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Research Article

IMPACT OF CRUDE OIL PRICE CHANGES ON SELECT INDIAN INDUSTRIES

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Abstract

The study quantifies the impact of crude oil price changes on the production, sales turnover and raw material cost of select industries in India where crude oil is a major direct or indirect raw material. The results show that there exists a relationship between crude oil price changes and production of chemicals, coke, and refined petroleum products, a significant impact is observed on the sales turnover of plastic, oil refinery, and automobiles industries. The raw material cost of fertilizers, food processing, and paints industries show a high correlation with crude oil. Energy is the undercurrent that drives economic activity in the world. Fortunes of countries have changed because of crude oil. Its importance to the global economy is unmatched, proven by the fact that oil is responsible for 2.5% of the world GDP. If provided a conducive business environment, companies around the world would like to tap opportunities a billion plus people in India present. India is heavily dependent on crude oil imports thus volatility in crude oil prices is a cause for concern.

Keywords: crude oil; price; global economy; GDP; industries

Introduction

About 31 % of the world's total energy demand are met by crude oil. The total oil consumption of the world is around 96 million barrels per day. United States of America being the largest consumer followed by China. Crude oil is the most traded commodity in the non-financial commodities segment. Despite many calls in climate change conventions to reduce its use, the reality is that crude oil is the king of raw materials; it is the most important raw material for many industries (www.eia.gov).

India ranks among the top five oil-consuming countries in the world. About 30% of India's total energy consumption is met by oil. Although India consumes around 3.68 million barrels of oil per day, the production is just about 0.751 million barrels per day (April 2015). With close to 70% of its oil requirements imported from more than eight countries, India is a net importer of oil. High economic growth rates being forecasted, and with over 1/6th of the world's population. India is and will be a noteworthy consumer of energy resources. Despite the global financial crisis, India's consumption continued to rise and it became the third-largest oil consuming country. Being heavily dependent upon oil imports, oil price changes are crucial in explaining economic performance of the Indian economy as a whole. The growth of Indian Industry is regarded as a crucial element in the future of India not only because current over-reliance on services will not be sustainable but also because of industries importance as the source of employment and wealth. Initiatives like the Make in India will further increase the demand for oil in India (www.tradingeconomics.com)

If India wants a sustainable future for its growing population, it is important to understand the impact crude oil price changes, to make suitable policy decisions concerning development of alternate sources of energy and raw materials, and minimise the use of crude oil to the extent possible, the first step is to understand its impact.

Need for the study and objectives

Research around the world indicated that there is a relationship between crude oil price changes and macro-economic performance. Review of relevant literature revealed some studies analysing the strength of the relationship and the channel of transmission. However, majority of them used aggregate data (broad macro-economic indicators) to study the relationship among these, the studies that looked at the disaggregate level were for foreign countries. No studies were found in the Indian context.

There was a need to conduct a study that analyses the effect of a change in oil prices on major industries in India, which depends on crude oil or its other forms as a source of direct or indirect input (Hamilton, 1983).

Literature review

Economists have been interested in finding empirical evidence that suggests that oil price changes may have an effect on the macroeconomic performance, initial works in this area started in 1970's. Factors such as poor performance of USA's economy and disruptions in oil market raised suspicion among researchers that there could be a causal relationship from oil prices to US macroeconomic. From that time till now, extensive research work has been done in this area to establish a link between oil and macroeconomic performance and to give empirical proof in its backing.

Hamilton (1983) was the first to establish a link, after him scores of studies were done both in American as well as European context. Using VAR, Burbridge & Harrison (1984) studied industrial production of Canada, Japan, West Germany, UK and the USA. Goodwin & Gisser (1986) found that oil price changes have a significant impact on some macroeconomic variables. Rotemberg & Woodford (1996) quantified the effects of oil price shocks and showed them in terms of elasticities, they concluded that a 1% rise in the price of oil will lead to a reduction in US output of about 0.25% after five to seven quarters.

Early works that looked at the macro economy presented different theoretical perspectives backed by empirical evidence and estimated the magnitude of such shocks, their impact on the macro economic variables. These early works on finding the type of relationship shed some light on the channels of transmission and laid the basis for further research to find various transmission channels and their magnitudes.

Sectoral reallocation could result in an asymmetric response of economic activity to positive and negative oil price changes. Therefore, an increase in oil prices will lead to a reallocation of labour and capital from declining sectors to expanding sectors (Davis & Haltiwanger, 2001). Therefore, for an oil importing country, an increase in oil price will to a reduction in employment and real income, which according to Kilian (2009) will lead to an increase in precautionary savings, also a household in order to meet it consumption oil requirements will need to spend extra to foot the bill. Households will cut their expenditures elsewhere, and this will eventually lead to a demand driven decline in production. Bhanumurthy, et al., (2012) Study the transmission mechanism in Indian context and present that impact of crude oil price changes is through Import, Price and Fiscal channel.

