In recent times, the trade deficit has widened to USD 15.71 billion in December of 2020, an increase of 25.89% over the preceding year.[1] Consequently, India's currency against the US dollar has consistently been weak depreciating at regular interval. Over the decade, the Indian rupee has depreciated by over 62% and presently is trading at Rs 73.40 against the greenback.[2] However, the Balance of Payment deficit is sufficiently combatted by the impressive inflows of foreign direct and portfolio investment, exhibiting India as a favorable country to invest in. The performance of the stock markets during COVID health crisis have seen FII pumping in as much as Rs 1,28,078 crores during the 3rd quarter of the FY 2020/21 fiscal alone.[3]

Therefore, given the diverged macroeconomic numbers the question arises, then, is India's competitiveness in global markets not sufficient to combat the rising deficits? This paper aims to delve into the relationship of the Indian trade balances, GDP and other economic indicators with respect to its exchange rate.

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[1] India Balance of Trade | 1957-2020 Data | 2021-2023 Forecast | Calendar | Historical (tradingeconomics.com)
[2] Exchange rate taken on 12/01/2021
[3] Moneycontrol.com 12/01/2021
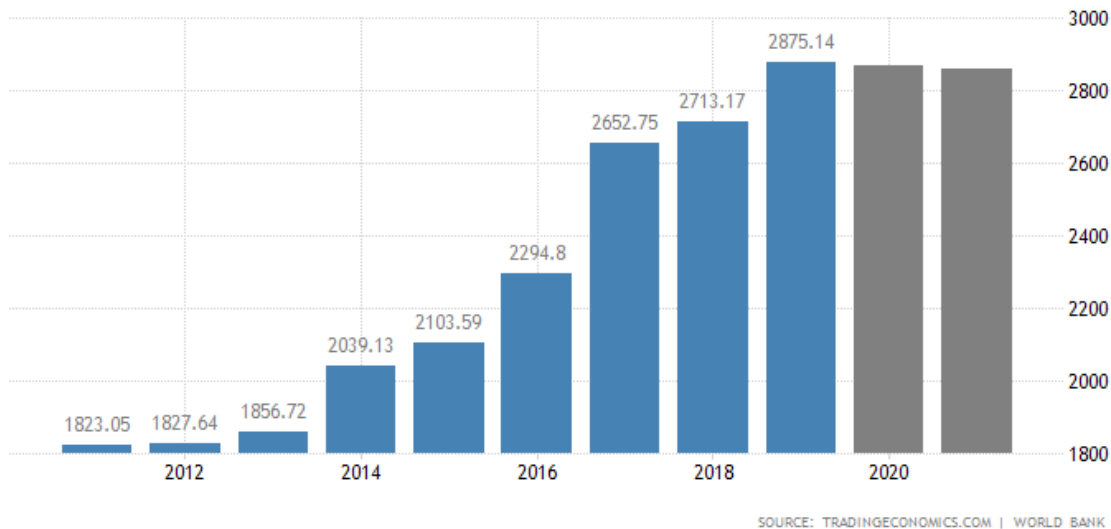
1.1 India's Gross Domestic Product

Figure 1: Gross Domestic Product

The GDP refers to the total market value of all goods and services that are produced within a country per year. It is an important indicator of the economic progress by a country and arguably often seen as a measure of wealth creation. India's GDP stands at US$ 2.87 trillion putting her in the league of top 10 GDPs in the world averaging around 7% over the past decade. In FY2019-20, India's real gross domestic product growth was at about -10.29% compared to the previous year largely affected by COVID pandemic crisis. However, a recent study by Moody's suggests that India could be able to achieve over 6% growth rate for the FY2021 while another study by S&P Global Rating pitch India's growth rate at an impressive 10.15% for 2021-22 fiscal.[4]

Recent years have witnessed a shift of economic power to the strengthening economies of the BRIC countries as the growth rate of gross domestic product in these countries is overwhelmingly larger than in traditionally strong economies, such as the United States and Germany. Part of the reason for India's success is the economic liberalization that started in 1991 bearing fruits coupled with overall growth across various sectors and industries, in particular the IT industry and in most recent times, the fintech sector. India's workforce has expanded particularly in the services sectors including financial services and back-office outsourcing — a profitable venture for the Indian economy. India is strongly poised to realise a fintech sector valuation of USD 150-160 billion by 2025, translating to an incremental value-creation potential of about USD 100 billion, a report by Boston Consulting Group (BCG) and Ficci said.

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[4] Moody's slashes India's GDP growth to `zero' in FY21 - The Hindu BusinessLine and S&P Global Ratings india economic growth 2021-22 gdp latest news | Business News – India TV (indiatvnews.com) Dated 12/01/2021 Time 11:15am

1.2 Balance of Payment – Current Accounts

One could redefine the balance of payment as the country's balance sheet depicting the inflow and outflow of goods and services impacting the country's competitiveness in international trade, foreign exchange rate and reserves. The current account of the Balance of Payment represents the country's transactions with the rest of the world. While the capital account records the inflows & outflows of capital that directly affect a nation's assets and liabilities.

