Determinants of Crude Oil Prices in India

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Abstract

Crude oil is an essential commodity for any economy hence the requirement of crude oil has been growing at a rapid pace as the economies grow, which has made India to depend more on its crude oil imports. Usually the price of crude oil is invariably much lesser than the import duties, it is the import duties which makes it costlier for a common man. This study gives an insight to the present condition of crude oil prices, and their imports in India. The data used for this study is monthly time series data from April 1994 to December 2015. This study has made an attempt to find out the major determinants of crude oil prices, for this purpose, we have employed the econometric technique i.e. ordinary least squares method. The study finally concluded that the determinants of crude oil prices (Brent crude oil prices, index of industrial production, exchange rate, and inflation) are found to significant.

I. INTRODUCTION

A. Crude Oil

Generally, oil is a mixture of hydrocarbons that exists in liquid phase in natural underground reservoirs and remains liquid at atmospheric pressure after passing through surface separating facilities. Oil includes crude oil, condensates, natural gas liquids, refinery feedstock's and additives, other hydrocarbons (including emulsified oils, synthetic crude oil, mineral oils extracted from bituminous minerals such as oil shale, bituminous sand and oils from CTL and GTL) and petroleum products (refinery gas, ethane, LPG, aviation gasoline, motor gasoline, jet fuels, kerosene, gas/diesel oil, heavy fuel oil, naphtha, white spirit, lubricants, bitumen, paraffin waxes and petroleum coke).

B. Recent developments in Crude oil prices

Crude oil is the main energy source in today's world. It gained importance during the war-era when the major powers in the world were energy-hungry. In the period post- World War II, the major control body that determined crude prices was the Texas railroad commission of United States. From 1948-1960, oil price remained in the range of $2.5 to $3 per barrel in terms of value today, it is around a measly $17 per barrel. The price continued to be constant around $3 till the end of the 1960s.

By 1971 there was a complete power shift from Texas railroad commission to the OPEC. In the same year the membership of OPEC increased with the induction of Qatar, Indonesia, Libya, the United Arab Emirates, Algeria and Nigeria into the cartel body. Oil prices were heavily influenced by controlling the production levels. It became the price dictator with very few centres with spare capacity outside the membership of the body.

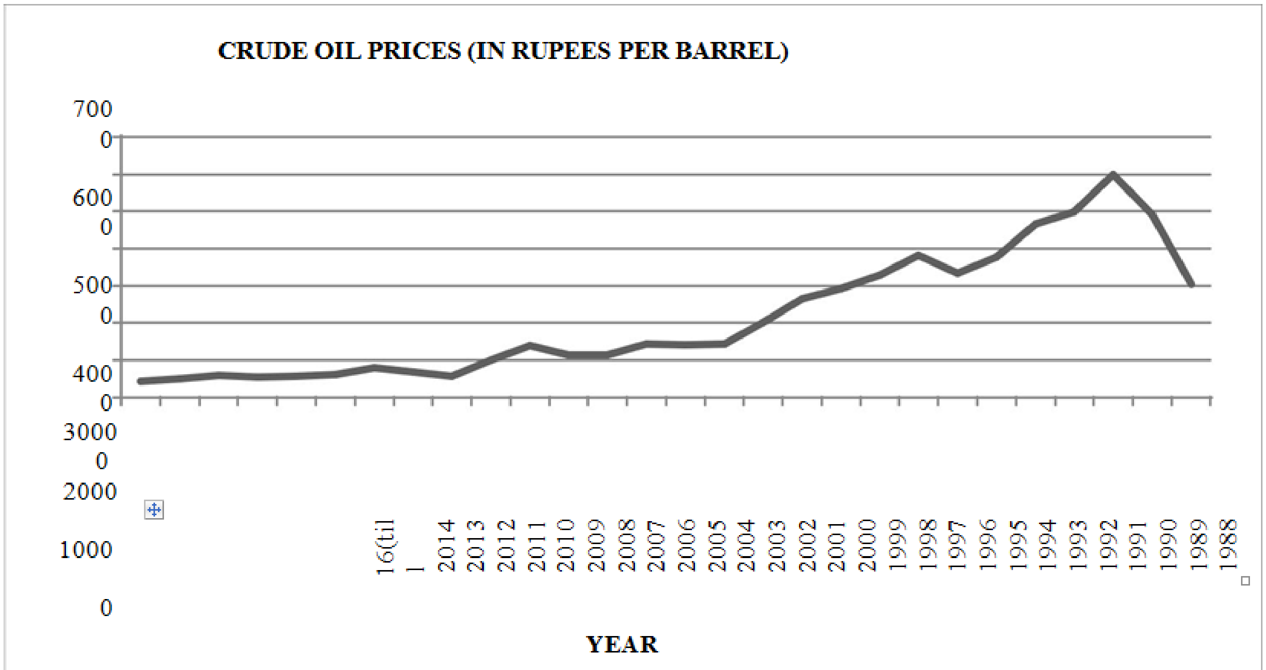
With the same fluctuations in oil prices, the time of Yom Kippur war in 1972 saw a fourfold increase in oil prices. It was followed by the crisis in Iran and Iraq in the 1980s. The change in production levels resulted in the price doubling instantly. The following decade witnessed many historic events. Iraq's invasion of Kuwait, the gulf war jacked up the prices. The price declined gradually from then on till 1997. It was in the last decade of the century that importance of Asia as a monstrous consumer of crude oil was realized by the OPEC. With Asian consumption on the rise and few producers of spare crude oil in the region, OPEC increased their production quotas to meet the needs.

