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DETERMINANTS OF CRUDE OIL PRICES IN INDIA AND ITS IMPACT ON INDIAN ECONOMY

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Abstract

Crude oil is an essential energy source for practically every country and its people because of its impact on global development and daily life. Crude oil is vital to many parts of the economy, including those dealing with energy, manufacturing, transportation, and household goods. In June 2016, oil continued to be the most used fuel on Earth, making up 32.9% of total energy use, according to the BP statistical assessment of global energy. Crude oil's complicated market structure and unpredictable price swings are results of its meteoric rise to global commodity status since its commercial beginnings in the 1860s. There are a lot of things that go into deciding how much oil costs. These include supply and demand, government actions and decisions, MNCs, geopolitical conflicts, economic events, and groups like OPEC. Decisions, plans, and forecasts at the governmental, organizational, and individual levels can all benefit from a better understanding of the factors impacting the price of crude oil because of the essential role it plays in nearly every modern activity. This research aims to review the relevant literature on the subject in order to discover the elements that influence global crude oil prices.

1.1 INTRODUCTION

The oil market is comprised of a diverse array of industries that carry out a broad range of tasks within the petroleum industry, beginning upstream and continuing downstream. The majority of the world's crude oil is located in underground reservoirs, which are both inaccessible and highly prized. After the proper petroleum arrangements have been made, either a national company or a private business will extract the crude oil. Separation of crude oil from other byproducts, including water, natural gas, and potentially dangerous gases, organo metallic compounds, and basic sediment and water (BSW), occurs following extraction. It is thereafter sold and sent to refineries all around the globe via oil pipelines, tanker ships, and the like. Atmospheric distillation, hydro cracking, and blending are a few of the physical and chemical processes that refineries employ to turn crude oil into products that consumers and industrial customers can purchase. Gasoline, diesel, asphalt for new road building, power, plastics, petrochemicals, and countless other goods are the final stages of oil's journey to the consumer.

1.2 DETERMINANT OF THE CRUDE OIL PRICING SYSTEM

Oil reservoirs, which are most commonly found in sedimentary rocks, contain crude oil, which is an unprocessed, combustible liquid that occurs naturally and is mainly constituted of hydrocarbons. This resource, often called fossil fuel, is finite and nonrenewable, meaning it cannot be replenished by natural means once used up.

Commodity Pricing

The American Petroleum Institute (API) uses a 42-gallon barrel, often called a stock tank barrel (stb), and an atmospheric pressure of 60 degrees Celsius as its unit of international crude oil trading. Because of the wide variety of formation circumstances, crude oil exhibits a wide range of physical characteristics and quality standards. Density, pour point, sulfur content, API gravity, and color are some of the characteristics of crude oil.

Oils are mostly classified by their acidity index (AI) and sulfur content due to the fact that their characteristics vary. The monetary worth of oils is dependent on these two characteristics. The API gravity is a degree-based measurement that compares the oil's gravity to water's gravity. Lighter crude oil is associated with a higher API gravity. The sulfur content of an oil is a measure of the proportion of sulfur by weight in crude oil. Sour crudes include a high concentration of sulfur, whereas sweet crudes contain almost no sulfur at all.

Crude oils range from 5 oAPI to 55 oAPI in API gravity. Light crudes are between 35 and 45 degrees API, heavy oils are less than 25 degrees API, and average crudes are 25 to 35 degrees API.

Crude oils that are light and sweet are more valuable and often priced higher than crude oils that are heavy and sour. This is due to the fact that light sweet crude oil can be readily and inexpensively refined into gasoline and diesel fuel, despite these products selling for a premium over residual fuel oil and other "bottom of the barrel" goods. This refining process also requires far less energy and sophistication. It is more expensive to treat sour crudes since they are caustic.

Refining companies' willingness to pay per barrel of crude oil is affected by factors such as the amount of entrained water and salt content, which are independent of the country of production. Brent Blend (North Sea, Europe), West Texas Intermediate ("WTI" in the US), and the OPEC reference basket consisting of thirteen (Bonny Light, Arab Light, etc.) blends from member nations of OPEC are among the most important crude oil price benchmarks. There is a strong correlation between the prices of these benchmark crudes; for many years, the margin between WTI and Brent was about $1.44, but it has been about equal for decades.

To trade these different oil blends, oil providers and buyers gather on commodity markets. Options, futures, and physical delivery of crude oil and other oil products are traded on commodity exchanges. New York City's New York Mercantile Exchange (NYMEX) and London and Atlanta's Intercontinental Exchange (ICE) are two of the most important oil trading platforms. You can see the density and sulfur concentration of several crude oil blends.

