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IMPACT OF OIL PRICE FLUCTUATION ON CURRENCY EXCHANGE RATES IN INDIA

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Abstract: The main objective of the paper is to test the impact of changes in crude oil price fluctuation on exchange rate movements in India. Compiling the daily data from 2007 to 2017, Augmented Dickey Fuller (ADF) Test, Granger Test and Cointegartion test have been tested. The result of ADF-Unit Root Test suffice that both the variables are non-stationary at level and stationary at first difference which allowed the researcher to test long-run cointegrating relationship among variables. The findings of the Johensan's cointegartion failed to find any long run relationship among the variables. However, the findings of Granger causality test certainly provide an evidence that the adjustments in exchange rates from oil price shocks in the economy are negative but for short run.

Keywords: Real Exchange Rate, ADF-Unit Root Test, Granger Causality Test, Exchange Rate Volatility.

1. INTRODUCTION

The sharp spike in the international crude oil prices has ballooned the trade deficit of oil importing countries and it has also increased the concerns of economists to contain the economic instability caused by such fluctuations. Hamilton (1983) was the first to document the association among oil prices and macroeconomic variables. He reported in his research paper that the increase in the oil prices is potent reason behind the recession after World War II. Researchers made several attempt to identify the reaction of these changes on various macroeconomic variables in the economy i.e. GDP, inflation, employment, exchange rate and stock market.

The main stream of studies investigated the oil price, exchange rate and stock market nexus (see; Moore (1990), Sadorsky (1999), Ratanapakorn and Sharma (2007), Sharma and Mahendru (2010), Najaf and Najaf; 2016,). Figure [1] shows the most influential milestone that influences the crude oil prices over decades.

As documented in Figure 1, in last few years global financial market witnessed the episodes of volatility

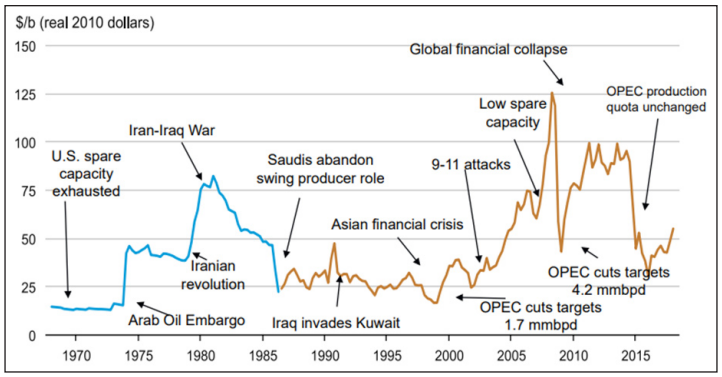

Figure 1: Spot oil price fluctuation

Source: EIA (Agency for Statistics and analytical analysis of the U.S. Department of Energy)

which in turn jolted the import trends, FOREX reserves, international trade & investments, interest rates, cost of production and price of the goods. The increase in cost of production decreases the aggregate supply of intermediate goods and hence reduces the profit margin of the producer and pushes the price of final goods which in turn erodes the purchasing power and disposable income of an Individual.

Global and Domestic Perspective on Rising Oil Prices

Globally, demand of oil has been fluctuated significantly in last two decades. The mismatch between demand and supply drives the international trade of oil which influences the FOREX reserve of the countries. On the demand side, largest oil consuming countries are United States, China, India, Japan and Russia with a continuously increasing dependency on oil imports, while the oil imports are dependent on major OPEC and few of the non-OPEC countries.

The world oil market is complex because of its geographical diversity. A map of world oil reservoir revolves around OPEC countries. However, US and European nations started obtaining bulk of oil from Non-OPEC sources.

According to the *World Factbook* published by Central Intelligence Agency (CIA), USA, the listed 10 countries purchased 72.5 percent of crude oil imports in 2017 as shown in Table 1 below. United States stood first for several years as the largest oil importer across the world but researchers has forecasted that in next few years China will surpass the U.S. imports. India is third largest importer of oil in the world and nearly it imports around 82 percent of its total oil needs. The global oil prices fell down by almost 40 percent in year 2009 from $110 per barrel to $40 per barrel. The sudden drop in the oil prices pressed the panic button among the OPEC and other oil exporting countries and provoked the OPEC countries to ensure a sustainability in the area of production and supply of crude oil.