The price of crude rose soon with demand far ahead of supply. The south- East Asian crisis unfolded in 1998. It immediately led to a drop in demand in the region that resulted in drop in the price. The prices were further pushed into a downward spiral following the 9/11 attacks on the US. The price recorded an immediate 35% drop. Subsequent to it the US government embarked on a low interest regime that boosted economic recovery. Asia too saw an economic recovery. Consumption was high again and so was the crude oil need. . The price increased gradually till the recession that began in late 2007. At that point, the price touched an all-time high of $145.29 but the complete fall in economic activity brought the price crashing to $40 by the end of 2008. The crisis plagued the world for over 18 months.

Price recovery took place in 2009. The OPEC responded with production cuts to influence price. Asia, which housed world's top energy consumers – china and India, saw a recovery in demand quickly with the Indian sub- continent not taking a severe hit from the crisis. The period has also witnessed lots of political uncertainty with the Libyan civil war, the removal of Qaddafi, the war in Ukraine, the Syrian revolution, the

Israel- Palestine clash, etc. the price has remained on an upward curve. From 2010 0nwards there is an upward trend in the oil prices till 2014. From 2010 to 2011 the crude oil price increased heavily due to heavy demand by the countries who are importing.

The recent unexpected fall of the world market crude oil prices in the 2nd half of the 2014 is comparable to 2 other past episodes in 1986 and 2008-09.the fall in the oil price directed towards the rise in real income for consumers. So, the real income gain should result in higher spending, which further leads to global economic growth, by considering the other factors unchanged. Oil prices fell by about 50% in-between 2014 to 2015, i.e., prices of oil fell from $110 a barrel in June 2014 to $65 a barrel in December 2015; this fall is mainly due to the excess supply and also the decision taken by OPEC in November 2015, not to curtail crude production of oil. Given the fall in the oil prices, net oil importing countries with small domestic oil sector benefit from gains in real income due to lower import prices. The net oil exporters experience trade loss.