Factors that Account for Crude Oil Price

Supply and Demand

The oil price is influenced by the fundamental law of demand and supply. The rule of thumb is that prices should rise as demand rises and fall when supply falls. The market forces of supply and demand from a specific period are reflected in the prices of oil and gas reserves. Crude oil product prices fluctuate in response to changes in supply and demand, with the goal of balancing present and future production. Conversely, when prices are high, production increases, and supply levels rise, leading to a decline in the price of oil and its derivatives.

Production

The "Seven Sisters" were a group of seven western oil companies that controlled the market until the 1970s. They were responsible for major advancements in the oil field and had operations all over the globe. Anglo-Persian Oil, Gulf Oil, Texaco, Standard Oil of California, Royal Dutch Shell, Standard Oil of New Jersey, and Standard Oil of New York were the seven sisters that made up the Seven Sisters. Global oil production was nationalized to a considerable extent following the political events and oil crisis of the 1970s. Although they own just under 5% of the world's oil reserves now, multinational corporations continue to have a significant role in shaping the oil market and the petroleum industry. For example, in the Middle East, the countries with the biggest oil reserves also happen to be the biggest oil producers. While some developed economies have reduced their reserve-to-production ratio by making better use of their reserves, others are seeing a fall in production as a result of depleting their reserves, even though they produced at higher rates. Despite having fewer reserves, the United States and Russia in particular produce at a fairly high rate.

Some of the world's most powerful oil exporters have used OPEC as a conduit for their interests since the 1970s. As a sister organization of the OECD (Organization for Economic Co-operation and Development), the International Energy Agency (IEA) provides just a semblance of representation for other oil producers. Russia, China, and India are major consumers and producers, but they aren't members of either group.

Because oil is a nonrenewable natural resource, its availability around the world is contingent on factors such reservoir location, oil quantity and physical qualities, and the underlying geological formation. The extraction costs from a specific reserve are determined by some of these physical characteristics. Furthermore, finding and developing new reservoirs requires time and major cost. Therefore, oil prices in the near future are driven by factors that influence the world's oil production from existing fields in countries that export oil.

Conversely, technological advancements have lowered the cost of producing marginal oil and expanded the quantity of crude oil. Horizontal drilling and enhanced oil recovery are two examples of the new technologies that have raised the bar for reservoir recovery and production capacity. Technological improvements have made it possible to tap into previously unreachable oil deposits in deep offshore locations, and they have also decreased the cost of obtaining and treating unconventional oil reserves.

Consumption

Refined oil products are what generate the demand for crude oil. Consumption rates vary greatly among regions, with rich OECD nations like the UK, Germany, Luxembourg, and Denmark accounting for almost half of global demand. Crude oil is

in high demand from a variety of industries; nevertheless, the transportation and industrial sectors account for over 85% of the world's total, with the remaining 15% coming from residential, commercial, electric power generation, and heating. Transportation, on the other hand, relies nearly entirely on crude oil products for its energy demands, while industries can find alternatives in coal and hydroelectricity. Substituting technologies have struggled to acquire traction, even when oil prices have risen, because the transportation infrastructure and industry have been constructed around oil products during long decades of cheap fuel prices. Power generation and industrial heat are the primary uses of oil in the industrial sector. Additionally, polymers, industrial chemicals, and asphalt are made from these raw materials.

Late in 2013, China's oil consumption rates surpassed those of the United States, the world's second-largest importer of liquid fuels, largely due to the country's booming economy. The Energy Information Administration projects that China will consume 3 million additional barrels of oil per day in 2020 compared to 2012, making up approximately 25% of the increase in world demand during that period.

Organization of Petroleum Exporting Countries (OPEC)

At the Baghdad Conference on September 10–14, 1960, Venezuela, Iran, Iraq, and Kuwait formed the Organization of the Petroleum Exporting Countries (OPEC), a permanent intergovernmental organization. As of 2015, thirteen member nations have joined the original five, including Nigeria in 1971 and Libya in 1962. An efficient, economical, and consistent supply of petroleum to nations that use it; a reasonable return on investment for individuals who put money into the business; and fair prices for petroleum producers are the goals of OPEC's coordinated and unified petroleum policies.

OPEC has a significant impact on oil prices worldwide because its members produce 42% of the world's oil and have 73% of the world's "proven" oil reserves. International laws and the oil market are now heavily influenced by OPEC decisions. When disputes or public disturbances cause intermittent and inconsistent disruptions in supplies, the effect might be amplified. There were far-reaching and long-lasting effects on the world economy as a result of the enormous price rises and OPEC's income and riches caused by output limitations in the 1970s. Oil prices tend to rise when OPEC members reduce their production targets, which the organization began doing in 1980.

