

# Crude Oil and Foreign Exchange: An Empirical Study of their Relationship of BRICS Nations

## Authors

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**Abstract:** Crude oil is the most essential commodity used by different economy to bring their country in force. This examination intends to research whether the Crude oil prices promotes Foreign exchange rates against USD among the BRICS nations. There can be the utilizations of monthly crude oil prices which can have direct or indirect influence on the monthly foreign exchange rate because the pricing of crude oil is made in American dollar. This provides us with rich information to the experimental examination. The results in general shows that, in oil exporting countries, when the oil prices increase then the rate for foreign exchange appreciates. In oil import countries, when the oil prices increase then the rate for foreign exchange depreciates except that in the case of China. The research also analysis one SD shock on Crude oil to foreign exchange rate has no impact on the long run but has a positive or negative impact in short run. The study is using Unit root test, Regression, Granger Causality, and Impulse Response to analyze the impact of Crude oil on Foreign exchange for all the 5 nations (Brazil, Russia, China, India, South Africa) against USD. The monthly period of the study has been taken from 1/12/2003- 1/05/2018.

**Keywords:** Crude Oil, Unit root test, Regression, Granger Causality, Impulse Response.

## 1. Introduction

The crude oil's price impact all over the world by changing the global economic situation. That means oil is not only driving the vehicles but the whole country. Currency fluctuation depends from places to places. Let's take the example of India and Indian Rupee. We know that India is one of the largest oil consumer after US, China and Japan, and imports most of the oil from Middle East countries. When oil prices falls down then India can import same quantity of crude oil and pay less USD in return this will decrease the demand for USD in the market. USD is weekend against INR. Interesting part of this whole tantrum is the vicious circle. Because if the oil producing country is getting less payments, the economy starts to shrink. All these projects start to shake as they are highly dependent on finance coming from oil selling as a result of which they tend to slow down their oil distribution and wait for the appropriate time to deliver the oil, that is when the price shoots up again. When we compare the recent USD/INR exchange rate chart with the oil price chart we see that USD strengthened even though oil prices is getting curtailed every day. This is because exchange rate depends on other factors too. If China, starts buying large quantity of oil then USD value will increase and there will be an impact on INR- USD rate also. Therefore these other factors include Trade balance between USA and India, Rate of Inflation, Rate of Interest Rate, FII, FDI and many more.

## COMMON FACTORS DRIVING OIL PRICES AND EXCHANGE RATE

These factors include-



## 2. Literature Review

**(Joscha Beckmann, June 2017)** examined theoretical and empirical research on the relationship of crude oil and exchange rates. The author uses tools like ganger causality, cointegrations, VAR, GARCH and to come to the conclusion. The main findings from the research is that oil prices and foreign exchange relation has been evolving over time and has become more volatile. Author makes a strong evidence that the oil price and exchange rate are related in the long run. There is an inverse causality between USD depreciation and increase in the oil prices. Determining the oil supply and demand is an important factor for the analysis of the relationship.

**(Rath, 2016)** studies a bidirectional nonlinear causality between oil prices and India's exchange rate similarly for China, unidirectional nonlinear causality running from exchange rate to oil prices. The methodology used is Granger causality test to the VAR residuals GARCH (1,1), robustness check. The Variables in the study Real effective exchange rate (REER) of China (RXC) and India (RIX), Crude oil price (real terms and deflated by US CPI). The main Finding from the research in India significant bi-directional nonlinear Granger causality with lagged information from oil prices influences the exchange rate and vice versa. In China nonlinear and unidirectional causality shows exchange rate causes change in oil prices

**(Domenico Ferraro, 2012)**, examines whether oil prices have dependable and firm out of sample relationship with the Canadian/U.S Dollar nominal exchange rate. The test statistics used are regression, random walk etc. The empirical results are noteworthy, as it provides clear evidence of short-term relationship between oil prices and exchange rate and a little systematic relation between them in monthly and quarterly basis. In the later stage the predictive ability is fleeting.

**(MAURIZIO MICHAEL HABIB, 2016)**, examines whether oil shocks are a factor of change in global exchange rate in particular the countries who export and import high quantity of oil. The methodology used is identification of global stocks in a VAR approach, The main finding was that the oil exporting countries

exchange rate appreciates after the increase in oil demand stock, which is balanced by foreign exchange reserves accumulations. The author ensures that the external sustainability of oil-importing countries the real exchange rate depreciates for positive non-oil trade balance.

