Analysis of Crude Oil and Petroleum Products Production and Consumption in India

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***Abstract*- Crude oil is essential for our day to day life. The demand for crude oil is increasing continuously throughout the world. But all the countries cannot able to produce crude oil for fulfilling their need. Today most of the country's economy is depends on the basis of crude oil production. India is one of the largest consumers of crude oil, it occupies third place in oil consumption. India is occupying third place at world level. India is producing crude oil and petroleum products but it could not fulfill its demand. The study is analyzed that the production and consumption of crude oil in India and how India does is adjusting the demand for crude oil through import from other countries and also used time serious modeler and ARIMA model for analyzed import, export and consumption and production of petroleum products in India from 2002-03 to 2015-16**

Index Terms- Crude oil, Petroleum products, Import and export.

1. INTRODUCTION

Crude oil is occupying very important place in global economy and this is a part of our day to day life. The demand for oil was much higher than what it actually produced in the world. Today most of the country's economy is depends on the basis of crude oil production. In consumption of crude oil, India is occupying third place at world level. Consumption of crude oil is more than the production of crude oil in India. Most of the Arabian countries and some of the countries are having oil fields. In India the first oil field was discovered in 1889 in Assam and Gujarat. [1] Natural gas gained further significance after the discovery of large reserves in the South Basin fields by ONGC in the 1970s.[2] The major producing oil companies India are Adani Welspun Exploration Limited (AWEL), Bharat Petroleum Corporation Limited (BPCL), Essar Oil Limited, Gas Authority of India Limited (GAIL), Hindustan Petroleum Corporation Limited (HPCL), Indian Oil Corporation, Oil India Limited (OIL), Reliance Petroleum Limited and Tata Petro dyne Ltd(TPL)[3]

2. WHY INDIA IS NEEDED TO PRODUCE MORE PETROLEUM PRODUCTS?

Petroleum products are using for various purposes in India. At present it is very essential for economic development. India is having more population. Because of that the uses of petroleum products are also more level. Petrol and Diesel mostly using for transport purpose. Consumption of vehicle is increasing every year in India. The passenger vehicle is run by petrol and Diesel. At present most of the passengers are preferring petrol vehicle than Diesel Vehicle. Diesel is using for operating heavy vehicle motor vehicles and for electric generation. Petroleum products are provides the ingredients for produce soap, detergents, paints and LPG. Motor spirit or gasoline is essential for using principally as a fuel for internal combustion engines. Kerosene is very essential product for our country. It is a fuel for stoves; most of the poor people are still used kerosene for cooking in India. And it is used for lamps, aircrafts and tractor. It is used for making pesticide, killing a variety of insects. It is often used as a synthetic hydrocarbon for decay experiments to simulate crude oil in field condition. [4] Naphtha is using for so many purposes. Factories use naphtha as a raw material for the creation of plastics such as polypropylene and polyethylene. Different naphtha chemicals also find use as raw materials for the creation of petrochemicals including butane and gasoline. [5]HSD is normally used as a fuel in medium and high speed compression ignition engines (operating above 750 rpm) in commercial vehicles, stationary diesel engines, locomotives and pumps etc.

[6] Light diesel oil (LDO) is used for diesel engines, generally of the stationery type operating below 750 rpm. [7]Bitumen is widely used in the construction of asphalt roads and bituminous membrane products. It is commonly used to build highways, motorways and rail networks and it is widely used for making roofing products, industrial applications, from mix paints to sound-proofing. Used for the construction of railway tracks and by using special types of bitumen such as Polymer Modified Bitumen, the vibration and noise levels are reduced due to a dampening effect. It has been proven to be effective on both It is also used for surfacing airfield runways and air strips (PMB is preferred due to its fuel resistant properties) high-speed railway tracks and heavy load railway tracks and taxi ways. Bitumen is used for hydraulic applications such as canal lining, underwater tunnels, river bank protection, dam construction and sea defences. Not only that using for numerous industrial applications like roofing felt material, printing inks, packaging paper, linoleum, electrical cable / Junction box insulation, mastic for roofing of terraces, and duplex paper manufacture. [8]Motor oil is specifically used in engines a variety of different engines and types of machinery, preserving quality aiding functionality, reducing unnecessary wear and is the sole reason for prolonged and continued use.[9] All the above petroleum products are supporting to our economic development in many ways. These products are fulfilling India's domestic needs as well as it also exporting to other countries.