Futures Market

We may thank the oil futures market for determining the current price of oil. Oil futures contracts are legally binding agreements that grant the right to buy barrels of oil at a future date and price. Clients buy futures to protect themselves from the negative effects of crude price fluctuations on profitability. Oil producers may decide to hold off on selling their oil until later in the hopes of making a bigger profit if futures prices are higher than spot prices, which leads to higher expectations of future pricing. This has the potential to significantly impact oil prices by reducing the present supply.

Speculators and Brokers

Oil price movements are influenced by market speculators and brokers. Someone who bets on the future of a product's price without planning to purchase it is considered a speculator. Since less than 3% of futures contracts really lead to the buyer

actually owning the commodity, most futures trading is done by speculators, says the Chicago Mercantile Exchange (CME).

Speculators were believed to be driving up oil prices to an unsustainable level of $140 per barrel in 2008 due to their bidding wars. There was insufficient demand to sustain the high price level, and by the end of 2009, prices had dropped to $30 a barrel.

Oil price movements are also heavily influenced by market sentiment. For instance, as speculators and hedge funds buy up oil futures contracts, the simple expectation of a future spike in oil demand can cause current oil prices to skyrocket.

Exchange Value of the Dollar

People around the world use their local currencies to purchase petroleum products, while traders use US dollars to transact crude oil. As the value of the dollar falls against other currencies, oil becomes more affordable for countries whose currencies do not appreciate against the dollar, while countries whose currency are pegged to the dollar end up paying more for the same amount of oil. There will be repercussions for global oil consumption as a result of dollar fluctuations. The purchasing power of one dollar will diminish when the value of the US dollar falls relative to other currencies. Crude oil prices will rise as a result of increased demand in currencies other than the US dollar. Therefore, it is anticipated that the US dollar exchange rate will have a negative correlation with fluctuations in the price of crude oil.

Government in Consumer and Producer Countries

The availability, production, and use of oil are heavily influenced by political actions, as governments hold around 94% of the world's proved reserves.

Subsidies on petroleum products for transportation, farming, industry, and other sectors are another tool governments use to rein in inflation. Subsidies protect specific industries from the impact of rising oil prices. Subsidized nations see little to no reaction from price fluctuations in crude oil demand. Approximately 96% of the increase in global oil consumption in 2007 came from nations like China, India, Ghana, and Bahrain that either currently or previously subsidize gasoline and other oil products, according to BP's estimations.

Political Tensions

War, terrorism, and guerilla actions stemming from political unrest or conflict deplete the world's oil reserves. Oil output and pricing have been greatly affected by political instability in countries, particularly in oil-producing zones like the Middle East. The resurgence of long-suppressed animosity between nations and indigenous communities, rifts in religious beliefs, and struggles for access to scarce resources like petroleum are all potential causes of such conflicts.

Economic Factors

Oil prices are very sensitive to changes in the economies of the countries involved, as are the pricing of many other commodities. Oil consumption and demand across all industries rises in tandem with rising economies, industries, and

populations, and falls in tandem with recessions. The United States and China, two of the world's largest oil consumers, will see their need for oil rise in tandem with their economies, driving up oil prices.

Natural Factors

Oil demand follows the ebb and flow of weather patterns, like that of most commodities. In the winter, heating oil consumption is higher, and in the summer, gasoline consumption is higher due to increased driving. Seasonal fluctuations in oil prices occur annually, despite the fact that markets are aware of when to anticipate these spikes in demand. In areas rich in oil reserves, natural disasters like hurricanes, tsunamis, and thunderstorms pose a particular threat to production facilities and infrastructure, which in turn can interrupt oil supplies and cause price spikes.

Other Energy Sources

Whether the price of crude oil will have an effect on renewable energy and other energy industries is an open question. Legislative requirements, competing alternatives, and different regional effects are all factors that need to be thought about. As other energy technologies have advanced and their capital costs have been steadily falling, our reliance on crude oil has been decreasing.

Refinery Capacity

The world's refineries can process a maximum of crude oil per year, divided by the total number of days in that year. This is called the global refinery capacity or utilization. How much refined oil is available for consumption is directly related to how productive and efficient refineries are. Refinery outages and disruptions can temporarily reduce the availability of petroleum products. Therefore, crude oil prices are affected by changes in refinery output and processing capabilities.