As it stands, the current account as a percentage of GDP stands at -0.9% amount to US$ 15.5 billion surplus in July-September 2020, or 2.4% of GDP, compared to a US$ 7.6 billion deficit in the same period last year.[5] Dissecting the components of the current account sequentially, large imports of oil, gold and electronics have chronically inflated the country's import bills. For instance, oil imports went up by 47% to US$ 156 billion in 2011-12, with the country sourcing 80% of its crude abroad. In 2018 the deficit was a 5-year high due to high oil prices and again our oil imports rose by a staggering 56.61%.

India Trade	Last	Previous	Highest	Lowest	Unit
Balance of Trade	-15710.00	-9870.00	790.00	-20210.90	USD Million
Current Account	15530.87	19797.95	19797.95	-31857.18	USD Million
Current Account to GDP	-0.90	-2.10	2.30	-4.80	percent
Imports	42600.00	33390.00	45730.00	117.40	USD Million
Exports	26890.00	23520.00	32720.00	59.01	USD Million
External Debt	556243.00	554746.00	563941.00	96392.00	USD Million
Terms of Trade	73.70	73.30	100.00	57.90	points
Foreign Direct Investment	4627.00	2412.00	17800.00	-1336.00	USD Million
Capital Flows	-87.28	-780.34	766.97	-822.33	USD Million

Source: India Capital Flows | 2010-2020 Data | 2021-2023 Forecast | Historical | Chart | News (tradingeconomics.com)

Table 1: India's Balance of Trade Data Factsheet

This clearly exhibits a strong positive correlation between oil prices and oil imports translating to a higher oil deficit which then influences the trade deficit. It highlights the inelasticity for our imports for oil since we are still highly dependent on the rest of the world it.

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[5] India Current Account | 1949-2020 Data | 2021-2023 Forecast | Calendar | Historical (tradingeconomics.com)

Exports from India went down 0.8% year-on-year to US$ 26.89 billion in December of 2020, preliminary estimates showed.[6] Looking at the exports end, India has taken several steps to boost exports, such as improving ease of doing business, scheme for development of trade-related infrastructure and schemes to mitigate the disadvantage of high costs of transportations of exports. The services trade is mainly in surplus, supporting the current account and is primarily driven by IT exports that are correlated with the big 3 India IT company revenues (Infosys, TCS, Wipro).

The current account deficit is mainly supported through a surplus in the capital account which is mainly driven by FDI inflows and portfolio flows. The RBI report suggests that Foreign Direct Investment in India increased by US$ 4.62 billion in October of 2020.The current account has seen a steady rise whilst the capital account has been rather volatile. One reason that can justify the increasing capital inflows is simply the substantially more attractive interest rate that India boasts of as opposed to countries like the US.

A stark contrast to the historical trend can be observed in 2020 where India's current account balance recorded a surplus of $19.8 billion in the April- June 2020 quarter, compared to a surplus of $0.6 billion in the preceding quarter.

Some crucial reasons have been:

- Fall in local demand that led to a decline in the imports

- Global fall of commodity prices and slump in oil prices

- Increase of foreign exchange reserves at $551 billion (decline in imports of crude oil and gold and Indian companies attracted huge foreign direct investments)

1.3 Exchange Rate

The nominal exchange rate is the relative price between two currencies. The nominal exchange rate can be quoted in one of two ways: the price of the domestic currency in terms of foreign currency; and the price of foreign currency in terms of the domestic currency. Given that we traditionally look at USD-INR, it is the latter definition that is followed. So, if the nominal exchange rate quotes the price of the foreign currency in terms of the domestic currency, then an increase in the exchange rate corresponds to a depreciation of the domestic currency (the foreign currency has become more expensive). Conversely, a reduction in the nominal exchange rate corresponds to an appreciation of the domestic currency.

1.3.1 Analyzing a few inflection points through history:

The Indian rupee had touched an all-time low of 53.40 on December 2011. The fall was nearly 21% since August 2011 (when it was 44.04). The proximate causes were the weakening current account deficit

[6] Ministry of Commerce and Industry, India

and capital flight from India. In August 2013, the rupee had fallen to 68 against dollar which was a major single-day drop since October 1995 due to a rise in oil prices, which as aforementioned, have a strong impact on the deficit.

The major factor stated to be the global economic slowdown due to devaluation of China's Yuan and other impacting factors were FII and India's Trade Deficit. The rupee has often gotten the tag as one of the worst performing currencies in 2018 due to strengthening of US dollars compared to its peers.

