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Dynamics of Exchange Rate and Crude Oil Price- Evidence from India

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Abstract:
Determining country's currency value and predicting its volatility in international market is very complicated yet most focused and important aspect of country's growth at international level. Currency value, to be precise, exchange rate is an important indicator of relative economic wealth of a country. Exchange rate is influenced by a large number of economic variables including stock prices, interest rates, inflation rate, IIP, oil prices, gold prices and many more. The objective of this paper is to study the relationship between international oil prices and real exchange rate for India.The monthly data for oil prices and nominal exchange rate has been obtained for period January 2001 to September 2013. The data has been processed using regression technique and excel has been used for analysis and charting purpose. The hypothesis has been tested by using F-statistics and applying statistical formulae. The results obtained showed that there exist a relationship between oil prices and real exchange rate for India. The result reveals a negative relation between oil prices and real effective exchange rate. Hence, as oil prices go up, Indian rupee will depreciate against US dollar in real terms which in turn implies a rise in nominal exchange rate. As oil prices rise, India being an importing nation of crude oil results into shift of its wealth to exporting nation thereby putting downward pressure on rupee worth in international market.

Keywords: Exchange rate, f- statistics, oil prices, regression

1. Introduction

India is considered to be as one of the fastest growing economy in the world. Growth rate in India over the years has been very dynamic with the changes taking place in various macroeconomic indicators of the country. Various indicators such as interest rates, inflation, IIP, gold prices, stock prices etc. plays a crucial role in determining a country's competitive strength in international financial markets. One of the most important factors which establish a country's strength is the value of its currency in world market. This basically implies the exchange rate that is applicable on the country. India's exchange rate regime has evolved over a period of time from pegged exchange rate regime to presently floating exchange rate regime. In flexible exchange rate regime, the rupee dollar exchange rates are set by market forces of demand and supply. This demand and supply mechanism of rupee and dollar is influenced by a number of macroeconomic variables like inflation rate, stock prices, IIP, interest rates etc. are said to have significant impact on exchange rates.

With the growing level of international trade and capital movements, exchange rate has become the most important determinant of a country's relative economic health. In the recent past, the Indian Rupee has fluctuated tremendously with respect to dollar in international market. This has made the study of exchange rate volatility all the most important. Among various factors to be studied for understanding the impact on exchange rate, one important factors is crude oil prices.

Crude oil is one of the most important resource of energy being used in every field of economic activity. It's a non renewable and naturally available resource which is used in making of almost everything including plastics, rubber, steel, aluminum, fabrics etc. It is usually considered as a comparative advantage and one of the important strategic resources for country.

It is widely accepted fact that oil is an important factor determining the global economic performance and its price fluctuations can influence world economy in significant way. An increase in crude oil price will lead to increased cost of production which implies higher prices of commodity thereby impacting demand for it in downward side and vice versa. A change in oil price will also result into shift of income from importing nation to oil exporting nation which in turn is bound to have an impact on exchange rates. It thus becomes essential to study oil price dynamics and the way it influences the world economy.

India accounts for nearly 17.6 % of world population. With this size of population the country has to produce nearly one trillion worth of its GDP to satisfy needs of its people. In such a huge production, India requires nearly 2.5 million barrels of oil per day. It accounts to nearly 4.5% of world's total oil demand. This ever growing demand results in high import of oil in India leading to higher inflation rates in country. The rising price levels reduces the competitive strength of Indian currency vis a via dollar.

This study is concentrated on modeling approach. The paper is aimed at examining the relationship between India's foreign exchange rate and crude oil price over the period of past 13 years from 2001 to 2013. The study will help to understand the trend oil price and exchange rate relationship over past decade and will reveal to what extent exchange rate volatility of rupee dollar is subject to international oil price changes.

2. Literature Review

The following section is dedicated to explore the work done so far in this area of study. Literature review will help to explain the general idea of this study and further understanding the relationship between exchange rate and macro economic variables with major emphasis on crude oil prices.

Theoretically, the relation between the two variables of this study has very well been explained by early studies of Golub(1983) and Krugman(1983). According to study conducted, an oil importing country may experience exchange rate depreciation when oil prices rise and vice versa. Similarly, Blomberg and Harris (1995) explained the possible effect of exchange rates on oil prices, by implying one price for all tradable goods law. It was suggested that as oil is homogenous, world tradable and US dollar priced commodity, a depreciation in dollar increases the purchasing power of foreigners, which in turn increases the crude oil demand thereby pushing oil prices upward.