This paper is organized in four Sections, Section-1 has already elaborated about the global and domestic perspective on rising oil prices, Section-2 contains discussion about the literature in this retrospect, Section-3 consist of data and methodology and Section-4 reports the results of empirical work followed by the findings and conclusion.

Table 1
Top 10 Crude oil Importing Countries

S.No.	*Country*	*Import (BBL/Day)*
1	United States	7,850,000
2	China	6,167,000
3	India	3,789,000
4	Japan	3,181,000
5	Korea South	2,942,000
6	Germany	1,837,000
7	Spain	1,285,000
8	Italy	1,231,000
9	France	1,096,000
10	Netherlands	1,090,000

Source: World Factbook, Central Intelligence Agency, USA.

2. LITERATURE REVIEW

Previous research has worked on the relationship between oil prices and exchange rate for many countries.Najaf and Najaf (2016) analyzed the impact of crude oil on the Bombay Stock Exchange. For this purpose they took data from secondary source spanning from Dec, 2008 to August 2013. They documented that the increase in the oil price may cause increase in inflation. Sadorsky (1999), Papapetrou (2001), Asteriou and Bashmakova (2013) suggested that a positive oil price changes lead to negative stock market return.On the other hand, Henriques and Sadorsky, (2008), Apergis and Miller, (2009), Jammazi and Aloui, (2010) noted that the oil price changes have no impact on stock market return.

Amano and Norden, (1998) Jiménez-Rodríguez and Sánchez, (2005) investigated the impact of oil price fluctuations on macroeconomic variable. On the other hand, Edwards, (1986) Eichengreen,and Leblang, (2003) and Peter B. Clark, et. al., (2004) examined the effect of exchange rate volatility on macroeconomic variables. Bénassy-Quéré, Mignon and Penot (2007) highlighted a long-term relationship among the real effective exchange rate of dollar and oil prices. Jin (2008) found in his research work that an appreciation in real exchange rates

leads to a positive impact on the growth rate. Despite of all theoretical and empirical research work,there is no consensus about the relationship between the variables.

3. DATA AND METHODOLOY

Data: In this study the data on spot crude oil prices and exchange rates (spot USD/INR) have been collected from the database maintained by Reserve Bank of India, National Stock India Limited, Energy Information Administration - EIA *(Agency for Statistics and analytical analysis of the U.S. Department of Energy)* and Quandl.com respectively. The range of the data is from April, 2007 to March, 2017. As the annual or monthly data does not serve the purpose of analysing the data, it is kept on daily basis.

Methodology: The Oil prices downloaded from U.S. Energe Information Administration and has been kept as dependent variable and exchange rate has been taken as independent variable.

Stationarity Check: A stationary time series has a property of constant mean, variance and auto co-relation over the period of time. We check stationarity for the reason that a stationary variable is easy to predict and it has the same statistical property over the past. Hence, a stationary time series gives robust results.

In this study, Augmented Dickey Fuller (ADF) test has been employed. The null hypothesis for ADF test is;

H_0: The series has Unit Root against the alternative that the series is stationary.

$$\Delta Y_t = \delta Y_{t-1} + \theta_i \sum_{j=i}^{p} \Delta Y_{t-1} + \mu_t \quad \text{(i)}$$

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \theta_i \sum_{j=i}^{p} \Delta Y_{t-1} + \mu_t \quad \text{(ii)}$$

$$\Delta Y_t = \alpha_0 + \beta t + \delta Y_{t-1} + \theta_i \sum_{j=i}^{p} \Delta Y_{t-1} + \mu_t \quad \text{(iii)}$$

where, Y_t represents the dependent variable, p is the number of lags determined empirically and the hypothesis $\delta = 0$ is tested. Equation (i) is pure random walk, Equation (ii) includes a drift and Equation (iii) is a Random Walk Model with both a time trend and a drift.

Garnger Causality Test

Granger (1968) proposed an approach to answer the question - Whether the variable X causes Y? How much Y can be explained by past values of Y and thereafter to note the improvement in the explained variable by adding lag values of variable X and *vice-versa*. In the case mentioned above, X is helpful in forecasting Y variable and Y is said to be Granger caused by X($X \rightarrow Y$). Similarly, if X is influenced by its lag and the lagged values of Y, then we call it X to be Granger caused by Y($Y \rightarrow X$). Now, if the variable X causes Y and the variable Y causes X, we call it bi-directional causality. Hypothesis testing null hypotheses are as follows:

H01: Spot oil prices does not Granger cause exchange rates.