Source: Investing.com Dated 12/01/2021

Figure 2: Performance of India rupee against the US$ since 2016

As for the performance of the rupee this year, it has underperformed emerging markets peers despite the markets attracting record dollars because of RBI intervention that has soaked most of it up. RBI forex reserves have expanded by over US$100 billion so far in 2020; a record accretion showing the central bank's strong grip on the rupee. This highlights that the intervention plays a major role in determining the exchange rate and offsetting the capital inflows we receive to stabilize our balances, keep inflationary pressures in check and let our exports remain competitive. One could call it either prudent or manipulative.

1.4. Conclusion Remarks to Introduction

Economists often refer to the impossible trinity. It states that it is impossible to have all three of the following at the same time: a fixed foreign exchange rate. free capital movement (absence of capital controls) an independent monetary policy. Currently, India faces the dilemma of being exposed to a volatile exchange rate so that it can have monetary autonomy and no capital controls. It is important to reiterate this rationale for the study of our research problem. We shall discuss these macroeconomic parameters in finer details and understand and establish any correlation between them.

Does depreciation of the domestic currency make it all the more better for the flow of capital but at cost at times of repatriation of profits ? Does depreciation of the domestic currency allow the GDP to expand and in particular to plug the gap between exports and imports i.e. trade imbalance ? Does strengthening of the domestic currency help correct the trade imbalances for countries like India ?

The study aims to understand how the GDP and trade balances of India have performed under the guise of exchange rate performance of the Indian rupee against the US dollar.

2.0 Literature Review

As we attempt to analyze impact of the exchange rate and its depreciation on key economic variables, it becomes important to observe this impact in other emerging economies so as to better gauge how India is performing in comparison to its peers. One may make the assumption that the performance of any domestic country's currency against foreign counterparts would have implications on the flow of capital into the country in the form of investments and bare consequences for the trade balances. Needless to add that arguably measure the strength of domestic currency as a sign of economic prosperity in terms of her GDP.

Yildirim, Z. and Ivrendi, M. (2016) gives a sufficiently interesting view of the same, basing its findings on evidence from the four emerging economies of: Brazil, Turkey, Russia and South Africa. The paper highlights both the positive and negative consequences of a depreciation and raises important questions such as 'Does it create inflationary pressure?' or 'Does it distort financial and trade balance stability?'. Weakening purchasing power of the domestic currency triggered by higher inflation would cause the exchange rate to depreciate making it arguably competitive in the international trade markets but one needs to review its true implication by studying the scope for interest rate parity between the two trading economies to measure its true benefits.

However, having evaluated from both ends of the spectrum, the article substantiates its arguments by finding that a depreciation has had 'stagflationary' effects in these countries that are primarily transferred through supply-side channels in the form of a higher import cost and a negative impact on both consumption and investment when observed from the components of output point of view. An important point of contention for a major emerging economy like India which has had trade deficit due to higher import cost of crude oil and gold against a, traditionally, weaker Indian rupee. A conflict on impact on trade balance brews as one observes that the Marshall Lerner condition may or may not be likely to hold keeping empirical evidence in mind. The Marshall–Lerner condition is the condition that an exchange rate devaluation or depreciation will only cause a balance of trade improvement if the absolute sum of the long-term export and import demand elasticities is greater than unity.

Yildirim, Z. and Ivrendi, M. (2016) points out undiscovered factors such as productivity shocks that impact exchange rate fluctuations and statistically uncovers the impact on inflation, money supply and interest rates, molding the construct of a pattern consistent in all four emerging economies, it does not shed much light on how these adversities can be overcome, which may very well not be the objective of the researchers at that time.

Having put forth the conclusions of effect of macro-economic fundamentals on exchange rate in other emerging economies, we now take an India-centric approach. Sharma and Setia (2015) study the relationship between Indian rupee-US dollar exchange rate and the macroeconomic fundamentals for the post-economic reform period. They emphasize on the complexity of the relationship between the two and give a brief overview of the theories used to explain it such as Dornbusch's sticky price model.

Venturing into India, our country follows a flexible exchange rate regime since 1993 that relies on demand and supply and central bank intervention and interestingly coincides with the start of economic liberalization. When Sharma and Setia (2015) observed Indian theories, they realized that there is a dire need for models to account for structural breaks specially since there has been observed extreme volatility in INR in recent years. They set out to do that by studying the long-run relationship between the variables. The variables(fundamentals) taken into consideration were money supply, real income, CPI, overall trade balance; with respect to India and US.

Their conclusions show that fundamentals have a significant impact on each sub-period; however, their size of impact differs and depends on various regimes and period. This brings to light that macroeconomic environment can produce breaks that produce time-varying coefficients. This implies that for a developing country like India, the fundamentals matter in formulating an exchange rate policy, but their behaviour is not constant over the period.

As enlightening as the research is, it still primarily focuses on impact of fundamentals on exchange rates; not the other way round, which is something we attempt to study in this paper. This study delves into the effect of exchange rate risk on Indian exports using both nominal and real exchange rate by employing the indices of Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) as measures of exchange rate and competitiveness.