Amano and Van Norden (1998) conducted an empirical study to analyze relationship between US dollar real effective exchange rate and crude oil prices by applying co integration analysis and error correction model on monthly data for the period 1972 to 1995. It was found that oil prices were the reason for US dollar exchange rate shocks. Similarly Benassy- Quere et al.(2007) found the impact of oil on real effective exchange rate of dollar between 1974 to 2004 and revealed that approximate 10% rise in oil prices resulted into nearly 4.3% appreciation of the dollar in the long run. Raurava (2004) studied the role of oil prices and real exchange rate for Russian economy by applying VAR and co integration tools on quarterly data. The study concluded that an increase in oil price was related with the depreciation in rubel in the long period. Ghosh (2011) examined the relation between crude oil price and exchange rate in India over a period of one year from July 2007 to Nov 2008 and found that an increase in return on oil prices results into depreciation of Indian rupees in relation to dollar.

Cavalcanti and Jalles (2013) supported the findings of Ghosh (2011) for Brazil by making use of dataset from 1975 to 2008 and revealing the negative oil shocks results into appreciation of local currency of Brazil. Huang and Guo (2007) showed that real oil price shocks suggested a smaller appreciation for the real exchange rate of China by conducting four dimensional structural VAR model. Yousefi and Wirjanto (2004) studied the effect of changes in the US dollar on the development of OPEC oil prices by making use of general method of moments. The study suggested a negative correlation between changes in dollar and development of oil prices of OPEC.

GARCH and EGARCH models were used by Narayan et al. to study the relationship between oil prices and exchange rate between the US dollar and Fijian dollar. Daily data for the period from 2000 to 2006 was used for this purpose and it was found that Fijian dollar appreciated due to rise in oil prices. Akram (2009) gave evidence that a weaker a US dollar leads to higher oil prices and significantly accounts for oil price volatility, by using structural VAR model. Cifarelli and Paladino (2010) undertook a trivariate GARCH –M model having stock prices, oil prices and dollar exchange rate.it was found that there exist a negative relation between oil prices and exchange rate changes. Buetzer et al. (2012) discovered no evidence leading to an appreciation of exchange rate of oil exporters against oil importing nations.

The paper titled "Exchange rate slide – What impact is it having" of ASSOCHAM INDIA paper talks about falling rupee and its impacts on the economy. Wild fluctuations in the rupee exchange rate within a short span of time are unsettling and leave its imprint on the rest of the economy. The rupee depreciation particularly hit the industrial sector and put higher pressure on their costs as items like oil, imported coal, metals and minerals, imported industrial intermediate products all are getting affected. A depreciating rupee has also severely affected the cost of borrowings for the corporate sector and total external debt has increased. But RBI should put extra burden on its existing foreign reserves in order to check this exchange rate fluctuation.

Basher et al. (2012) also studied the relationship between exchange rates, crude oil prices and stock prices by applying structural VAR model for the time period of 1988 to 2008. But the study showed limited relationship between variables in question. A more recent paper by Turhan et al. (2013), showed that an increase in price of oil results into significant appreciation of domestic currency against the US dollar between 2003 to 2010. Lizardo and Mollick (2010) showed that a rise in real oil prices can lead to significant depreciation of dollar in relation to the exporting country such as Russia, however, the oil importing country's currency may depreciate in relation to US dollar in the same situation. Similarly Krichene (2005, 2006) in his study concluded that an appreciation of dollar may lead to both rise and fall in oil prices.

Finally, Reboredo (2012) in his study found that although the interdependence between the oil prices and exchange rate has rose significantly after the trouble of global financial crises, it is in general weak and there is no extreme market dependence between oil prices and exchange rates.

From the review done of various studies conducted in this regard, it is revealed that the oil price and exchange rate relationship is important from various perspectives. There exist a relationship between both however the extent to which they depend on each other is not explain with conformity. This paper will make an attempt to study the relationship between crude oil prices and rupee dollar exchange rate in India for past 13 years by making using of Correlation and regression technique.