3. REVIEW OF LITERATURE

Goldar and Mukhopadhyay (1990) and Ghosh (2009) calculated that the demand for crude oil in various states of India [10, 11]. And some studies were estimated and forecast demand for crude oil (Rao & Parikh 1996; Ghosh (2006); these type of estimations for petroleum demand was also done in some other countries [12, 13] Adams and Shachmurove (2008) estimated for China [14]; Altinay (2007) calculated for Turkey [15] and Saad (2009) analyzed for Indonesia [16]. India's Petroleum Act, 1934 mentioned to regulate petroleum products and for exploration of crude oil, government prepared National Exploration and Licensing Policy[17].The Essentials Commodities Act regulations by the dedicated ministry or the Nodal authorities like The Directorate General of Hydrocarbons (DGH). The DGH usually deals with the regulations that govern market factors like price determination, rules for Oil Marketing Companies, etc, whereas exploration and production is overseen by the Ministry for Oil and Natural Gas [18]. Wachtmeister examined that the Non-OPEC conservative projections were mostly constant in the last 15 years, while downward revisions were mainly allocated to OPEC countries [19].Hamilton (1983) examined about the impact on the US economy. He concluded that the crude oil prices have a strong relationship with the US business cycle and tends to highlight cost-push inflationary effects [20]; this article is focusing the production, import and consumption of crude oil and import and export of petroleum products in India.

4. OBJECTIVES OF THE STUDY

- To analyse the production ,consumption and import of crude oil in India
- To analyse the production, consumption and import/export of petroleum products in India

5. METHODOLOGY

The period of study has covers selected (14) financial years from 2002-03 to 2015-16. The relevant secondary data have been collected from various publications of Ministry of petroleum and Natural gas. Percentage method used for analyse the production, consumption, and import, price of crude oil in India. Used time series modeler for analyse consumption and export of petroleum products in India. Used Arima Model for analyse consumption, production, import and export of petroleum products in India.

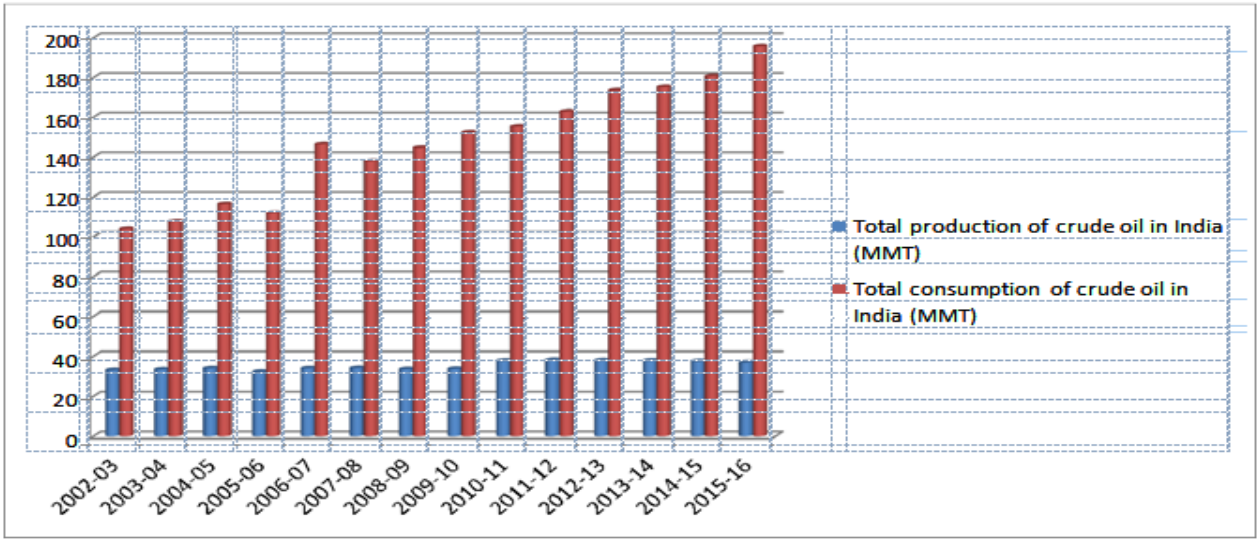
Table 1 Production and Consumption of Crude Oil in India (MMT) 2002-03 to 2015-16