It starts with addressing the anomaly that Indian exports have fallen flat over the past years as compared to the massive export growth that the country had experienced in the pre-crisis period while at the same time exchange rate volatility has been on a high following economic crisis in the US. Traditional models associate volatility with a negative impact on export volume and Sharma attempts to find that out by using micro-level data. The literature highlights that exchange rates along with others macroeconomic, financial, and trade indicators are determined in an endogenous framework but for trader's, movements in currency are an exogenous factor. Acknowledging both the demand and supply shocks that have hit the world economy over the years, the sensitivity of exchange rates is only justified.

The findings indicate in short run, the nominal exchange rate seems to be relevant, while in the long-time horizon, the real exchange rate should be more appropriate. The results confirm that volatility in both types of exchange rate measures have a significant impact on commodities' exports from India with differing intensities. The paper clearly indicates that exchange rate volatility impacts exports and consequently trade balances. However, the impact of exchange rate as an isolated tool is still slightly ambiguous.

3.0 Research Methodology and Problem Statement

As India has had trade deficit for majority of the times since independence, one may argue that there has not been much positive macroeconomic impact from the fluctuations in exchange rate. The hypothesis here would be that there is no correlation between the performance of the exchange rate vis-à-vis the performance of the GDP and trade balances as for majority of her time since independence, India has seen the exchange rate depreciate for better part yet boasts of being a country which attracts high FDI and FPI flows and GDP growth rate.

The question that this study aims to address is how the GDP and trade balances of India have performed under the guise of exchange rate performance of the Indian rupee against the US dollar. The method of research was basic, explanatory and deductive. It was to develop certain predictions about a topic well-questioned in academia, pin the causes and consequences of it and test the theory of correlation that exists or not.

Given the nature of both quantitative and qualitative data were used since the question demanded to understand not only if there was any correlation or not but also to gauge what factors contributed to its absence or presence. The primary methods through which data was collected were reading varied literature and observe the work that had already been done on the topic or observe any trends that were highlighted. The variables were to be measured on a quarterly basis and may have utilized simple/multiple regression models to determine the correlation and interdependence; hence using statistical methods to present significance or the lack thereof.

For certain variables where quarterly data was not available, monthly data was sourced and then an average was taken to build quarterly figures. The timeframe has been from the second quarter of 2005 to the last quarter of 2020, giving a total of 55 observations. The data, after having been compiled, has been analysed on a quarter-on-quarter basis to eliminate the effect of seasonality that would most likely be present in the data given its nature of being time-series. Another weakness owing to the same is the possibility of the nature of the data being non-stationary.

To detect this, the Augmented Dicky Fuller test has been implemented on each of the variables, to show the stationarity of data. However, GDP, Inflation are non-stationary time series and hence present flaws in the subsequent regression and analysis of output. Each variable's data has been sourced from the Database of Indian Statistics, RBI.

The regressions have been conducted on R-studio and the graphs on MS Excel. The use of time-series tools has assisted in making the data readable and gives an opportunity to interpret the outputs fairly.

Following are the limitations of the research approach:

- Non-stationarity of data for GDP and inflation
- Taking average of averages for exchange rate
- Running bi-variate regressions with respect to all the dependent variables to attempt an observe an isolated impact of exchange rate on all of them.

- Fewer observations for GDP and Inflation owing to lack of availability of data for the latter and change in base year for the former

The overall effect of the approach has been weak. This is owing to multiple factors as aforementioned and a stronger model could have been created with a higher number of observations, more sophisticated methods of time-series analysis and a clearer goal.

4.0 Research Findings and Discussion

4.1 Variables summary

Before going to the findings, here is a summary of all the variables used and a brief description of the same.

Variable (Units)	Type	Year	Source
Exchange rate (% change QoQ)	Independent variable	Q2 2005-Q4 2020	DBIE, RBI
Gross domestic product (% change QoQ)	Dependent variable	Q4 2012-Q4 2020	DBIE, RBI
Foreign Investment (% change QoQ)	Independent variable	Q2 2005-Q4 2020	DBIE, RBI
Foreign reserves (% change QoQ)	Independent variable	Q2 2005-Q4 2020	DBIE, RBI
Current account (% change QoQ)	Independent variable	Q2 2005-Q4 2020	DBIE, RBI
Inflation (% change of CPI QoQ)	Independent variable	Q4 2012-Q4 2020	DBIE, RBI

Table 2- Variables' Summary

We shall now dwell into the findings with the testing of the hypothesis with the data analysis. First let us understand the variables and its significance with a brief description and discussion of each of the variables:

(1) Exchange rate: The USD-INR exchange rate monthly averages had been taken for this variable. The averages were then averaged again to find quarterly figures on the basis of which the percentage change was determined. A positive change would most likely imply a stronger value and hence a USD appreciation. A negative value would most likely imply a weaker value and hence a USD depreciation. The exchange rate is the most critical variable since it is being used in order to explain the impact of an appreciation or depreciation on trade balances, reserves and GDP.