Over the years, many studies have been done about the effect of oil price changes on macroeconomic indicators for both developing as well as developed countries. A country's economy is made up of different industries and how does oil price changes affect these industries is important from the point of view of regulatory agencies, enterprise managers, market participants, etc. Bohi (1991) studied the impact of two oil price shocks in causing recession for USA, UK, Germany and Japan, using bivariate approach he could not find any similarities between the two recessions with regards to oil price movements but concluded that the relationship between energy cost and industrial output is more complex than what he could explain. Yurtserver & scholterds (2013) studied industries in Europe from 1983 till 2007, using unrestricted VAR model and multivariate regression they concluded that there is a relationship between oil amount used and industrial production for 38 industries under study. Jimenez & Sanchez (2008) investigated the disaggregated effects of a sudden oil price change on the industrial output of United Kingdom, France, Germany, Italy, Spain and United States of America using a recursively identified bivariate VAR with real oil price stated in the local currency of the country and macroeconomic indicators related to production as variables. The industries related to housing and constructions are impacted industries by an oil price shock in Italy and Germany. For France and Spain, paper industry, metal industry, machinery and equipment industry bear most of the negative impact. In the US and the UK, the industries most affected are those related to industrial demand (metal products, metal equipment in UK and chemical industry in the US). The least impacted industries are the ones related to personal consumption. Knop & Vespignani (2014) Using structural vector autoregression models (SVAR), measure the effect of commodity price shocks on industries in Australia, from Jan-1993 till March-2013. Commodity index comprises of base metals, rural commodities and bulk commodities. They concluded that mining, construction and manufacturing were the most affected industries whereas financial and insurance sector were least affected. (Lee & Ni, 2002) Analyse the effects of oil price shocks on demand and supply for industries in the United States using VAR from 1959 till 1997. According to them after an oil price shock, output decline occurs after a ten-month lag and is short lived. Oil price shocks affect both demand for products, and supply of raw materials for industries. They found that oil price shocks mostly reduce the supply of oil-intensive industries while the demand for many other industries, especially the automobile industry declines after an oil price shock.

Data

The study focuses on Indian manufacturing industry which forms around 75% of the Index of Industrial Production (IIP), period of the study is from 2005 till 2014. Financial data is annual data and taken from capitaline database. Each industry consists of companies whose data was available for the last ten years. Production data is monthly data and collected from the database of the Reserve Bank of India. Brent crude oil price data is collected from United States Energy Information Administration.

Methodology

The independent variable in the study is Brent crude oil price and the dependent variables can be divide into two segments first related to production, second related to financials. The preliminary test performed on the variables was unit root test to find at which level is the variable stationary. A stationary time series is without trend, the series has a constant variance over time, and its autocorrelation structure does not vary over the time period. Further, this time series will not include seasonality or periodic fluctuations. The ordinary least square technique was employed to measure the impact of crude oil price changes on the dependent variables.

The Tables 1, 2 and 3 list these variables, their notations and at which level they are stationary.

Table 1: Notations and results of stationarity test for production variables.

VARIABLES	Notation	Stationarity At
Chemicals and chemical products	lnChem	at level
Coke, refined petroleum products & nuclear fuel	lnCoke	at level
Electrical machinery & apparatus n.e.c.	lnElec	first difference
Fabricated metal products, except machinery & equipment	lnFabr	at level
Food products and beverages	lnFood	first difference
Furniture, manufacturing n.e.c.	lnFurn	at level
Intermediate Goods	lnInter	at level
Luggage, handbags, saddlery, harness & footwear, tanning and dressing of leather products	lnLugg	at level
Machinery and equipment n.e.c.	lnMach	at level
Medical, precision & optical instruments, watches and clocks	lnMedi	at level
Motor vehicles, trailers & semi-trailers	lnMoto	first difference
Office, accounting & computing machinery	lnOffice	at level
Other non-metallic mineral products	lnNonmetal	at level
Other transport equipment	lnOthertrans	at level
Paper and paper products	lnPaper	at level
Publishing, printing & reproduction of recorded media	lnPubl	first difference
Radio, TV and communication equipment & apparatus	lnRadio	first difference
Rubber and plastics products	lnRubber	first difference
Textiles	lnText	at level
Tobacco products	lnToba	at level
Wearing apparel, dressing and dyeing of fur	lnWear	at level
Wood and products of wood & cork except furniture, articles of straw & plating materials	lnWood	at level

Table 2: Notations and results of stationarity test for sales turnover variables.