Year	Total production of crude oil in India (in MMT)	Percentage growth of crude oil production in India	Total consumption of crude oil in India (MMT)	Percentage growth of consumption of crude oil in India
2002-03	33.04	-	104.12	-
2003-04	33.37	1.00	107.75	3.48
2004-05	33.98	1.82	116.34	10.79
2005-06	32.19	-5.27	111.92	9.62

2006-07	33.99	5.59	146.55	13.09
2007-08	34.12	0.38	138.10	9.42
2008-09	33.51	-1.79	144.70	10.47
2009-10	33.69	0.55	152.6	10.54
2010-11	37.71	11.85	155.4	10.18
2011-12	38.09	1.08	163.0	10.48
2012-13	37.86	-0.60	173.6	10.65
2013-14	37.78	-0.19	175.3	1.09
2014-15	37.46	-0.87	180.8	10.31
2015-16	36.95	-1.36	195.8	10.82

The above table shows that the production and consumption of crude oil in India from 2002-03 to 2015-16. In the year 2002-03 the production of crude oil in India was 33.04(MMT) where as it was decreased in the year 2005-06 and 2008-09.Again it falls in the year 2012-13 from 37.86 to 36.95 in the year 2015 -16. The percentage growth of crude oil production was declined after 2010-11 it reached negative from 2012-13 to 2015-16.The percentage growth of consumption of crude oil in India was low in the year 2013-14 (1.09) and 2003-04 and high in the year 2006-07(13.09). Consumption of crude oil in India was gradually increased up to 2015-16 except in the year 2007-08.

Diagram 1 Production and Consumption of Crude Oil in India (MMT) 2002-03 to 2015-16



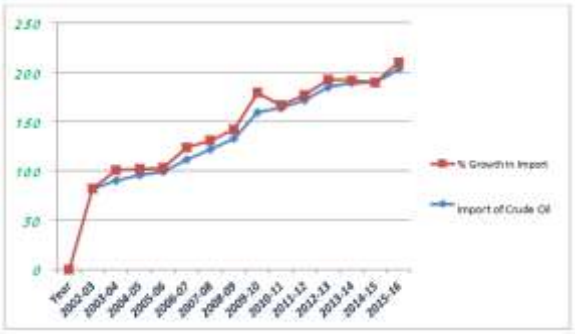
The above chart shows that the production and consumption of crude oil in India. Indicates the total production of crude oil in India. Indicates the total consumption of crude oil in India. India's consumption of crude oil was increased continuously than the production of crude oil. The geological condition is not suitable for produce more crude oil in India.

Table 2 Import of Crude Oil and Average Crude Oil Prices

Year	Import of Crude Oil (MMT)	% Growth in Import of Crude Oil	Average Crude oil Prices (US$/bbl.)	Percentage growth of oil prices
2002-03	81.989	-	26.59	-
2003-04	90.434	10.30	27.98	05.23
2004-05	95.861	06.00	39.21	40.14
2005-06	99.409	3.70	55.72	42.11
2006-07	111.502	12.16	62.46	12.10
2007-08	121.672	9.12	79.25	26.88
2008-09	132.775	9.13	83.57	05.45
2009-10	159.259	19.95	69.76	-16.53
2010-11	163.595	2.72	85.09	21.98
2011-12	171.729	4.97	111.89	31.50
2012-13	184.795	7.61	107.97	-3.50
2013-14	189.238	2.40	105.52	-2.27
2014-15	189.435	0.10	84.2	-20.24
2015-16	202.851	7.08	46.17	-45.14

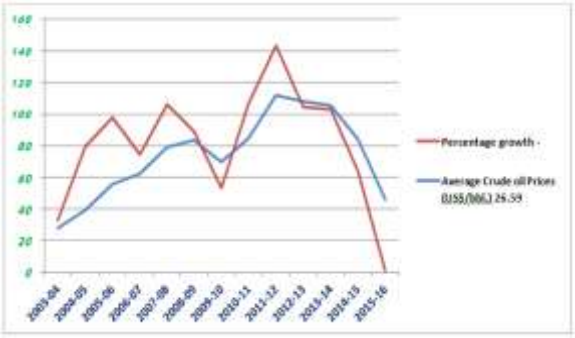
The above table shows that the import of crude oil in India and percentage and average crude oil prices in India from 2002-03 to 2015-16. The import of crude oil was increased in the year 2009-10 than the other periods. The percentage growth of import of crude oil was also high in the same year compared to other years. The average crude oil prices in US $ per barrel was so high in the years 2011-12, 2012-13 and 2013-14 than the other period. The percentage growth of oil prices were reached in negative after 2012-13 to 2015-16 .The average crude oil prices were also declined after 2014-15 to 2015-16.