(2) Real GDP: Given that GDP is an important indicator of economic performance, one might want to observe the impact of the exchange rate on the same to see if it steers the growth of the former in any particular direction.

(3) Foreign investment: A critical part of the total Balance of Payments position of the country, it determines the inflows and outflows of the capital account of the Balance of Payment which is ideally what balances or sets off the deficits/surpluses of the current account. It includes but is not limited to FDI and FPI and has scope of being affected by the movements in exchange rate as a stronger USD makes investments in

India more attractive whereas a stronger Rupee reduces India's competitiveness and investors would flock abroad to find more tempting deals.

(4) Foreign exchange reserves: Traditionally, foreign reserves refer to foreign currency and securities that a government or central bank hold. Foreign reserves may include foreign currencies, gold, special drawing rights with international lending agencies, and sovereign debt instruments. For India, foreign reserves consist of foreign currency assets, gold, reserve tranche position and SDRs with amounts to in excess of US$590 billion as of February 2020. The motivation to include this as a dependent variable is to determine the impact of the exchange rate on reserves since India maintains a balanced float.

(5) Current account: A component of the Balance of Payments that covers trade in goods, services, current transfers and factor income. Given that the theoretical relationship between the current account and exchange rate, we know that an appreciation of a currency could theoretically make imports to become cheaper and exports to become more expensive. The opposite happens for a depreciation case. We know the impact of indicators on the exchange rate but we need to understand the impact of the exchange rate itself, as a consequence on the same indicators.

(6) Inflation: In India, the Consumer Price Index is used as the indicator for inflation. This only surfaced from 2011 onwards, hence posing a limitation in the data collection. The inflation as a metric in imperative since in spite of a country having a depreciated currency, it can fail to gain international competitiveness, is the advantage in the price of its goods is dampened by the persisting inflation in the economy.

4.2 Hypothesis test and findings

Now that we have understood the significance of each variable, we shall now focus on the hypothesis testing with the application of simple two variable regression methodology.

Hypothesis I - Does strengthening or weakening of the domestic currency have any bearing in the inflow and outflow of foreign investments into the country.

Null: Fluctuation in foreign exchange rate does not have any bearing in the inflow and outflow of foreign investments
Alternative: Depreciation of domestic currency does have bearing in the inflow and outflow of foreign investments

Foreign investment = B0+ B1 (Exchange rate)

The first bi-variate model regresses foreign investment on exchange rate to observe the impact of the latter on variables such as the Foreign Portfolio Investment (FPI) and Foreign Direct Investment (FDI). We see that the B1 coefficient (often referred to as beta) is negative 3.66%. This suggests that one point change in the exchange rate brings about -3.66 point change in foreign investment. The direction seems accurate enough however the p-value, at 0.4355, does not allow us to reject the null hypothesis. Acceptable p value of less than 0.05 is needed to reject the null hypothesis. In terms of exchange fluctuations, we could argue that depreciation of the rupee leads to an increased inflow of foreign investments as rupee per unit of foreign currency increases thereby favouring increased inflow of foreign investments. Opposite would be true in the case of rupee appreciation against the dollar.

Hypothesis 2 - Does strengthening or weakening of the domestic currency impact the total value of foreign reserves of the central bank.

Null: Fluctuation in foreign exchange rate does not have an impact on the total value of foreign reserves of the central bank
Alternative: Fluctuation in foreign exchange rate does have an impact on the total value of foreign reserves of the central bank

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Foreign reserves = B0+ B1 (Exchange rate)

Foreign reserves, an accumulation of the aforementioned entities, can be potentially impacted if the central bank uses forex market intervention in order to maintain relative stability in the volatile forex markets. According to our regression, the B1 co-efficient is -0.66 point which suggests that one point change in the

exchange rate causes the foreign reserves to change by -0.66 point. Rather interestingly, the p-value is extremely high at 0.794, not allowing us to reject the null hypothesis suggesting that change or variability in the exchange rate does not have an impact on the foreign exchange reserves.

Hypothesis 3 - Does strengthening or weakening of the domestic currency help correct the trade imbalances for countries like India and in particular to plug the gap between exports and imports?

Null: Fluctuation in foreign exchange rate does not impact the trade balance

Alternative: Depreciation of domestic currency does impact the trade balance

$$\text{Current account} = B0 + B1 \text{ (Exchange rate)}$$

In this model, we shall regress the current account against the foreign exchange rate to determine whether any change in exchange rate beings about any kind of proportional variability in the current account. Using a simple regression model, the model threw an interesting picture in that the coefficient came as 15.32 suggesting an extremely strong variability in the current account. It is understandable that the current movements are impacted by variations in the exchange rate as internal competitiveness keeps shifting grounds, but the size of impact seems substantially huge. With the p-value at 0.1139, one fails to reject the null hypothesis.