**(Slav, Oct 18, 2018,)** Chinese refiners are buying Canadian oil that was trading at a discount of as much as US\$50 to WTI, which is great bargain. China purchases 1.58 million barrels of heavy Canadian crude oil. China's other main sources of crude oil Australia and Venezuela are going through a production decline. Moreover, china's growth problem and structural shift in its economy from industrial sector which is very energy intensive to service sector which is far less energy intensive, leads to decrease in oil demand.

**(Hashimova, December, 2017)** examines the effect of oil price fluctuations on the exchange rate of the national currency of Azerbaijan. The result showed that during 2014 the price started to fell and crossed the lower limit if USD 34 per barrel. Decreasing global demand for oil changes the OPEC policy and also appreciates the USD value as a result of which the exchange rate of Azerbaijan manat increased at high rate, as Azerbaijan is an oil producing country. The analysis was done with 4 years of data and also provides an overview of oil forecasts.

## 2.1 Research Gap:

Despite several researches the relationship between crude oil prices and foreign exchange of different countries cannot be determined. This research adds values by providing futuristic analysis of the data. Therefore, it can be used for future studies by researchers and for other academic purposes. This research has not been collectively done for the BRICS nation as a whole. The paper also explores the short and long run relationship between crude oil prices and foreign exchange rate of BRICS against USD and also the effect of change of such prices on the economies.

## 3. Objectives:

- To Study the impact of change in price of crude oil on Foreign exchange
- To explore the short and long run relationship between crude oil prices and foreign exchange rate of BRICS against USD.

**4. Data and Methodology-** This paper aims to study The Impact of Crude Oil prices on the Foreign exchange rate of BRICS against USD. In order to facilitate the study 5 countries including Brazil, Russia, China, India and South Africa has been selected. The Foreign Exchange rate and the Crude oil Price have been taken into consideration. The Foreign Exchange rate is taken against USA as Dollar is the universal currency used all over the world. Monthly Data for almost 15 years, has been collected starting from December 2003 to May 2018. The monthly data for Crude oil have been collected from different sites likes MCX and Index Mundi- <https://www.mcxindia.com>, <https://www.indexmundi.com>, and foreign exchange prices has been collected from Investing.com- <https://www.investing.com>. In order to identify the presence of Unit root Augmented Dickey Fuller Unit root test was performed. And then Granger Causality test was performed to evaluate the cause and effect of indices on the overall market at that period of time. Regression was performed to know the degree to which two variables are related and examine the

relationship between the independent and dependent variable. And then impulse responses has also been performed for the given data. The results for the test were obtained by EViews statistical software package, Student version 10SV.

#### **4.1 Research Design & Hypothesis:**

Causal research design is used to study the extent of the relationship between Foreign Exchange & Crude oil.

The Hypotheses for the study are:

##### **Hypothesis 1-**

Ho- there is no impact of Crude oil price on foreign Exchange

H1- There is an impact of Crude oil price on Foreign Exchange

##### **Hypothesis 2-**

H0- There is no short run and long run impact of Crude oil prices on Foreign exchanges

H1- There is a short run and long run impact of Crude oil prices on Foreign exchanges

#### **4.2 Scope of study**

The study includes foreign exchange of countries Brazil, Russia, South Africa, China and India - Oil importers in the world who heavily are responsible for most of the demand of oil in the world. It includes the crude oil price effect on their foreign exchange rates. Data and information of these economies has been taken from the year 2003 to 2018. The study is done to know whether there is an impact of crude oil prices on Foreign exchange rate or not in the BRICS nation. It is further helpful in analysing the short term and long-term effect of change in crude oil prices on the foreign exchange rate.

#### **4.3 Statement of Problem**

The study firstly focuses on the understanding of the economic State of Each of the 5 Economies, and then relating the changes happening in these economies with the Oil. Secondly, it focusses on the changes that affected the oil prices and its demand and supply throughout these countries. Then analyse it with the Foreign exchange rate of the country, and lastly to explore the short and long run relationship between the variables. There are various other factors that affect the foreign exchange rate that includes GDP, Inflation etc.