3. Objective of Study

The objective of this paper is to draw relationship between crude oil prices and exchange rate for India and to study how significant oil prices can be for determining floating exchange rate for Rupee dollar relation. The paper will also make an attempt to study the situation during the global financial crises and does it impacted the trend so discovered between oil price and exchange rate at all in any manner.

4. Methodology

4.1. Data and Software
The data used in this study are monthly nominal exchange rates (expressed in Indian rupee per US dollar) and oil prices per barrel for the period January 2001 to September 2013. The data were taken from websites of Indexmundi, RBI database and IMF. The data so collected has been processed by using regression technique to study the relation between the said variables i.e. oil prices and exchange rates. MS EXCEL has also been used to depict the trends in different variables used in study over a period of time.

4.2. Hypothesis Testing
Hypothesis testing has been done on the regression model to check the model fit i.e. whether the independent variable i.e. crude oil considered to be having any significant impact on the exchange rate.

4.3. F-Test
F –statistics has been used to check if the model has significant explanatory power. The null hypothesis here is that the crude oil price does not have any relationship with exchange rate i.e. $R^2=0$.

4.4. Formulae Used

$$F = \frac{Explained\ Variance}{Residual\ Variance} = \frac{\frac{ESS}{K-1}}{\frac{RSS}{n-k}}$$

$$\beta = \frac{dX}{dY}$$

$$R = \frac{1}{n-1}\frac{\sum(x-\bar{x})(y-\bar{y})}{\sigma x \sigma y}$$

$$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS}$$

$$TSS = \sum_{i=0}^{n}(Y-\bar{Y})^2$$

The degree of freedom of TSS is n-1

$$RSS = \sum_{i=1}^{n}(Y-\hat{Y})^2$$

The degree of freedom of RSS is n-k.

$$ESS = \sum_{i=0}^{n}(\hat{Y}-\bar{Y})^2$$

5. Data analysis and Interpretation
From the data observed it has been found that the exchange rate has got almost double since 2001. The trend has been depicted for exchange rate in chart below.
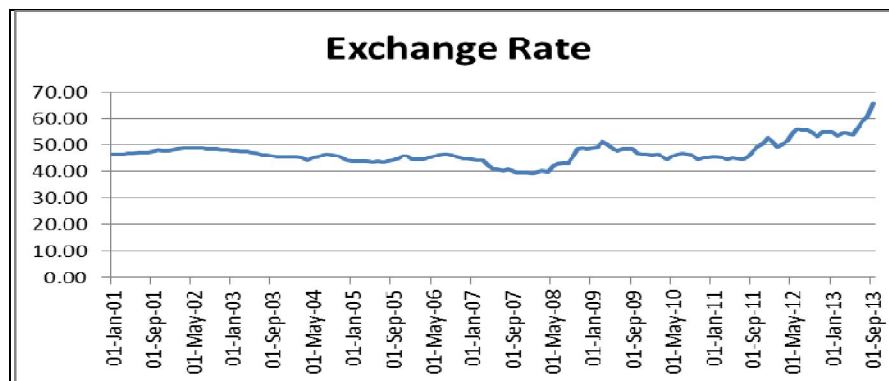

Figure 1: Exchange Rate

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
EXCHANGE_RATE	153	26.49	39.37	65.86	46.9750	4.21059	17.729
Valid N (listwise)	153						

Table 1:Descriptive Statistics

There has been large depreciation during the period 2009-10 and in recent months. The depreciation in 2009-10 was on account of slowdown in FII inflows because of economic slowdown in US and European economies. The sensex returns were also falling. Also there has been a huge depreciation in rupee in the recent months of 2013. The reasons have been large FII outflows, increase in gold imports and increase in oil prices.
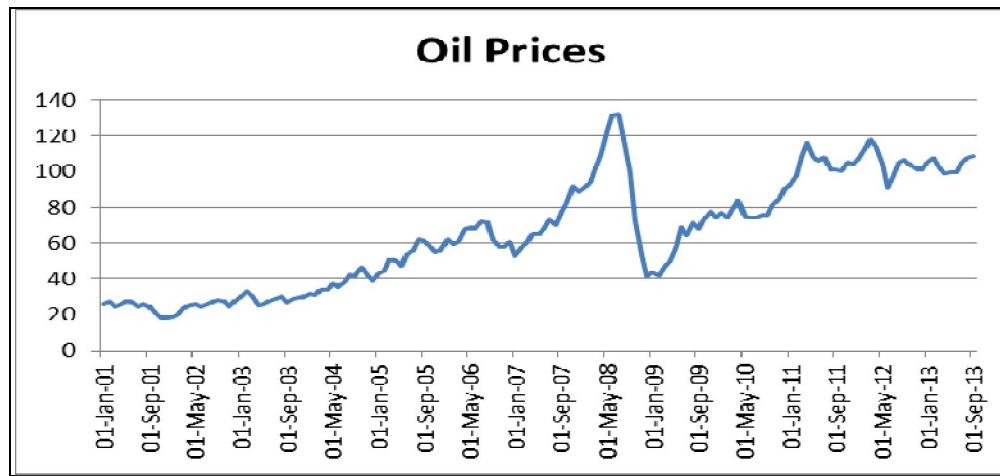