The fact that coefficient is of 15.32 makes it a remark correlation between the exchange rate and the current account thereby suggesting the possibility of exchange rate depicting the strength of the economy which has a strong influence on the country's competitiveness in the international trade markets.

Hypothesis 4 - Does strengthening or weakening of the domestic currency coupled with prevailing inflation (CPI) allow the GDP to expand?

Null: Fluctuation in foreign exchange rate does not impact the performance of the GDP driven by inflationary conditions.

Alternative: Depreciation of domestic currency does impact the performance of the GDP driven by inflationary conditions.

$$\text{GDP} = B0 + B1 \text{ (Exchange rate)} + B2 \text{ (Inflation)}$$

Notably, this multi-variate regression was limited with number of observations being below 30. This and other reasons, caused the variables to be non-stationary (ADF test results in supplementary data). Running the regression regardless, gives an interesting output with B1, i.e. the exchange rate, having a negative co-efficient at -0.015 and the inflation gives a positive coefficient at 0.17 points. The former suggests that an

change of 1 point in the exchange rate leads to a fall in GDP by -0.015 points. However, the p-value (0.822), does not allow us to reject the null hypothesis suggesting that foreign exchange rate does not impact the performance of the GDP driven by inflationary conditions. The output on the other hand suggest the contrary.

4.3 DISCUSSION:

The results of our macro model present some interesting findings. One can observe that the nature of the effect of the independent variable exchange rate is sufficiently, theoretically and practically accurate when mapped on various different dependent variables. This matches the expectations of the model. However, the significance of the model is flawed statistically primarily because of a poor goodness of fit (R^2 and adjusted R^2) in all four cases.

The study demonstrates an accurate direction and possible strength correlation between exchange rate and all dependent variables as has been observed through past literature and findings. Some variables end up having been impacted more severely than the others (such as current account) whilst some posit a result not entirely expected (such as GDP).

This research raises some important questions that can be tackled by academia further, such as what exactly in the consequential implication of an appreciation or depreciation of the USD/INR exchange rate that was caused by some exogenous factor. It can follow the trail of the impact of foreign exchange markets on international trade markets and by extension, national income as well.

The generalizability of the results is limited by multiple factors that have been brief explained in the research methodology. The reliability of this data is impacted by real constraints such as lack of availability of quarterly data for certain indicators, modification of existing data, non-stationarity of data to name a few. It is beyond the scope of this study to understand and analyse the impact on all possible macro-economic indicators across a larger time span, not only due to availability constraints but also because India, as an emerging nation, has gone through magnanimous structural shifts, right from independence to the early 1990s liberalisation policies, to the global financial crisis, the flattening of the trade curve, taper tantrum and much more.

This leads one to introspect the changes that can be made to the model in order to make it more accurate and telling. Further research is needed to establish the impacts of structural breaks and this can consider all that the current model lacks.

5.0 CONCLUSION:

This model hence concludes that the variability in the UDS/INR exchange does not have a significant impact on Indian macro-economic indicators such as the trade balance, GDP and the likes. The performance of the GDP is driven by many other factors including economic policies of the government and other macroeconomic conditions.

It has been observed, empirically, that when it comes to the causal effect, the USD/INR exchange rate is significantly impacted by the Balance of Payments. That is to say that sharp movements of the USD/INR exchange rate are always driven by a lower Balance of Payment surplus or a Balance of Payment deficit. Another way to put it is that a Balance of Payment surplus and performance of the Indian rupee exhibit a positive correlation.

Another point to keep in mind is that in spite of India being a perennially current account deficit country, the nature of this CAD is changing. Some changes are owing to structural factors, some owing to cyclical factors. The former including moderation in electronic imports and higher import duties and gold prices. The latter including lower oil prices and weak volume growth, weak investment growth, weak demand and commodity prices. These factor in when one realises the nature and components of the Balance of payment that are impacted by the exchange rate in return.

For instance, the country's current account is dominated by oil. It is an inelastic import and plays a huge rule in signalling the strength of the current account. An uncertainty in oil market as witnessed in recent times in the early part of 2021 majorly impacts oil prices which inherently impact oil imports and prices of petroleum products. However, one cannot ignore the added burden of taxes levied by the government to plug its financial deficits

This brings one to wonder about the Marshall Lerner condition which needs to be satisfied, theoretically, if a country's current account is expected to improve over time following a depreciation of its currency. The Marshall–Lerner condition is satisfied if the absolute sum of a country's export and import demand elasticities is greater than one. If it is satisfied, then if a country begins with a zero-trade deficit then when the country's currency depreciates, its balance of trade will improve. We can see that that cannot be the case with India owing to its rigid dependence on overseas for oil. The import elasticity is much lesser than 1; the J-curve condition cannot be observed. When the Marshall-Lerner condition is not met, and the sum price elasticity of demand for imports and exports is less than 1, then the balance of trade will worsen when a currency depreciates. This can go to explain a plausible reason for the results of our model specially since non-oil exports have fallen flat over the past 7 years.