Source: FRED economic data

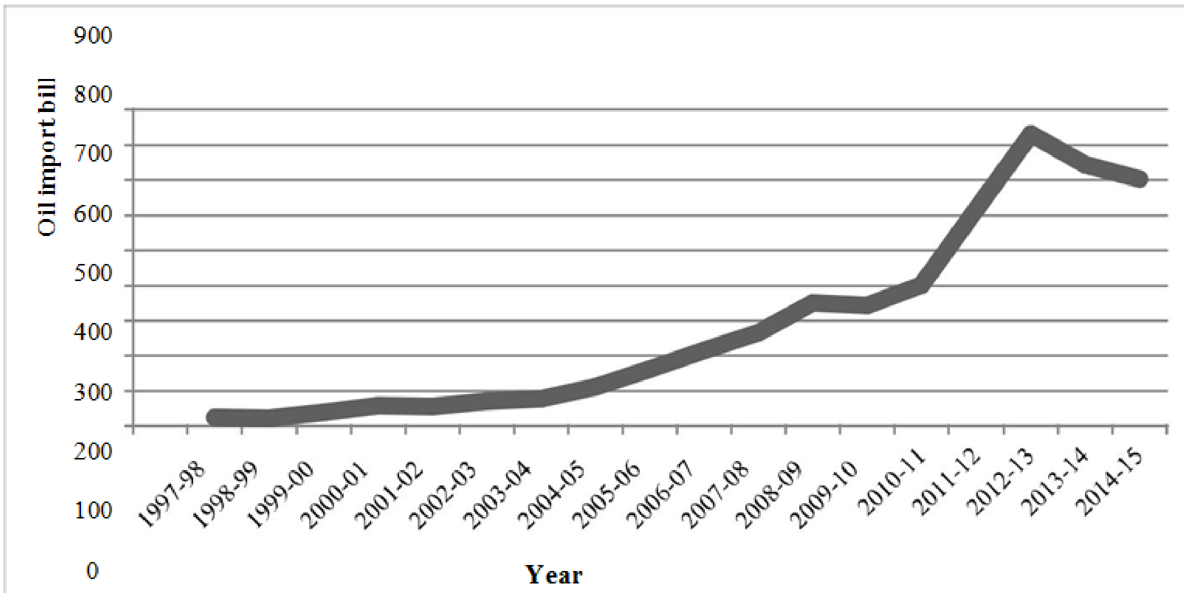
The above graph depicts the crude oil prices in rupees from 1988-89 to 2015-16 (till June). Initially there is a gradual rise in the oil prices and due to the financial crisis the oil prices fell (European economies effected badly by the financial crisis). After 2014, the price fell drastically due to the fall in the demand by the importing countries and also by the surprise decision of OPEC countries (i.e. even the price of crude oil is falling but they didn't want to cut down production).

C. Imports of Crude Oil in India

Since the beginning of civilization natural resources have played an important role in the development and advancement of mankind. Metals such as gold, silver acted as a medium exchange, thus establishing a standard means for trade. Even today the trade takes place through the four hard currencies i.e., the Dollar ($), Euro, GBP (Global Britian Pound) & Yen which are indirectly pegged to gold. Thus even today after all the modern advancement, specialization & development of economics, trade, and commerce, gold plays an important role. Likewise, the black gold popularly known as crude oil plays an important role in today's world economy. It is the basis for the modern lifestyle and the various products and by products extracted from crude oil is widely used in the world of consumerism. From the basic activities of travelling to operation of advanced machinery forms of crude oil are used and are an essential input for many industries, transportation, etc.& are used by all irrespective of his financial status, social status, and geographical region.

Thus the need for oil transcends all boundaries, social and geographical, its consumption is unaffected by the domestic availability. Thus, crude oil plays an important role in the development of an economy and is essential for the sustenance of the economy. Hence the major import share of all developing or developed countries which lack crude oil sources domestically, is accounted for oil imports.

Crude oil being an important necessity in the life of a modern man, thus making it inelastic. Thus the availability of crude oil and its price fluctuations in the international market play a crucial role in the stability of the currencies of many countries. Thus effecting macroeconomic stability through the import of inflation. Oil price fluctuations account for the fluctuations of all other commodities directly or indirectly; thus playing a significant role in the stability of economies of the world. Thus from the above graph it is clear that the import bill of crude oil in India have increased steadily with the increase in population, which is around 17.2% of world population. India has to import 2.5 million barrels of crude oil to fulfil the needs of huge population. Over all since crude oil is a necessary commodity its import bill has been rising steadily since 1997. During 2008-09 the import bill of crude was stagnant due to the financial crisis which affected the Middle East countries very badly. After 2008-09 the crude oil imports increased by India. From 2014 onwards the oil imports bill has been falling due to excess supply and weak demand conditions. This fall in the crude oil prices are helpful for economic growth if the countries are oil importing and fall in the crude oil prices lower the economic growth, if the countries are oil exporting.