Example- An increase in the crude oil price would mean that there will be an increase in the cost of producing the goods and vice versa. This rise in price will pass on to the consumers in the form of inflation. Experts in this field believe that with an increase in \$10/barrel in crude oil prices there can be an raise of 10 basis points in inflation.

#### 4.4 Data analysis techniques:

The following Statistical and Econometric Techniques are used for data analysis

- Augmented Dickey-Fuller Unit Root Test
- Regression Test
- Granger Causality Test.
- Impulse response Test

#### 4.5 Limitations:

- The limitation of the study is taking just 5 countries foreign exchange and does not include other countries making it very specific hence, it cannot be generalized.
- The data has also been taken from the last 15 years only. All factors affecting the oil prices have not been included. The data collected is also secondary.
- Moreover, the variable considered in the research are only foreign exchange rates of countries like Brazil( Real), Russia (Ruble), India (INR), China (Yen), and South Africa (Rand) other Major variable which have an impact over the change in the price of the crude oil like GDP, Inflation, Interest rate, Stock Prices have not been taken into consideration.

### 5. Analysis and Interpretation:

#### 5.1 Stationary Test-

##### ADF TEST:

Therefore, to check the stationary test, the following is the hypothesis:

**Ho:** prices are not stationary or prices have unit root

**H1:** prices are stationary or prices do not have unit root

**Table 5.1**  
**Stationary Test of Crude Oil**

INDEX	t-Statistic	Probability
China's Crude oil price	-2.896461	0.0478
China's Foreign exchange rate	-9.650208	0.0000
India's Crude oil price	-8.493436	0.0000
India's Foreign exchange rate	-12.02150	0.0000
Brazil's Crude oil price	-9.755778	0.0000
Brazil's Foreign exchange rate	-12.65054	0.0000
Russia's Crude oil price	-10.35166	0.0000
Russia's Foreign exchange rate	-8.783544	0.0000
South Africa's Crude oil price	-9.034710	0.0000
South Africa's Foreign exchange rate	-13.12651	0.0000
Test critical values: 1% level	-3.468521	
5% level	-2.878212	
10% level	-2.575737	
**Mackinnon (1996) one sided p-values		

**Interpretation-** As can be seen in the table, the probability value is less than 0.05 ( $p < 0.05$ ), so we reject the null hypothesis, thus stating that the data is stationary and can be used to do further analysis.

## 5.2 REGRESSION-

**Foreign Exchange Rate=  $B_0 + B_1(\text{crude oil prices}) + u$**

HYPOTHESIS:

**H<sub>0</sub>:** There is no impact of crude oil prices on foreign exchange rates

**H<sub>1</sub>:** There is an impact of crude oil prices on foreign exchange rates

Variable	Coefficient	Std. Error	t-Statistics	Prob
C	7.614087	0.178134	42.74368	0
China	-0.001371	0.000344	-3.980751	0.001
R-squared	0.084358			
Adjusted R-squared	0.079035			

**CHINA**

**Interpretation-** In this case the value of p is **0.00** which is lesser than 0.05 ( $p < 0.05$ ) therefore, we reject null hypothesis ( $H_0$ ) and accept alternative hypothesis ( $H_1$ ). We can say There is an impact of crude oil prices on foreign exchange

Crude oil price there is an impact and the coefficient value is - 0.0013 which shows there is an negative impact thus, it means: there is an indirect relationship among the variable.

If 1 unit of x increases 0.0013 unit of y decreases

If 1 unit of x decreases 0.0013 unit of y increases

**Adjusted r squared** : (value for multiple linear regression analysis) **7.9%** of variation in dependent variable can be explained by the independent variable. The remaining 92.1% of the variations can be explained by other variables not taken into consideration.

## INDIA

Variable	Coefficient	Std. Error	t- Statistics	Prob
C	45.36663	1.953113	23.22786	0.0000
India	0.001887	0.000487	3.877092	0.0002
R-squared	0.080370			
Adjusted R-squared	0.075024			

**Interpretation:** In this case the value of p is **0.0002** which is lesser than 0.05 (**p<0.05**) therefore, we reject null hypothesis (Ho) and accept alternative hypothesis (H1). We can say There is an impact of crude oil prices on foreign exchange

Crude oil price there is an impact and the coefficient value is 0.0019 which shows there is an positive impact thus, it means: there is an direct relationship among the variable.