At the same time, as stated earlier, India's foreign exchange reserves have risen to the highest level on record at $542bn whilst India's import cover is also at its highest level. One can observe that large portfolio outflows of $17bn in FY20 caused a depreciation of the INR against the USD 71 to 74-76 level. Since then, the Indian rupee has remained stable despite a large Balance of Payment surplus due to RBI reserve accretion. This is also known as managed floating- dollar purchases by the RBI have led to liquidity injection. This

scenario is referred in order to point out to the fact that the RBI intervention cannot be treated lightly as it is one of the factors that influence the behaviour of the INR in global markets.

Another reason to highlight the inability of the depreciation of the Indian rupee to sustain international competitiveness is the fact that India also poses to have one of the highest levels on inflation amongst its peers that can dampen the effect the depreciation might have in working towards its favour.

As for the impact of the exchange rate on GDP, one realises just how gigantic a figure such as the GDP is. It can only be influenced through various policy frameworks and impositions, not controlled. The policy implications are also lagged and are not observed in the time period that they are implemented in as opposed to the exchange rate which can be controlled quite easily as mentioned above. Since the exchange rate is more susceptible to short-term changes as well, it it understandable that a relationship between the two cannot be viewed.

We take the findings of this paper in a positive stride as it only reflects just how greater a reflection is needed into the topic at hand. One realises that it is just as imperative to observe history in order to discern what is happening in the present so as to create wiser solutions for the future.

6.0 Appendix 1- ADF tests results

```
        Augmented Dickey-Fuller Test

data:   EXCHANGE RATE
Dickey-Fuller = -4.4133, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary

Warning message:
In adf.test(`EXCHANGE RATE`) : p-value smaller than printed p-value
> adf.test(`FOREIGN INVESTMENT`)

        Augmented Dickey-Fuller Test

data:   FOREIGN INVESTMENT
Dickey-Fuller = -4.2739, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary

Warning message:
In adf.test(`FOREIGN INVESTMENT`) : p-value smaller than printed p-value
> adf.test(`FOREIGN RESERVES`)
```

```
        Augmented Dickey-Fuller Test

data:   FOREIGN RESERVES
Dickey-Fuller = -4.6847, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary

Warning message:
In adf.test(`FOREIGN RESERVES`) : p-value smaller than printed p-value
> adf.test(`CURRENT ACCOUNT`)

        Augmented Dickey-Fuller Test

data:   CURRENT ACCOUNT
Dickey-Fuller = -3.6763, Lag order = 3, p-value = 0.03489
alternative hypothesis: stationary

>
```

```
        Augmented Dickey-Fuller Test

data:   GDP
Dickey-Fuller = -1.2354, Lag order = 2, p-value = 0.8637
alternative hypothesis: stationary

> adf.test(`EXCHANGE RATE`)

        Augmented Dickey-Fuller Test

data:   EXCHANGE RATE
Dickey-Fuller = -3.0819, Lag order = 2, p-value = 0.1602
alternative hypothesis: stationary

> adf.test(INFLATION)

        Augmented Dickey-Fuller Test

data:   INFLATION
Dickey-Fuller = -2.4749, Lag order = 2, p-value = 0.3915
alternative hypothesis: stationary
```

6.1 Appendix 2- Regression outputs

```
> modelts1 <- lm(`FOREIGN INVESTMENT`~`EXCHANGE RATE`)
> summary(modelts1)

Call:
lm(formula = `FOREIGN INVESTMENT` ~ `EXCHANGE RATE`)

Residuals:
    Min      1Q  Median      3Q     Max
-7.9032 -1.3575 -0.7732  0.3319 11.7714

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)       0.9953     0.4400   2.262   0.0278 *
`EXCHANGE RATE`  -3.6629     4.6610  -0.786   0.4355
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.993 on 53 degrees of freedom
Multiple R-squared:  0.01152,   Adjusted R-squared:  -0.007133
F-statistic: 0.6176 on 1 and 53 DF,  p-value: 0.4355
```

Figure 3: Regression Output- modelts1

```
> modelts2 <- lm(`FOREIGN RESERVES`~ `EXCHANGE RATE`)
> summary(modelts2)

Call:
lm(formula = `FOREIGN RESERVES` ~ `EXCHANGE RATE`)

Residuals:
     Min       1Q   Median       3Q      Max
-0.41685 -0.07929 -0.02762  0.04872  0.49438

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      0.13368    0.02384   5.607 7.6e-07 ***
`EXCHANGE RATE` -0.06640    0.25256  -0.263   0.794
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1622 on 53 degrees of freedom
Multiple R-squared:  0.001303, Adjusted R-squared:  -0.01754
F-statistic: 0.06913 on 1 and 53 DF,  p-value: 0.7936
```