Source: RBI handbook of statistics

The above graph depicts clearly that the import bill oil by India is on steadily rising fashion till 2012-13 because India is largely dependent on oil imports. This heavy dependence (on oil) also leads to the rise in import duties by the government of India. After 2014 the oil import bill fell but not the quantity of oil. This is mainly because of fall in the global crude oil Prices.

II. LITERATURE REVIEW

The determinants of prices of crude oil are subjective in their nature and are a subject of debate. There are varied views on the determinants of prices of crude oil. One of the view is that the behaviour of oil prices is because of the market forces of demand and supply. Another view is that that of the producers of oil, the OPEC. One another is that of a result of the increase in trading of the oil derivatives over the past decade. There exist arguments on both sides favouring and opposing all the three theories. (Krichene, 2006 and Dees et al, 2007) explain the increase in oil prices using the market mechanism of demand and supply. Further analysts use the effective demand for oil by emerging economies, especially the demand by that of India and China. (Dees et al, 2008 and Kaufmann and Ullam, 2009) use the role of speculation and the power of OPEC. (Einloth, 2009; Phillips and Yu,2010; Shu-ping, 2011) are studies done to see whether the role of speculation had any influence on the prices of oil in the past. As shown by (Hamilton, 2008; Dees et al, 2008) the determinants of oil prices need not be independent or separate from each other but can complement or go together. (Hamilton, 2008) explains the causation for changes in oil prices due to major factors as, speculation of future supply shortage will occur whenever rate of increase in demand is far greater than the rate of increase in supply of crude oil.

A. Demand

The demand for crude oil has been rising and the extent of rise has been varied in 1999, 2000, 2003-07, 2010. The main source of surge in crude oil demand is the emerging market economies' industrial sector which mainly consists of countries such as India, China, Latin America, the Middle East. The parallel movement between economic growth is common. Many recent studies reason that demand for crude oil is an important factor behind crude oil price increase from 2003 (Hamilton, 2008; Hicks and Killian, 2009; Killian, 2009b; Wirl, 2008) The rising crude oil prices in 2010 and 2011 show that the rapidly growing demand in the emerging economies can be certainly anticipated to continue to be an important crude oil price determinant, certain that the crude oil demand is highly income elastic.

B. Supply

Crude oil is a non-renewable natural resource and is exhaustible. As a matter of fact, the price of exhaustible resource increases over time. In the period 2003-2007, there was an unexpected increase in the supply from 79.5 mb/d to 83.1 mb/d as a response to the increase in crude oil prices. But during the period 2005-2007, the supply of crude oil stagnated even though there were price hikes offered as an incentive to increase the production. The supply of oil depends mainly on the OPEC and Middle East country.

C. OPEC power

The major producer of oil in OPEC countries is Saudi Arabia, which had an understanding with Mexico and Venezuela to manage the crude oil supply. In October, 1999 the crude oil price had more than doubled, to reach $23.45 a barrel compared to $11 in December 1998. The Organization of the Petroleum Exporting Countries adopted a price band between $22 per barrel to $28 per barrel in 2000, having an understanding with its members that they would adjust their production in order to keep the prices within the range of the OPEC crude oil basket. This stance adopted proves to be an unsuccessful move as the prices of crude oil increased quickly to reach more than $35 a barrel in September, 2008, and thereafter oil prices fell until the end of 2001 and then increased steadily to reach $40-$50 a barrel by September, 2005. OPEC accounts for about 40% of global production of crude oil, and about 55% of exports, and it holds for more than two-thirds of the World's reserves of crude oil (OPEC, 2009). From the 1980's, the role of OPEC has weakened due to the declining OPEC world market share and growth of efficient energy usage technology as well as the development of efficient spot markets. Nevertheless, OPEC in the year 2003 driven by the surging crude oil demand experienced a revival of its market power. OPEC always aims at keeping the prices of oil at moderate levels as it is a vital source of energy, and, as a result OPEC reduces its production when the crude oil prices are low and increases the production when the crude oil prices are high (Alyousef, 1998).