VARIABLES	Notations	Stationarity At;
Chemicals industry	lnChem	second difference
Paints industry	lnPaint	second difference
Automobiles industry	lnAuto	second difference
Fertilizer's industry	lnFert	first difference
Food processing industry	lnFood	second difference
Plastic industry	lnplas	second difference
Oil refineries industry	lnOilRef	second difference
Cement industry	lnCement	first difference
Auto ancillary industry	lnAutoAnc	second difference
Textile industry	lnText	second difference
Personal care industry	lnPerCare	second difference
Paper industry	lnPaper	first difference
Packaging industry	lnPckg	second difference

Table 3: Notations and results of stationarity test for raw material cost variables.

VARIABLES	Notations	Stationarity At;
Chemicals industry	lnChem	second difference
Paints industry	lnPaint	second difference
Automobiles industry	lnAuto	first difference
Fertilizer's industry	lnFert	first difference
Food processing industry	lnFood	second difference
Plastic industry	lnplas	second difference
Oil refineries industry	lnOilRef	second difference
Cement industry	lnCement	second difference
Auto ancillary industry	lnAutoAnc	second difference
Textile industry	lnText	second difference
Personal care industry	lnPerCare	second difference
Paper industry	lnPaper	first difference
Packaging industry	lnPckg	second difference

Results

Impact on production

Industries which were significantly affected were refined petroleum products, chemicals & chemical products, coke, intermediate goods. Crude oil is a direct source of raw material for many industries: chemical industry uses naphtha, kerosene etc. whose prices are directly affected by changes in price of crude oil so, when crude oil prices go up production in these industries goes down (Table 4).

Food products & beverages and rubber & plastics industry present a unique picture. Constituents of crude oil are widely used in the production of plastics and synthetic rubber (Table 5).

In India, 80% of the rubber manufactured is natural rubber the demand for which has declined, as synthetic rubber is cheaper. Therefore, from the Indian perspective decline in prices of crude oil is beneficial for plastics industry but not for rubber industry. Data provided for these two industries is combined therefore separate impact could not be ascertained. The relationship between crude oil price and production of rubber and plastics in India is significant, 1% rise in the price of crude oil would lead to a decline in production of rubber and plastics by around 0.68%.Demand for Food products and beverages is inelastic in nature. With increasing population, demand is sure to rise for this industry in India, so increase or decrease in crude oil price should not affect the production for food products and beverages, as the coefficient is positive hence no relationship between food products and beverages and crude oil price changes.

Industries which showed a not so strong relationship with crude oil were leather, paper, motor vehicles, trailers & semi-trailers. These industries do not use crude oil or it's refined in large quantities, only furniture industry uses it proven by the fact that around 60 litres of crude oil goes in making a sofa (Table 6)

Table 4: Results for impact on production for industries which showed significant relationship with crude oil changes.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Coke, Refined Petroleum products & nuclear fuel	-0.27	0.349	0.338	-3.14
Chemical & Chemical Products	-0.1958	0.38	0.36	-2.46
Leather Industry	-0.23	0.361	0.35	-2.077
Textiles	-0.18	0.29	0.28	-2.04
Intermediate goods	-0.156	0.38	0.37	-1.91
Paper and paper products	-0.15	0.31	0.3	-1.75

Table 5: Results for impact on production of rubber and food industry.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Rubber and Plastics products	-0.068	0.506	0.497	-1.337
Food products and beverages	0.236	0.618	0.6123	2.23

Table 6: Results for impact on production for industries, which showed a weak relationship with crude oil price changes.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Furniture, manufacturing n.e.c.	-0.204	0.459	0.449	-1.42
Motor vehicles, trailers & semi-trailers	-23.14	0.295	0.283	-1.3
Other Transport Equipment	-0.33	0.2599	0.2474	-1.23
Machinery and Equipment	0.193	0.4718	0.4627	-1.1
wearing apparel, dressing and dying of fur	-0.17	0.46	0.45	-1.09

Industries which were not affected by changes in crude oil price were mostly those which do not use crude oil as a raw material or those which have inelastic demand for its products like tobacco industry (Table 7).

Impact on financial parameters

Operating income can be affected by changes in sales revenue or changes in cost of goods sold or both. Crude oil can affect sales revenue. For example, when crude oil prices go up, running costs of a car increases which dissuades car purchases. (Table 8 & 9) Similarly, for an oil refinery, if oil price goes down its raw material costs go down, unit fixed costs go down because of increase in product demand and volume and operating profit margins increase. Therefore we have studied the impact on both sales revenue and raw material costs of industries.