H02: Exchange Rates does not Granger cause spot oil prices.

$$ER_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i OIL_{t-i} + \sum_{i=1}^{n} \beta_i ER_{t-i} + \varepsilon_{t1} \quad \text{(iv)}$$

$$OIL_t = \omega_0 + \sum_{i=1}^{n} \gamma_i IP_{t-i} + \sum_{i=1}^{n} \theta_i OIL_{t-i} + \varepsilon_{t2} \quad \text{(v)}$$

where, ER stands for Exchange Rate, OIL is spot crude oil prices, α_0, ω_0 are the constant terms, n signifies the lag length, ε_{t1} and ε_{t2} are the error terms assumed to be serially uncorrelated with zero mean and finite covariance matrixes.

Cointegration Test

The analysis of non-stationary time series may give spurious results. Engle and Granger in year 1987pointed out this issue and developed a cointegartion model to test two or more non-stationary time series variable with linear combination. This model may be interpreted as long-run equilibrium relationship among the variables. There are two popular test of cointegration: **First** is Engle and Granger test and **Second**, Johansen Cointegration Test. Johansen cointegration Test has been employed as it is the latest and powerful tool to measure the cointegartion among variables.

4. RESULT AND CONCLUSION

This paper has empirically examined the impact of oil price fluctuations on currency exchange rates by using

Granger causality and cointegration test. The test results have been documented below.

Empirical Results

Augmented Dickey-Fuller (ADF) estimator for checking the stationary process of the data series are as follows;

Table 2
Augmented Dickey Fuller Unit Root Test

H_0: The series has Unit Root	*Level*		*First Difference*	
	Intercept		*Intercept and Trend*	
	T-statistics	*p-value*	*T-statistics*	*p-value*
Oil Prices	–1.6011	0.4818	–36.52135	0.0000
Exchange Rate	–1.2808	0.6404	–46.9186	0.0001

Source: Compiled by author.

As one can notice the probability value (*p*-value) is 0.2743 in Table 2, hence, we cannot recect the null hypothesis of presence of Unit root in the time series at level. However, after first difference the p-value is less than 5 percent representing the series stationary at first difference meaning they are I(1).

Based on the results of Unit root test, the next section consist of the results of short run Granger causality test of spot oil prices and currency exchange rates.

Table 3
Granger Causality Test

Null Hypothesis	*F-statistic*	*P-Value*
Spot Oil prices does not Granger Cause Exchange Rates	1.8527	0.0410
Exchange Rates does not Granger Cause Spot Oil Prices	0.4587	0.9287

Source: Compiled by author.

The Granger Causality test results are summrised in Table [3] and the *p*-value indicates a uni-directional relationship among the variables where the causality runs from oil prices to exchange rate.

Table 4
Johansen's Cointegration Test

	Null Hypothesis	*Eigen-Value*	*Trace Statistic*	*P-value*
1.	None*	0.0027	10.0845	0.2743
2.	At most 1*	0.0013	3.5621	0.0491

*Optimal Lag Length-4 lags.
Source: Compiled by author.

In addition, from Table [4], the results of cointegration test displayed a *p*-value of 0.2743 for first null hypothesis, revealed the absence of cointegrating relationship and further, it is confirmed by the *p*-value of second null hypothesis.

5. CONCLUSION

The article has investigated the relationship between exchange rates and crude oil prices and the results of this paper suggests that there is a short-run dynamic causal relationship and the causality runs from oil prices to currency exchange rates. To get a clear picture the empirical analysis of Unit Root Test, Granger Causality test and Cointegartion test have been incoroprated. The result of Unit root test confirmed that both the variables are non-stationary at level and stationary at first difference which allowed the researcher to test long-run cointegrating relationship among variables. The findings of the Johensan's cointegartion failed to find any long run relationship among the variables. However, the findings of Granger causality test certainly provide an evidence that the adjustments in exchange rates from oil price shocks in the economy are negative but for short run.

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