A paper was written by Kim. J. Zietlow, in his paper, the market power of OPEC – implications for the world market price of oil, to what extent OPEC is the key reason for the world market price of crude oil. Despite of OPEC significant power, there are other factors which would influence the price oil crude oil by demand and supply constraints. Based on the empirical results, the major factors which would influence crude oil in the long run, and they are global demand, future supply (highly uncertain to remain stable).

He concludes by saying that OPEC is the dominant player in the world's crude oil market. In the similar lines a study was done by Uma C Swadimath, Prasanna B Joshi titled as rise and impact of crude oil price in India. One of the major objectives of their study was to find out what determines the crude oil prices, and for this reason he found that the factors which would influence crude oil prices are production, inventory, demand and speculation. They also said that changes in crude oil prices are mainly by the OPEC decisions, wars and also changes in the value of US dollar, since crude oil is traded in US dollars. Osama M. Badr and Ahmed F. El- Khadrawi also tried to understand what are the factors that would determine crude oil price fluctuations. They used the quarterly data from 2008Q1 to 2015Q4 for their analysis. They used the Engel and granger econometric techniques to see the long run effects of supply, demand and factors associated with the behaviour of financial market shareholders on the crude oil prices. The results of their model shows that robust effects of GDP growth for both china, an OECD country to the crude oil fluctuations. Also Jochen Moebert undertook a study that is the crude oil price determinants. For this study, he chose oil price index as WTI and the data he chose was monthly from December 1995 to January 2006, so the number of observations were 122. The variables for the study was demand, supply, OPEC, future market factors. He found that the above mentioned variables are highly significant in determining the crude oil prices.

What drives the oil prices by Richard G Anderson & Jason T Bual. As reports say that, oil prices are more vulnerable, the price of west Texas intermediate oil from 1994 to 2004, it was ranging from $10 per barrel to $ 50 per barrel, but there was even much more volatile between 2004 to 2013, and the price crude oil was very high as $143 per barrel in

2008. The major factors responsible for changes in crude oil prices are demand, supply, speculation and other factors. Ultimately they found that demand and supply are the major determinants of oil price and also speculation doesn't lead to increase in oil price. Crude oil price determinants by Jochen Moebert, 2007 undertook a study to see what determines crude oil prices. He chose a monthly data for this purpose and a large set of covariates such as demand, supply variables and speculation.

He had shown empirically that demand influences most, in demand the most influential sub component is the production variables (also transportation included) which is basically the cost involved in production of oil, they would try to innovate new ideas to produce more oil with minimum cost incurring, if this happens their profit margins would rise because there is always rise in the demand for crude oil by almost all the economies. "Drivers of crude oil prices in India" by Professor S.K. Tanan, in his presentation he said that crude oil prices and consumption are closely related. India is the largest importer of oil, government of India had allowed 100% FDI in many segments of energy sector such as natural gas, petroleum product and refineries. The factors affecting oil prices in India are the fundamental factors of demand and supply and the non- fundamental factors of geo politics, exchange rate and financial speculation. He concluded by saying crude oil prices in India are mostly affected by the rise in demand and also the uncertainties about geo politics.in the similar lines, Taniya Ghosh undertook a study of oil price, exchange rate & the Indian macro economy. This paper tries to identify the dynamic relationship among the fluctuations in crude oil prices and exchange rate with the macro-economic variables like price, output, interest rate and money. That study used the structural vector auto regression (SVAR) approach. The study concludes by saying that the world price oil has a great potential to influence India's output. Also fall in the oil prices had a favourable impact on production or output. So the prices would fall which leads to fall in the inflation and also rupee appreciate. If India develops a research & development for developing an alternative energy technology which will reduce India's dependence on oil imports.

Determinants of crude oil prices between 1997-2011 by Nourah, in this paper it was mentioned that there are two views for the determinants of crude oil prices. The two views are as follows, one view is due to the fundamental factors such as demand and supply, and the other view is due to other factors such as market power, OPEC decision (sanctions) and the geo political uncertainty. For testing or finding what exactly determines crude oil price, for this purpose quarterly data had been collected from 1997-2011. The model suggested that it is difficult for determining the crude oil price by just considering the fundamental factors of demand and supply of crude oil but we need to add speculation into the model. The model also said that change in crude oil prices between January 1997 to December 2011 are majorly due to the crucial factors such as supply and demand of crude oil.