In 2010, Olimb and Ødegård made the statement that crude oil prices are influenced by refinery utilization rates, which are determined by the capacity of refineries to transform crude oil into finished goods. An increase in crude oil and petroleum products could be a result of a shortfall in supplies, which could be indicated by high refinery utilization rates. In contrast, if refinery capabilities are high, it could mean that there will be an excess of petroleum products on the market, which would lead to price drops. It went on to stress the importance of crude oil features and qualities in determining the quality and, by extension, the price of different crude oil benchmarks.

1.3 DETERMINANT OF CRUDE OIL PRICES IN INDIA USING THE VECTOR AUTO REGRESSIVE MODEL (VAR)

This section has empirically estimated the determinant of crude oil prices in India using the Vector Auto Regressive Model (VAR). The analytical process starts with the formulation of theoretical assumptions and analytical equations that characterize the underlying theoretical connection. To ensure that the time series variables are not non-stationary, a pre-requisite for co-integration is to assess their presence of a unit root using the Augmented Dickey-Fuller (ADF) test.

1.3.1 ECONOMETRIC MODEL: CRUDE OIL PRICES MODEL

COP= f (GDP, SC, DC, IC, ER, I, CAD/BOP)

COP(Crude oil prices), GDP(Gross domestic product), SC(Supply of crude oil), DC(Demand for crude oil), IC(Import of crude oil), ER(Exchange rate), I(Inflation) and BOP(Balance of payment)/CAD(Current account deficit)

$COPt = \alpha0 + \alpha1\ GDPt + \alpha2SCt + \alpha3\ DCt + \alpha4\ ICt + \alpha5\ ERt + \alpha6\ It + \alpha7\ BOPt + \mu t$

First, we determined the primary variables that affect crude oil prices by calculating the correlation coefficient and P value.

There are a number of factors that affect the price of crude oil, but the most important ones are the GDP and inflation rate. The crude oil price is positively connected with all factors except BOP (-0.78001), which is negatively correlated. Additionally, there is a strong correlation between Indian crude oil prices and the following variables: 0.97436 for worldwide crude oil prices, 0.94419 for India's crude oil imports, 0.93726 for GDP at constant price, and 0.9203 for India's crude oil consumption.

1.3.2 EMPIRICAL ANALYSIS USING JOHANSEN COINTEGRATION AND VECTOR AUTO REGRESSIVE MODEL (VAR MODEL)

We followed a three-step process to identify time series variables. To start, check if the variables are stationary using the Augmented Dickey Fuller (ADF) test. If they are, then figure out what order to integrate them. Second, the Johansen method of co-integration can be used to detect long-term relationships if the variables are integrated in the same order, for example, I (1). At last, we have the VAR model.

Unit Root Test

The majority of economic time series display non-stationarity or trending behavior. Finding the best data fluctuation form is a significant econometric task. In order to do additional analyses and statistical tests for co-integration, it is necessary to model the data series and convert them to stationary form. Some sort of trend elimination is necessary if the data are showing fluctuations. initial differencing is a common method for de-trending or removing trends from data. To find the initial differences and make the data stable, one can utilize unit root tests. Likewise, the co-integration equation requires that all time series integrate in the same direction. Finding out if our equation variables are stationary or not was the next step in the research.

Augmented Dickey-Fuller Test

The study tested the order of integration using an ADF t-test. A time series sample can be tested for the unit root using the enhanced dickey fuller test. For a more extensive and intricate set of time series models, it is an enhanced variant of the dickey fuller test (Swamy, Chakravarthy, and Koka, 2014).

Data series at levels show a steady trend as well as a linear one across time. So, here is how the ADF test is formulated:

$$\Delta z_t = \alpha_0 + \theta z_{t-1} + \gamma_\tau + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \ldots\ldots + \alpha_p \Delta z_{t-p} + a_t$$

Our initial observation was that there is only a constant, and no discernible trend. Therefore, the following is its ADF model:

$$\Delta z_t = \alpha_0 + \theta z_{t-1} + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \ldots\ldots + \alpha_p \Delta z_{t-p} + a_t$$

where, Δ is the first difference operator, zt is the variable being considered, α_0 is the intercept constant, t is the time trend, θ is the coefficient presenting process root, i.e. the focus of testing, γ coefficient on the time trend), at (random error term), p (lag- length) which was determined by using Schwarz Bayesian Information Criterion (SBIC).

Verifying the determinant GDP constant's stationary

One can check for stationary in various ways. This research made use of the Augmented Dickey-Fuller test. All of the remaining factors have been subjected to this evaluation.