Figure 2: Movements in oil prices

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
OIL_PRICE	153	114.03	18.52	132.55	65.0578	31.08880	966.513
Valid N (listwise)	153						

Table 2: Descriptive Statistics

The oil prices have increased tremendously in the period studied. It was around $20/ barrel and today it hovers around $115/ barrel. Oil prices reached its peak in the period 2007-08 on account of Oil shocks in OPEC nations. The recent disturbances in Arab nations have been the reason for recent increase in oil prices.

Regression Statistics	
Multiple R	0.173720586
R Square	0.030178842
Adjusted R Square	0.023756185
Standard Error	30.71730203
Observations	153

Table 3: Model Summary

ANOVA					
	Df	SS	MS	F	Significance F
Regression	1	4433.574	4433.574	4.69881	0.03175
Residual	151	142476.4	943.5526		
Total	152	146910			

Table 4

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	4.805386641	27.90659	0.172195	0.863514	-50.3324	59.94319	-50.3324	59.94319
X Variable 1	1.282640721	0.591713	2.167674	0.03175	0.113535	2.451747	0.113535	2.451747

Table 5

The value of the F- statistics obtained is 4.69 which is greater than the 4 (critical value from F- table). Also the p- value or significance is less than .05 therefore null hypotheses is rejected implying that the model does have an explanatory power and there exist a relationship between crude oil price and exchange rate.

The value of correlation between oil price and nominal exchange rate is positive which implies that they both move in same direction i.e. if oil prices fall the nominal exchange rate also falls and vice versa. This implies that the real exchange rate will move in opposite direction with oil prices, i.e. as oil prices go up, our imports become expensive, we have to pay more per dollar worth to get same quantity thereby leading to increase in nominal exchange rate but fall in real effective exchange rate and thus

the Indian rupee depreciates as oil prices rise. Hence, there exist an inverse relation between oil prices and real effective exchange rate.

Further R^2 is .03 approx which implies that nearly 3% of variation in exchange rate is explained by oil prices. This shows that oil prices do affect exchange rates if not in very significant manner. The beta value for the model is 1.28 which implies that any change in crude oil prices will bring about 1.28 times change in nominal exchange rate.

The result thus implies that oil prices and real exchange rate are negatively correlated with each other while oil prices are positively correlated with nominal exchange rate. So study goes in consistency with prior studies and the result satisfy the applicability for Indian economy also as suggested by prior studies for world economy.

6. Limitations of the Study

The study has attempted to explain only one factor oil prices impacting nominal and real exchange rate but there are a number of factors which are also acting simultaneously and hence the results might get affected when the impact of other factors is studied simultaneously on exchange rate. To get a better view in regard to India, other factors affecting has also be taken into consideration. Also the period of study involved global crises and huge political instability in India, which further affected the exchange rates prevailing for this period.

7. Conclusion

Based on above study it can be said that exchange rate in India is influenced by changes in international crude oil prices. The study shows a negative relation between oil prices and real effective exchange rate. Exchange rate is a complex indicator to be studied as it is influenced by a large number of macroeconomic variables of which crude oil is one. The results so obtained are consistent with the prior studies showing that as crude oil prices the currency of importing nation depreciates against exporting nation. India being an importing nation of crude oil the impact felt of changes in oil prices are relatively high. The study can further be expanded by regressing exchange rate on multiple variables to get a better understanding of this phenomenon.

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