Here we try to find out what are the variables that majorly determines the Indian oil prices, from the previous research papers we could get some information, i.e., some of the variables like Brent crude oil prices, exchange rate, index of industrial production, inflation and influences the prices of Indian oil price. We constructed a model and the result is as follows,

III. DATA & METHODOLOGY

The study uses the monthly series of data for the period April 1994 to December 2015. Since the data chosen are a monthly time series data, there can be a problem of seasonality. So the time series variables are seasonally adjusted in order to deliver better and appropriate results. Since all the variables have different units of measurement and some of them range in very high denominations, all of them have been converted to the natural logarithmic forms to scale them down on to the same and comparable level of measurement. The variables are named as follows:

Exchange rate of the Indian rupee vis-a vis the US dollar (nominal exchange rate) _LNEXR Domestic oil prices per barrel (based on opera mundi index) _LNIOP Brent crude oil prices per barrel (in dollars) _ LNBRENT

Inflation rate using wholesale price index (inflation rate= WPIt-WPIt-1/WPIt-1) _LNWPI Index of industrial production (general commodities) _ LIINP

All the variables are taken in the log form to maintain the uniformity of the data. Data for all the variables had been collected from the RBI handbook of statistics on Indian economy.

IV. EMPIRICAL ANALYSIS

In the following OLS model, we try to find out what are the variables that majorly determines the gold prices, from the previous research papers we could get some information, i.e., some of the variables like London gold prices, Bombay stock exchange, exchange rate, currency in circulation, Indian oil prices, inflation and silver influences the prices of gold. The results of the stationarity test are as follows

VARIABLE	LEVELS I(0)	1ST DIFFERENCE I(1)	INFERENCE
LNBRENT	-0.941202	-12.73266*	I(1)
LNEXR	-1.540945	-11.55735*	I(1)
LNIIP	-7.885124*		I(0)
LNINF	-1.179402	-10.93622*	I(1)
LNIOP	-1.150348	-12.20780*	I(1)

ADF TEST RESULTS

Source: Authors calculation
τ-values significant at 1%, 5% and 10% level of significance *, **, *** Critical *τ values:* 1%= -3.995800, 5%= -3.428198, 10%=3.137485

Using the ADF test we found that all the variables are stationary at 1st difference except IIP. For the purpose of the study the OLS model is suitable because it lays more emphasis of impact of change in independent variables on the change in dependent variables, that is the reason why I chose OLS method for empirical analysis.

Determinants of oil prices in India

D(LnIOP)=-0.0026+0.9024*D (LnBRENT)+0.6496*D (LnINF) + 0.0309*D (LnIIP(-3))