If 1 unit of x increases 0.0019 unit of y increases

If 1 unit of x decreases 0.0019 unit of y decreases

**Adjusted r squared** : (value for multiple linear regression analysis) **7.5%** of variation in dependent variable can be explained by the independent variable. The remaining 92.5% of the variations can be explained by other variables not taken into consideration.

## BRAZIL

Variable	Coefficient	Std. Error	t- Statistics	Prob
C	2.545206	0.202916	12.54313	0.0000
Brazil	-0.000855	0.001211	-0.706181	0.4810
R-squared	0.002891			
Adjusted R-squared	-0.002906			

**Interpretation:** The value of p is **0.4810** which is greater than 0.05 (**p>0.05**) ,thus we accept Ho and can say that there is no impact of crude oil prices on foreign exchange

## RUSSIA

Variable	Coefficient	Std. Error	t- Statistics	Prob
C	17.51714	3.138730	5.580966	0.0000
Russia	0.007826	0.001175	6.661997	0.0000
R-squared	0.205110			
Adjusted R-squared	0.200489			



**Interpretation:** In this case the value of p is **0.000** which is lesser than 0.05 (**p<0.05**) therefore, we reject null hypothesis (Ho) and accept alternative hypothesis (H1). We can say There is an impact of crude oil prices on foreign exchange

Crude oil price there is an impact and the coefficient value is 0.0078 which shows there is an positive impact thus, it means: there is an direct relationship among the variable.

If 1 unit of x increases 0.0078 unit of y increases

If 1 unit of x decreases 0.0078 unit of y decreases

**Adjusted r squared :** (value for multiple linear regression analysis) **20.05%** of variation in dependent variable can be explained by the independent variable. The remaining 79.95% of the variations can be explained by other variables not taken into consideration.

## SOUTH AFRICA

Variable	Coefficient	Std. Error	t- Statistics	Prob
C	6.348293	0.557875	11.37941	0.0000
SOUTH AFRICA	0.004366	0.000810	5.391746	0.0000
R-squared	0.144580			
Adjusted R-squared	0.139607			

**Interpretation:** In this case the value of p is **0.000** which is lesser than 0.05 (**p<0.05**) therefore, we reject null hypothesis (Ho) and accept alternative hypothesis (H1). We can say There is an impact of foreign exchange rates on crude oil prices

Crude oil price there is an impact and the coefficient value is 0.0044 which shows there is an positive impact thus, it means: there is an direct relationship among the variable.

If 1 unit of x increases 0.0044 unit of y increases

If 1 unit of x decreases 0.0044 unit of y decreases

**Adjusted r squared :** (value for multiple linear regression analysis) **13.96%** of variation in dependent variable can be explained by the independent variable. The remaining 86.04% of the variations can be explained by other variables not taken into consideration.

## 5.3 GRANGER CAUSALITY

H0- Variable 1 does not Granger Cause Variable 2

H1- Variable 1 does Granger Cause Variable 2

The pairs give 3 types of results i.e, unidirectional relationship, bidirectional relationship or no relationship.

The rationale behind the interpreting is adopted from the user guide of the EViews which stated that if probability is greater than 0.05 then the null hypothesis cannot be rejected and if the probability is lesser than 0.05 then the null hypothesis can be rejected.



Table: Granger Causality Test

<b>Pairwise Granger Causality tests</b>			
<b>Date: 01/23/19 Time: 21:30</b>			
<b>Sample: 12/2003 07/2018</b>			
<b>Lags: 2</b>			
Null Hypothesis	Obs	F-Statistic	Prob.
China's crude oil prices does not granger cause china's foreign exchange against USD	171	3.55233	0.03085
China's foreign exchange against USD does not granger cause China's Crude oil price		0.08352	0.43557
India's crude oil prices does not granger cause India's foreign exchange against USD	171	0.08710	0.9166
India's foreign exchange against USD does not granger cause India's Crude oil price		0.39301	0.6757
Brazil's crude oil prices does not granger cause Brazil's foreign exchange against USD	171	4.75515	0.0098
Brazil's foreign exchange against USD does not granger cause Brazil's Crude oil price		2.01754	0.1362
Russia's crude oil prices does not granger cause Russia's foreign exchange against USD	171	1.33458	0.2661
Russia's foreign exchange against USD does not granger cause Russia's Crude oil price		3.46815	0.0335
South Africa's crude oil prices does not granger cause South Africa's foreign exchange against USD	171	4.98883	0.0079
South Africa's foreign exchange against USD does not granger cause South Africa's Crude oil price		0.5867	0.5573