Diagram 2 Import of crude oil and the percentage growth of import of crude oil



India could not fulfil the demand of crude oil through production so it is continuously imported crude oil from other countries. The above line diagram shows that the import of crude oil in India and the percentage growth of import of crude oil in India from 2002-03 to 2015-16.

Diagram 3Average crude oil prices and percentage growth of crude oil prices.



The above chart shows that the average crude oil prices and percentage growth of oil prices in India from 2002-03 to 2015-16.

5.1. Time Series Modeler

The Time Series Modeler procedure estimates exponential smoothing, univariate Autoregressive Integrated Moving Average (ARIMA), and multivariate ARIMA (or transfer function models) models for time series, and produces forecasts. The procedure includes an Expert Modeler that attempts to automatically identify and estimate the best-fitting ARIMA or exponential smoothing model for one or more dependent variable series, thus eliminating the need to identify an appropriate model through trial and error. Alternatively, you can specify a custom ARIMA or exponential smoothing model. Time Series Modeler Data Considerations for data as dependent variable and any independent variables numeric and assumptions of the dependent variable and any independent variables are treated as time series, meaning that each case represents a time point, with successive cases separated by a constant time interval.

Model Description:

The variables "Consumption of petroleum products" and "Export of petroleum products" are consider as dependent variables and variables "Production of Petroleum Products" and "Imports of Petroleum Products" are consider as independent variables. These four variables are "ARIMA Model Parameters" for the analysis.

Tables 1 Model Description

			Model Type
Model ID	Consumption of petroleum products	Model_1	ARIMA(0,0,0)
	Export of petroleum products	Model_2	ARIMA(0,0,0)

Hypothesis:

Model 1

H0a: There is no significant difference between the variable "Consumption of Petroleum products" and two of the variable terms "Production of Petroleum Products" and "Import of petroleum products"

H1a: There is significant difference between the variable "Consumption of petroleum Products" and two of the variable terms "Production of Petroleum products" and "Import of petroleum products"

Model 2

H0b: There is no significant difference between the variable "Export of petroleum Products Consumption of petroleum products" and two of the variable terms "Production of Petroleum products" and "Import of petroleum products"

H1b: There is no significant difference between the variable "Export of petroleum Products Consumption of petroleum products" and two of the variable terms "Production of Petroleum products" and "Import of petroleum products"

Model Fit:

In the model fit Stationary R-squared, R-squared, Root mean square error (RMSE), Mean absolute percent errors (MAPE), Maximum absolute percentage error, Mean absolute error and maximum absolute error are explained and the same is depicted in the table 2 bellow.

Table 2 Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum
Stationary R-squared	.958	.029	.938	.978
R-squared	.958	.029	.938	.978
RMSE	4952.249	790.776	4393.086	5511.413
MAPE	8.706	8.963	2.368	15.043
MaxAPE	34.846	42.233	4.982	64.709
MAE	3687.686	728.497	3172.560	4202.811
MaxAE	8050.907	847.638	7451.536	8650.278
Normalized BIC	17.544	.321	17.317	17.771

5.2. ARIMA Model

The parameters considered for ARIMA Model are "Consumption of petroleum products", "Export of petroleum products" "Production of Petroleum Products" and "Imports of Petroleum Products"

Table 3 ARIMA Model Parameters

		Estimate	SE	t	Sig.
Consumption of petroleum products (Model 1)	Consumption of petroleum products	48833.199	4350.763	11.224	.000
	Production of Petroleum products	.404	.035	11.602	.000
	Import of petroleum products	1.225	.224	5.479	.000
Export of petroleum products (Model 2)	Export of petroleum products	-25877.743	5458.316	-4.741	.000
	Production of Petroleum products	.420	.044	9.614	.000
	Import of petroleum products	-.128	.280	-.458	.005