Industries whose both sales turnover and raw materials cost were significantly affected were oil refinery industry, chemicals & dyes industry and automobiles industry. Oil refineries use crude oil directly and their output becomes input for chemicals & dyes industry which further process it and sell it to be used for other manufacturing process or to the direct consumer (Table 8 & 9).

Automobiles ancillary industry is the industry whose only sales turnover is affected (Table 10 & 11). This may be because of the backward effect as a crude oil price rise will lead to an increase in running cost of automobiles leading to reduced demand for automobiles industry which will in turn lead to reduction in demand for automobiles ancillary products. The coefficient in case of impact on raw material cost is negative meaning there relationship no relationship as a crude oil price rise should lead to increase in raw material cost rather than decreasing.

Products of these industries are essential in nature with less or no substitutes at all therefore demand is inelastic, impact due to crude oil price changes is not significant on sales turnover but raw material costs get affected. Food products, paper, fertilizers don't have major substitutes but they use crude oil or its refined products in their manufacturing process thus any change in crude oil price will impact their raw materials cost (Table 12 & 13)

Table 7: Results for impact on production for industries, which showed no relationship with crude oil price changes.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Electrical machinery & apparatus n.e.c.	-0.238	0.49	0.48	1.02
Fabricated metal products, except machinery & equipment	0.208	0.45	0.44	1.27
Medical, precision & optical instruments, watches and clocks	0.13	0.41	0.39	0.58
Office, accounting & computing machinery	-0.05	0.45	0.44	-0.15
Other non-metallic mineral products	-0.107	0.25	0.24	-0.82
Publishing, printing & reproduction of recorded media	-0.008	0.48	0.47	-0.15
tobacco products	0.09	0.007	-0.0013	0.91
Wood and products of wood & cork except furniture	-0.097	0.004	-0.003	-0.717
Radio, TV and communication equipment & apparatus	-0.096	0.58	0.58	-0.83

Table 8: Results for impact on sales turnover for industries where both financial parameters were impacted.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Oil Refineries Industry	0.464	0.775	0.6627	-3.667
Chemicals and Dyes Industry	-0.16756	0.603	0.523	-2.756
Plastic Industry	-0.109	0.49	0.39	-2.2
Automobiles Industry	-0.144	0.25	0.11	-1.324

Table 9: Results for impact on raw material cost for industries where both financial parameters were impacted.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Oil Refineries Industry	0.503	0.58	0.51	2.882
Chemicals and Dyes Industry	0.4159	0.528	0.45	2.59
Plastic Industry	0.131	0.77	0.68	1.215
Automobiles Industry	0.112	0.18	0.0469	1.159

Table 10: Results for Impact on sales Turnover for Auto ancillary Industry.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Auto Ancillary Industry	-0.177	0.373	0.248	-1.726

Table 71: Results for Impact on raw material cost for Auto ancillary Industry.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Auto Ancillary Industry	-0.313	0.798	0.698	-3.086

Table 82: Results for impact on sales turnover for industries where only raw materials cost was impacted.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Paints industry	-0.03	0.06	-0.127	-0.565
Fertilizers Industry	0.343	0.48	0.396	2.36
Packaging Industry	0.316	0.21	0.0759	1.26
Personal-care Industry	-0.077	0.135	-0.037	-0.8855
Food Processing Industry	0.056	0.102	-0.076	0.756
Paper Industry	-0.197	0.34	0.085	-0.84

Table 93: Results for impact on raw material cost for industries where only raw materials cost was impacted.

Dependent Variable	Coefficients	R^2	Adjusted R^2	t-Statistics
Paints industry	0.3	0.44	0.35	2.18
Fertilizers Industry	0.4754	0.76	0.675	1.834
Packaging Industry	0.204	0.37	0.265	1.879
Personal-care Industry	0.477	0.357	0.25	1.82
Food Processing Industry	0.225	0.118	0.2445	1.39
Paper Industry	0.3276	0.246	0.1213	1.402

Conclusion

Current Indian government's policies are focusing on economic growth by developing a favourable environment for manufacturing sector, promotion of "MAKE IN INDIA" brand is a major step in this regard. For many industries crude oil or its refined products are major inputs therefore crude oil directly or indirectly impacts impact industries in varying degrees. For policy point of view it is important that an environment which is conducive and sustainable for manufacturing is provided. Therefore making it important to understand the impact of the king of resources, "crude oil's" impact on industries at a disaggregate level for the Indian economy. The study brings out a linear relationship which brings out facts that oil refinery, chemicals, paints are significantly impacted and lays a basis for further studies as there could be nonlinear impact of crude oil price changes which could be studied for industries like automobiles. Also those industries which have shown a significant correlation with crude oil price can be studied further to develop a model which brings forth variables that explain variance in performance of industries to a large extent.

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