(-2.64) (88.26)(4.77)(1.955)
+0.9608*D (LnEXR) + 0.0447*DUMOIL

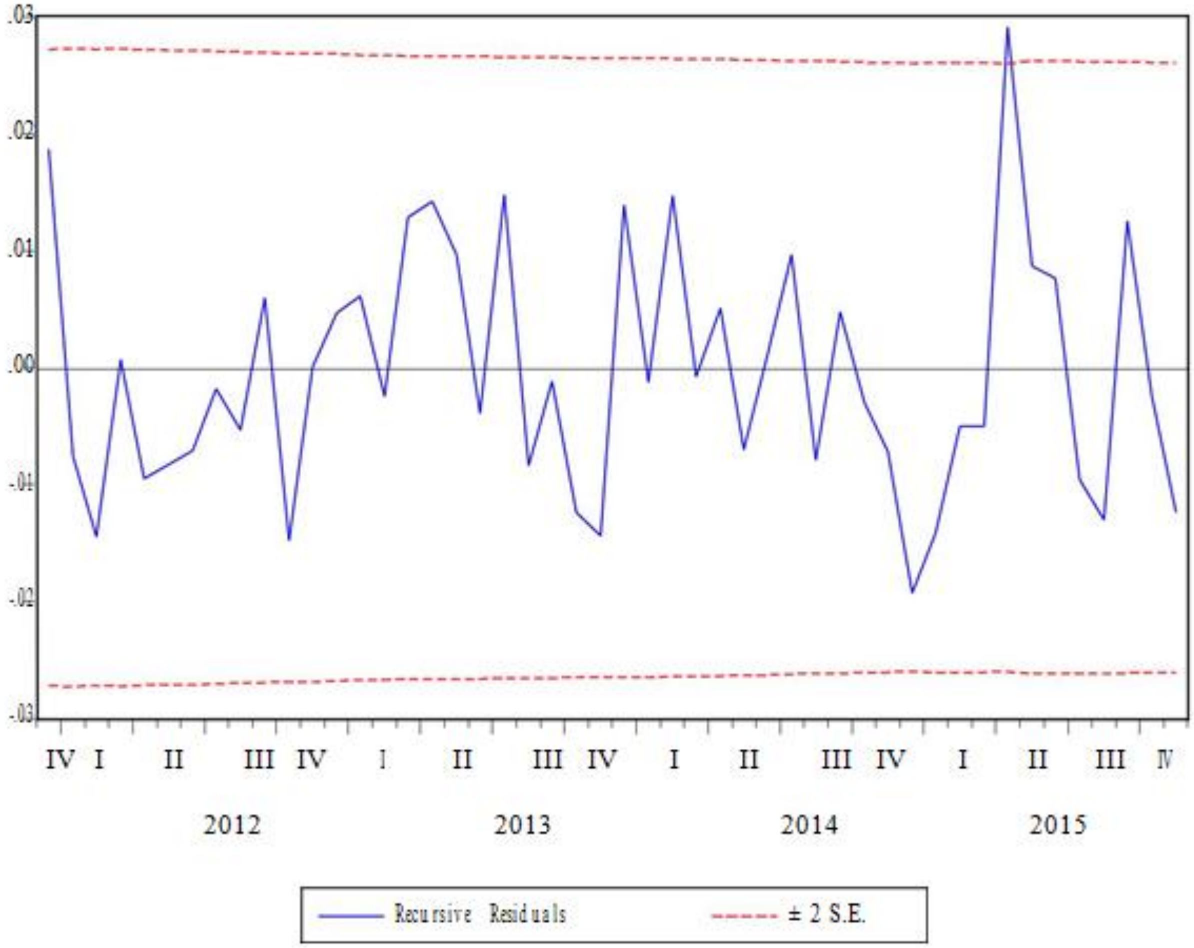
(19.44)

Adjusted R^2= 0.97 D-W Statistic= 2.15
F-Statistic=1867.47

From the above equation, we can say that the 97% changes in the oil prices are explained by the changes in independent variables such as Brent crude oil price, inflation, index of industrial production, exchange rate and a dummy variable. From the above, the major factor that influencing the changes in crude oil prices is the Brent crude oil price because for the simple reason that India imports oil heavily. D-W statistic is 2.15 which means that there is little presence of auto correlation but we can accept this. F- statistic is very high i.e., 1867.47 which basically tells the overall significance of the model and RMSE (0.024) is also very small. The reason for adding dummy in the year 2011 for the month of November is because of Eurozone crises.

Also the relationship among the variables are found to be significant and there also in line with the theory, that is by saying that there exists a positive relation with between IOP and BRENT, between IOP and INF, between IOP and IIP, between IOP and EXR which is being shown above.