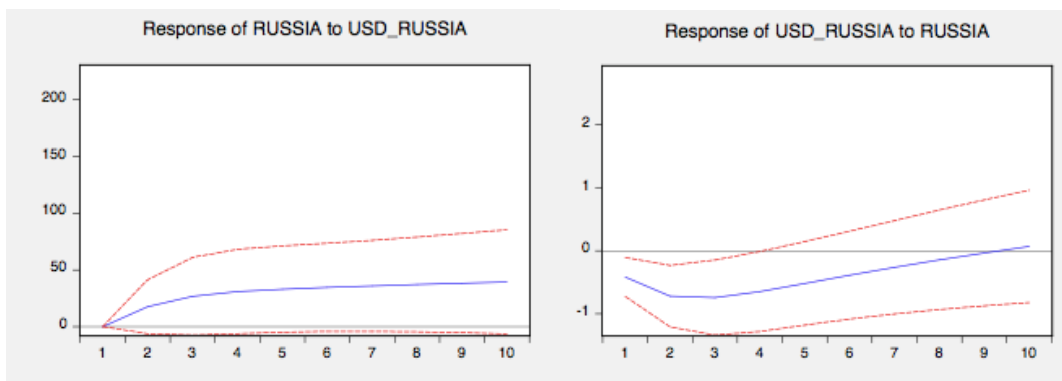
**INTERPRETATION-** As can be seen in table , since the probability value of all observations except China's crude oil prices does not granger cause chin

a's foreign exchange against USD, Brazil's crude oil prices does not granger cause Brazil's foreign exchange against USD, Russia's foreign exchange against USD does not granger cause Russia's Crude oil price ,South Africa's crude oil prices does not granger cause South Africa's foreign exchange against USD are more than 0.05 or 5%, so we fail to reject the null hypothesis in all situations thus stating that there exists no univariate or bivariate granger cause between the pairs under test.

In the case of China's crude oil prices does not granger cause china's foreign exchange against USD, Brazil's crude oil prices does not granger cause Brazil's foreign exchange against USD, Russia's foreign exchange against USD does not granger cause Russia's Crude oil price, South Africa's crude oil prices does not granger cause South Africa's foreign exchange against USD, the Probability value is less than 0.05 ( $p < 0.05$ ), so we reject the Null hypothesis, thus stating that there exists univariate granger cause between crude oil prices and foreign exchange rate.

**5.4 IMPULSE RESPONSE-** The CG test and Block test will not tell us the sum of the effects or relationship or how long these effects require to take place. We may like to know whether a change in a variable have a negative or positive effect on other variables and how this effect work in the system.

## RUSSIA

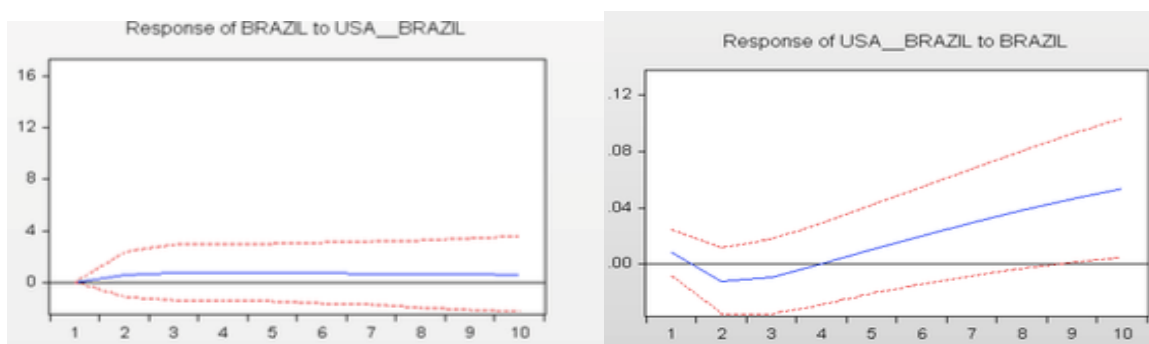


## INTERPRETATION-

Response on USD\_Russia (Foreign exchange rate): A one SD shock (innovation) to crude oil price (Russia) shows a negative impact till the end of period 9. Initially there is a decline then from period 3 it gradually starts to increase and in period 10 it becomes positive showing that the shocks to crude oil rate will have negative impact in short run and positive in long run.