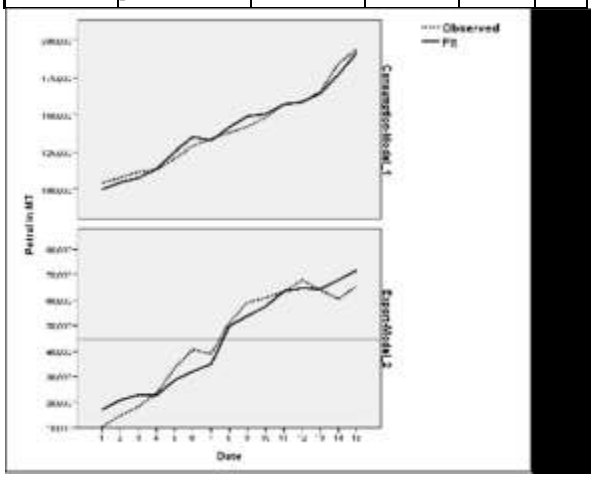


Figure 1 Model Charts

Interpretation

Model 1:

The association between the variable "Consumption of petroleum products" and two of the variable terms "Production of Petroleum products" and "Import of petroleum products" is to be determined the statistically significance by comparing the p-value (Sig.) for the variables significance level to assess the null hypothesis. The null hypothesis is that the term is not significantly different from variable, which indicates that no association exists between the term and the response and a significance level (denoted as α or alpha) of 0.05 indicates a 5% risk of concluding that the term is not significantly different from Variable. From the table 2 for model 1, we can conclude that the P-Value (Sig,) ≤ α and the term is statistically significant. The autoregressive term has a p-value that is less than the significance level of 0.05. You can conclude that the coefficient for the autoregressive term is statistically significant, and you should keep the term in the model. The calculated t value for Production of Petroleum products (11.602) is higher than the table value of 5.991. Hence, it implies that there is significant relation between Consumption of petroleum products and Production of Petroleum products. As for as the "Import of petroleum products" is concern, the calculated t value (5.479) is less than the table value of 5.991. Here we can conclude that there is no significant difference between Import of petroleum products and Consumption of petroleum products. The Consumption of petroleum products particularly impact Import of petroleum products.

Model 2:

The association between the variable "Export of petroleum products " and two of the variable terms "Production of Petroleum products" and "Import of petroleum products" is to be determined the statistically significance by comparing the p-value (Sig.) for the variables significance level to assess the null hypothesis. The null hypothesis is that the term is not significantly different from variable, which indicates that no association exists between the term and the response and a significance level (denoted as α or alpha) of 0.05 indicates a 5% risk of concluding that the term is not significantly different from Variable. From the table 2 for model 1, we can conclude that the P-Value (Sig,) ≤ α and the term is

statistically significant. The autoregressive term has a p-value that is less than the significance level of 0.05. You can conclude that the coefficient for the autoregressive term is statistically significant, and you should keep the term in the model. The calculated t value for Production of Petroleum products (9.614) is lower than the table value of 5.991. Hence, it implies that there is significant relation between Export of petroleum products and Production of Petroleum products. As for as the "Import of petroleum products" is concern, the calculated t value (-0.458) is less than the table value of 5.991. Here we can conclude that there is no significant difference between Import of petroleum products and Consumption of petroleum products. The Consumption of petroleum products particularly impact Import of petroleum products.

6. FINDINGS AND CONCLUSIONS

Import of crude oil in India during the study period was increased at decreasing level. Consumption of crude oil in India was also increased .Whereas India could not able to produce more crude oil in this period. As per the Arima model 1 there is no significant difference between Import of petroleum products and Consumption of petroleum products. The Consumption of petroleum products particularly impact Import of petroleum products. As per the Arima model 2, there is no significant difference between Import of petroleum products and Consumption of petroleum products. The Consumption of petroleum products particularly impact Import of petroleum products. Crude oil production in India was not improved too much in this study period. Compared to 2002-03 in the year 2015-16 only 3.91 (MMT) crude oil productions increased in India. India could not fulfill the demand of crude oil through domestic production so it is continuously imported crude oil from other countries. And some oil fields are aged so could not produce more oil from that fields. Not only have that the geological condition is not favoured to India to produce more crude oil. Since 2012-13, the average crude oil prices (US$/bbl) has been continuously declining. It is also one of the reasons that, the oil producing companies are not showing interest to produce more in India. Even though India is producing petroleum products, it does not meet the demand so India importing petroleum products from other country also. But compared to import of petroleum products from other countries, India's export of petroleum products was more. This is one of the good situations for India economy. The Indian government expected 0% import of products from other countries including the crude oil and petroleum products. For this the Government is taking some steps to increase domestic productions. I hope in future India will be produce more crude oil and petroleum products and fulfill its need and also it become a one of the exporter of Crude oil.

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