Tability Test for the Determinants of Crude oil Prices in India

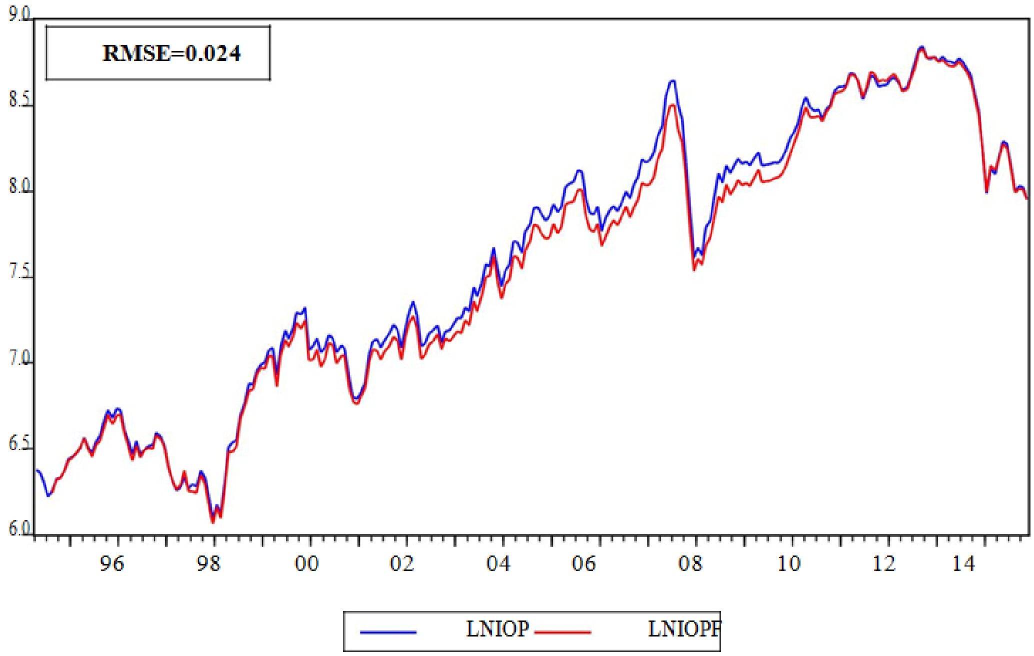


Source: Authors Calculation

In the above graph we can observe that the model is stable over a period of time, since the estimated model is within the $\pm$ 2 standard errors. The estimated model is represented by the BLUE line and the RED lines represents the standard errors. According to econometricians, for the model to be good fit, the estimated model (represented by blue line) should lie within the $\pm$ 2 standard errors (represented by RED lines). But you can that there is spike at one place crossing the $\pm$ 2 standard errors limit but we can accept this model as a stable one. Here we can also infer that the errors are minimum, so we can accept this model as good model.

Source: Author's calculation

From the above two graphs we can make out the estimated model is stable since the recursive residuals are lying within the $\pm$ 2 standard errors. from the in sample forecasting graph we can see that the estimated model and the forecasted model are almost same in the entire period. RMSE is also very small.



V. CONCLUSION

As we all know that India is a net importer since our imports are larger than exports. So the growth of Indian would majorly depend on how much we are paying for imports. The less we pay import bill the more economic growth is achievable. India imports majorly necessary goods such as crude oil, edible oils, fertilizers, and also gold etc. the above mentioned goods were almost all necessary goods. Crude oil prices very much volatile in nature, which caused some of the financial instability in Indian economy. To study why there are so many fluctuations in crude oil prices the study has been carried out i.e., determinants of crude oil prices in India. For the past 60 years, prices of crude oil have fluctuated within a wide range but did not follow any meaningful trend, and the average crude oil prices were low at Rs. 731.17 in February 1997 and high at Rs. 6534.09 in December 2013.

This study attempts to determine the factors which influence the oil prices either from domestic front or international effects. The study considers a monthly data set for all the variables from April, 1994 to December 2015, with a prime motive to estimate the effect of variables on oil prices.

From our analysis it is clear that a mix of both financial macroeconomic and international variables impacting the oil prices to fluctuate. Here financial variable is referred to as BSE, macroeconomic variables such as inflation, exchange rate and international variables such as BRENT crude oil prices and its own past prices influencing oil prices significantly.

After going through the study on the dissertation titled, *"determinants of Crude Oil prices in India"*. we can discuss some of the major policy implications pertaining to India. As we already mentioned that India is an emerging economy, it has to depend more on imports. Too much dependence on imports is also not good for an economy like India. So we import till our reserves doesn't deplete so much. One of the major reasons why the crude oil prices are low because of the fact that OPEC didn't bother to cut down its production even when demand was low for one of the months in 2014. We think OPEC has some agreement with the US, if the crude oil in OPEC countries gets depleted and cannot produced later, then US will dictate the crude oil prices since they have enormous shale reserves. Also depending too much on crude oil imports leads to increase the trade deficit and also all the macroeconomic indicators will show a negative indication to the rest of the world, which is not good for an economy especially like India.

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