Stationary Check

Table 1.1 Augmented Dickey-Fuller Test

Type 1: no drift no trend			
	Lag	ADF	p. value
	[1]	0 20.46	0.99
	[2]	1 4.38	0.99
	[3]	2 4.11	0.99
	[4]	3 3.02	0.99
Type 2: with drift no trend			
	Lag	ADF	p. value
	[1]	0 10.90	0.99
	[2]	1 4.14	0.99
	[3]	2 4.32	0.99

	[4]	3 3.30	0.99
Type 3: with drift and trend			
	Lag	ADF	p. value
	[1]	0 2.47	0.99
	[2]	1 1.85	0.99
	[3]	2 2.04	0.99
	[4]	3 1.83	0.99

Take note: really, p .value = 0.01 signifies that p .value <= 0.01.

According to the p-value in the results, the data was not stationary for the determinant "GDP_CONSTANT" and for all of the other determinants as well.

Phase 2 (Variation to Check for Stationary)

To ensure that the data was stationary, we utilized first-level differentiation for all determinants and refrained from doing log transformations.

The crude oil price curve for day 1 is equal to the difference between the crude oil price and day 1. A1=diff(GDP Constant) is the GDP constant. The output is the difference between the current GDP and GDP_Current. The output is the difference between the exchange rate and the d1 rate. Difference between BOP and BOP_d1Ensuring Stationary Following Initial Level Differentiation.

Table 1.2 Augmented Dickey-Fuller Test

Type 1: no drift no trend			
	Lag	ADF	p. value
	[1]	0 -5.12	0.0100
	[2]	1 -2.94	0.0100
	[3]	2 -3.44	0.0100
	[4]	3 -2.18	0.0313

Type 2: with drift no trend			
	Lag	ADF	p. value
	[1]	0 -5.04	0.0100
	[2]	1 -2.87	0.0667
	[3]	2 -3.54	0.0170
	[4]	3 -2.28	0.2289
Type 3: with drift and trend			
	Lag	ADF	p. value
	[1]	0 -4.94	0.0100
	[2]	1 -2.78	0.2667
	[3]	2 -3.83	0.0322
	[4]	3 -2.57	0.3433

Take note: really, p .value = 0.01 signifies that p .value <= 0.01.

It was found that all of the variables have roots in the unit root. Their non-stationary at higher-order differences is demonstrated by the unit root, although their stationary at the first difference is evident.

Table 1.3 Empirical Analysis of Co-Integration Test for Factors Influenced by Indian Oil Price

Combinations	p-value of residuals at ADF
Indian crude oil Price & GDP –constant price	.9092
Indian crude oil Price & GDP –current price	.2212
Indian crude oil Price & BOP	.5618

Co-Integration Test

The results suggested that it would be impossible to form co-integrating connections. All of the independent variables had P-values higher than the significance levelAccordingly, the co-integrating relationship's first need has been met. As for the residuals, the second condition to be co-integrated. It shows that the variables aren't integrated with one other. It suggests

that there is no long-term correlation between the two sets of variables.

VAR Model: For the purpose of estimating the relationships among numerous time series, vector auto-regression—a stochastic process model—is employed. By including support for several evolving variables, models expand upon the uni-variate auto-regressive model.

1.4 FORECAST VALUES

Using the best estimations from the models, crude oil prices for next six years have been anticipated.

Table 1.4 Forecast values (rs/bbl.) and confidence interval CI(90%)

Years	Forecast	Lower	Upper	CI(90%)
2016	4752.2	4214	5291	538.4
2017	-4470.0	-5618	-3322	1147.8
2018	6503.3	4992	8014	1510.9
2019	3612.3	1979	5246	1633.5
2020	-3371.7	-5084	-1659	1712.5
2021	-491.7	-2376	1393	1884.6

This research looked at the main variables that affected oil prices in India from 2016 to 2021. Johansen co-integration and Augmented Dickey-Fuller unit root tests were among the time series econometric methods employed in the research. All variables were found to be stationary in the first difference according to the ADF unit root test results.

1.5 CONCLUSION

The present price of crude oil is highly dependent on the past values of that price with a lag of 2 or 3 years, as well as on the exchange rate with a lag of 3 years. Historical GDP numbers, with lags of two years, have a substantial impact on the price of crude oil. The present price of crude oil is greatly influenced by GDP constant values with one and three year lags in history. Crude oil is highly sensitive to the last three years' worth of BOP values. Our investigation shows that the most significant variables, both positively and negatively, can be predicted using VAR with 95% and 90% confidence intervals, respectively. Exchange Rate d1.l3 was determined to be the most positively significant variable, whereas BOP d1.11 was determined to be the most negatively significant.

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