Responses on Russia (Crude oil price)- A one SD shock (innovation) to foreign exchange rate from the 1<sup>st</sup> period impact on crude oil price has an steady rise above its state value and remains in the positive region. The stocks to USA\_Russia will have a positive impact on Russia both in short term and long term.

## BRAZIL-

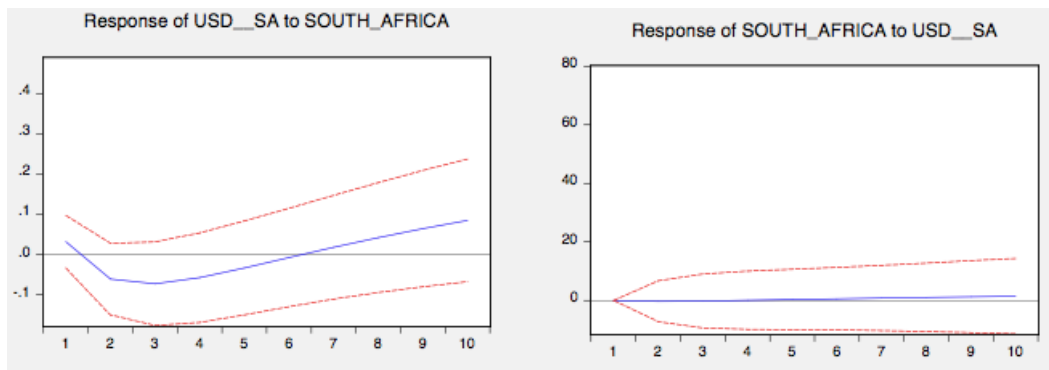


**INTERPRETATION-**

Response on USA\_Brazil ( Foreign exchange rate )- A one SD stock (innovation ) to Brazil (Crude oil price) has a noticeable negative impact in period 1 and 2. From the 2<sup>nd</sup> period the response gradually rises and becomes positive at the 5<sup>th</sup> period. This shows that the shocks to crude oil price will have negative impact in short run and a positive impact in the long run.

Response on Brazil (Crude oil price)- A one SD shock (innovation) to USA\_ Brazil(Foreign exchange price) initially there is a slight rise and then there is no noticeable impact on the Crude oil price. It always remain in the positive region. Means that the shocks to foreign exchange will have positive impact in short run and no impact in the long run.

**SOUTH AFRICA-**

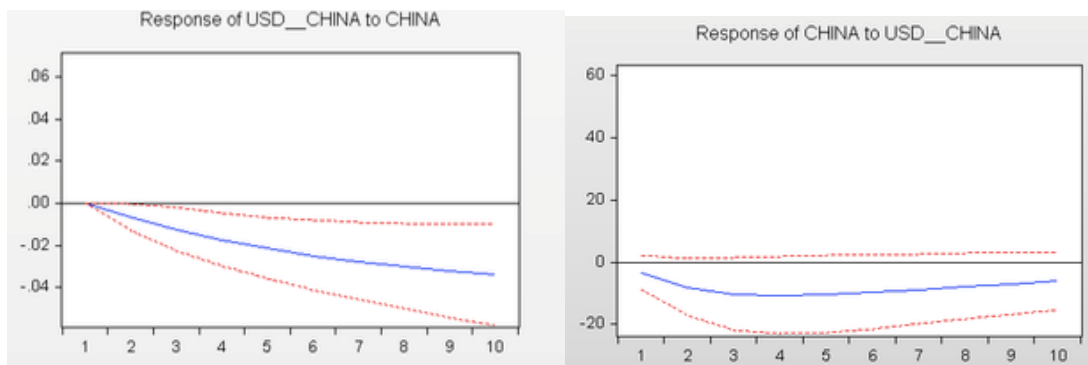


**INTERPRETATION-**

Response on USD\_SA(Foreign exchange rate)- A one SD stock (innovation) to South\_Africa (crude oil price) initially has a negative impact on foreign exchange then after the 3<sup>rd</sup> period it gradually increases and after the 6<sup>th</sup> period has an positive impact. This shows that shocks to crude oil price will have negative impact in short term and positive impact in the long run.