Figure 4: Regression Output- modelts2

```
> modelts4 <- lm(`CURRENT ACCOUNT`~`EXCHANGE RATE`)
> summary(modelts4)

Call:
lm(formula = `CURRENT ACCOUNT` ~ `EXCHANGE RATE`)

Residuals:
    Min      1Q  Median      3Q     Max
-32.296   0.214   1.319   2.229   4.418

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      -2.1338     0.8998  -2.371   0.0214 *
`EXCHANGE RATE`  15.3185     9.5310   1.607   0.1139
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.121 on 53 degrees of freedom
Multiple R-squared:  0.04647,   Adjusted R-squared:  0.02848
F-statistic: 2.583 on 1 and 53 DF,  p-value: 0.1139
```

Figure 5: Regression Output- modelts4

```
> nsdata2 <- lm(GDP~`EXCHANGE RATE`+INFLATION)
> summary(nsdata2)

Call:
lm(formula = GDP ~ `EXCHANGE RATE` + INFLATION)

Residuals:
      Min        1Q    Median        3Q       Max
-0.040502 -0.007176  0.001827  0.012911  0.028010

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      0.06034    0.01095   5.508 1.55e-05 ***
`EXCHANGE RATE` -0.01591    0.06980  -0.228    0.822
INFLATION        0.17205    0.22746   0.756    0.457
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.01723 on 22 degrees of freedom
Multiple R-squared:  0.02555,   Adjusted R-squared:  -0.06304
F-statistic: 0.2884 on 2 and 22 DF,  p-value: 0.7523
```

Figure 6: Regression Output- nsdata1

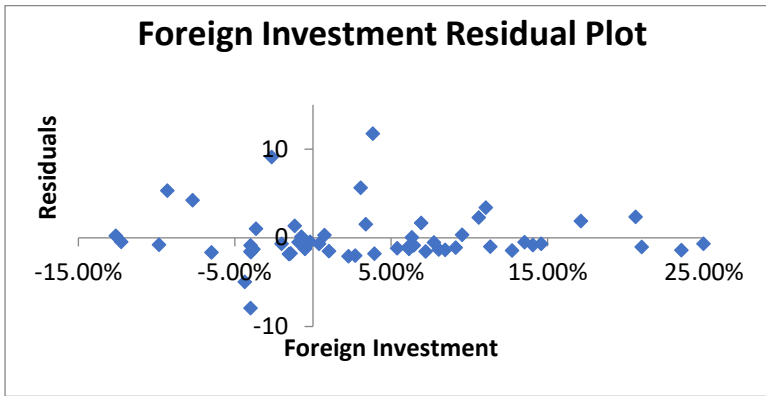## 6.3 Appendix 3- Graphical representation
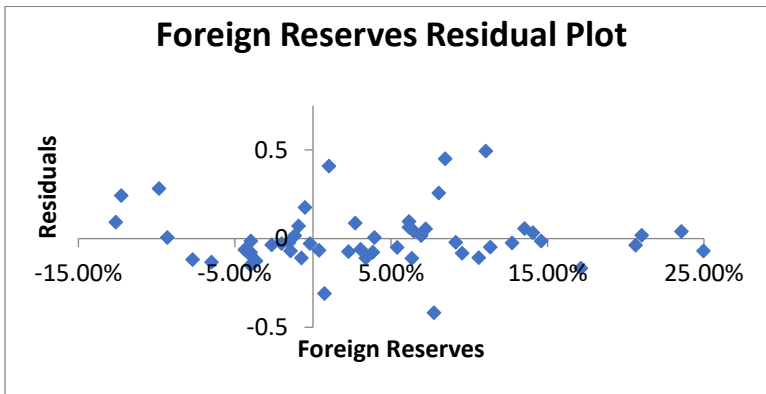

Figure 7: Residual Plot- Foreign Investment
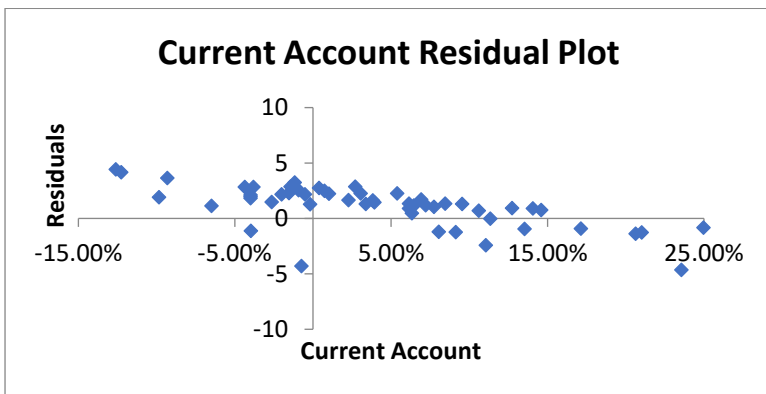

Figure 8: Residual Plot- Foreign Reserves

Figure 9: Residual Plot- Current Account

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