Response on South\_Africa (Crude oil prices)- A one SD stock (innovation) to USD\_SA (Foreign Exchange rate) shows no impact on the crude oil prices of South Africa.

**CHINA-**

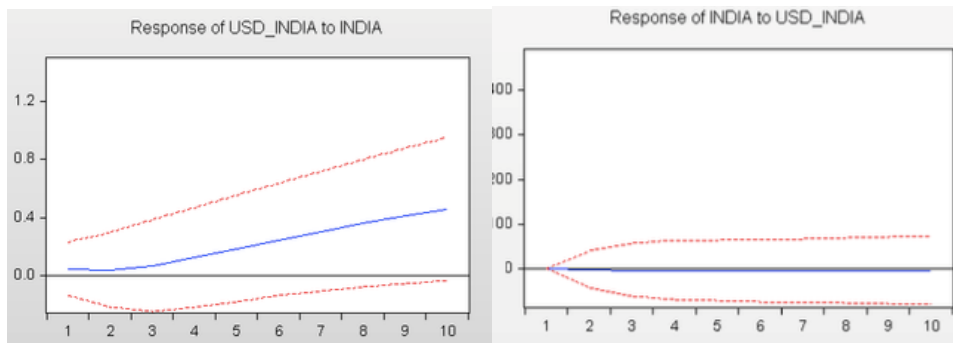


## INTERPRETATION-

Response on USD\_China(Foreign Exchange Rate)- A one SD shock (innovation) to crude oil price have a negative impact on the foreign exchange and gradually declines till the end of 10<sup>th</sup> period. Therefore the shocks to crude oil price have a negative impact both in short run and long run.

Responses on China (crude oil price)- A one SD stock (innovation) to foreign exchange has a negative impact both in short run and long run. Initially it falls then gradually rises but it is negative throughout the periods.

## INDIA-



## INTERPRETATION-

Responses on USD\_India( Foreign exchange rate) - A one SD shock (innovation) to crude oil price initially has no noticeable impact on the foreign exchange in periods 1 and 2. From the 2<sup>nd</sup> period the response gradually rises and remains in the positive region. That means stocks to crude oil prices will have a positive impact on foreign exchange rate both in short run and long run.

Response on India( Crude oil price)- A one SD stock (innovation) to foreign exchange rate shows no impact on the crude oil prices of India

## 6. Conclusion

The Primary objective of this paper was to study the Impact of Crude Oil prices on the Foreign exchange rate of BRICS against USD. In order to facilitate the study 5 countries including Brazil, Russia, China, India and South Africa has been selected. The Foreign Exchange rate and the Crude oil Price have been taken into consideration. The Foreign Exchange rate is taken against USA as Dollar is the universal currency used all over the world. Monthly Data for almost 15 years, has been collected starting from December 2003 to May 2018.. The tests conducted gave a interrelating picture between the crude oil prices and the foreign exchange rate, which after interpretation gives a larger picture. In order to perform Regression, Granger Causality test, and Impulse Response it's a prerequisite that the data must be stationary at level. And through the unit root test, we found the data to be stationary at level.

The regression model reveals there is impact of crude oil prices on foreign exchange in all the BRICS nation except from Brazil. Adjusted R square examines the variation in dependent variable can be explained by the independent variable. The remaining of the variations can be explained by other variables not taken into consideration. Hence for China it is 7.9%, India it is 7.5%, Russia it is 20.5% and for South

Africa it is 13.96%. The Granger Causality test reveals that China's crude oil prices granger causes the foreign exchange price, Brazil's crude oil prices granger causes the foreign exchange price, and South Africa's crude oil prices granger causes the foreign exchange price. That means there exists univariate granger cause between crude oil prices and foreign exchange rate in these countries. Impulse response shows that a one SD shock on the foreign exchange rate shows a positive impact in long run for all the country except China. And a one SD shock on Crude oil to foreign exchange rate has no impact on the long run but has a positive or negative impact in short run.

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