

# **“ATTEMPTING AN IN-DEPTH STUDY OF THE GLOBAL CONSUMPTION OF CRUDE OIL AND ENERGY SECTOR USING LINEAR REGRESSION TO DEVELOP A CALIBRATING FRAMEWORK AND ANALYTICS MODEL OF CRUDE OIL PRICES.”**

**TRIPTI PANCHAL**

*GARGI COLLEGE, UNIVERSITY OF DELHI*

---

The Indian economy keeps on appearing financial development. The nation's real gross residential item (GDP) developed at a noteworthy rate of 9.1 percent amid the primary portion of financial 2006 (April – September 2006), subsequent to developing by 8.7 percent in fiscal 2005. Together with the nation's amazing development, India has additionally turned into a huge shopper of vitality assets. As indicated by EIA gauges, India was the fifth biggest purchaser of vitality on the planet amid 2006. There are two sources of energy:

➤ **Non-Commercial Sources**

- Solar energy
- Wind energy
- Geothermal energy
- Biomass

➤ **Commercial Sources**

- Petroleum
- Coal
- Natural gas
- Electricity
- Nuclear energy

However, over the last fifty years, the most significant shift in India's energy consumption was the replacement of non-commercial energy sources with commercial sources.

Energy use has been integral to the advancement of the world economy over numerous hundreds of years and stays pivotal for reducing poverty, extending financial chances, giving light, warmth, and versatility, and improving the welfare of all of us. To the fore are petroleum products that give over 90% of the world's all out business vitality needs, with oil the main source in the worldwide vitality blend.

### India's Energy Profile

Different patterns of production, utilization, net imports, and reserves of petroleum in 2005-2006 are given in table 1.1

#### Petroleum

Various trends in production, consumption, net imports and reserves of crude oil in 2005-2006 are given in table 1.1:

Year	2005	2006
Crude oil production	32.19	33.99
Crude oil consumption	130.11	146.55
Net exports/ imports	-99.41	-110.86
Proved reserves	786	756

Source: Ministry of Petroleum and Natural Gas

#### Natural Gas

Different patterns of production, utilization, net imports and reserves of natural gas in 2005-2006 are given in table 1.2:

Year	2005	2006
Production	1056	1067
Consumption	1269	1349
Net exports/ imports	-213	NA
Proved reserves	32525	38880

Source: Ministry of Petroleum and Natural Gas

#### Coal

Different patterns of production, consumption and net exports of coal in 2005-2006 are given in table 1.3:

Year	2005	2006
Production	473.172	497.181
Consumption	507.315	542.787
Net export(trillion btu)	1018.832	1075.331

Source: Ministry of Petroleum and Natural Gas

**Electricity**

Details of net energy generation, net consumption, and installed capacity are given in table 1.4:

<b>Table 1.4: Generation, Consumption &amp; Installed Capacity of Electricity</b> (billion kilowatt hours)		
Year	2005	2006
Net generation	661.64	NA
Net consumption	488.53	NA
Installed capacity (Gwe)	137.578	NA

Source: Ministry of Petroleum and Natural Gas

Tables 1.1 - 1.4 shows that **energy consumption in India is growing at a rate faster than the production** and will continue to grow with increasing population which is projected at about billion by the end of XIth plan (2011-12).

To sum up, **challenges** faced by the Indian energy sector are:

- Coal depletion and pollution,
- Rising oil imports.
- Natural gas demands.
- Inefficient electric systems.
- Energy-related water shortages.
- Limited nuclear energy.

Hence, considering the linkage between GDP growth rate and energy consumption growth, there is an urgent need to switch over to a fresh approach, which emphasizes:

- Innovative and inter-disciplinary research targeting focusing on achievements in new innovations and procedures.
- Energy conservation through public education
- Reducing leakages and losses by an appropriate mix of policies and technologies.
- Adequate, affordable and environmentally sustainable supply of energy is one of the fundamental parameters for the economic growth of any country. At the same time, the detachment of the world among created and creating nations mirrors the division between the individuals who have a high for every capita utilization of vitality and the individuals who either don't have adequate vitality or can't tackle it. Earnest endeavors are should have been made to make a worldwide situation wherein each country motivates impartial chances to develop and the hole regarding vitality asset among creating and created nations is diminished

***Petroleum Industry***

Economic development in the past was joined by developing oil utilization. Be that as it may, as of late the development of the supply of oil has been abating and generation has now for all intents and purposes achieved a level. This has occurred in spite of verifiably high oil costs. As indicated by numerous specialists, in 2006-2007 world's oil industry had hit crest creation and has entered the primary period of progress to a dubious future that is world oil generation will begin to decay at first most likely increasing rates.

Crude oil is a mineral oil of regular birthplace including a blend of hydrocarbons and related polluting influences, for example, sulfur. Raw petroleum is the most imperative vitality bearer at a worldwide scale. In 2006 - 2007, around 35 percent of the world's essential vitality utilization is provided by oil, trailed by coal with 25 percent and naturalgas with 21 percent. Transport depends to well more than 90 percent on oil, be it transport on streets, by boats or via flying machines. Consequently, the economy and the way of life of industrialized social orders depends vigorously on the adequate supply of oil, additionally, most likely likewise on the supply of shoddy oil

***World Scenario***

Table 2.1 gives a brief picture of World top Oil Producers, Consumers, Exporters, Importers as in FY 2006-07.

**Table 2.1: World Top Oil Producers, Consumers, Exporters, Importers (2006-07)***(thousand barrels per day)*

Oil Producers	Production	Oil Consumers	Consumption	Oil Exporters	Exports	Oil Importers	Imports
Saudi Arabia	10665	United states	20687	Saudi Arabia	8525	United states	12357
Russia	9677	China	7201	Russia	6866	Japan	5031
United states	8330	Japan	5159	UAE	2564	China	3356
Iran	4148	Russia	2811	Norway	2551	Germany	2514
China	3845	Germany	2665	Iran	2462	Korea,South	2156
Mexico	3707	India	2572	Kuwait	2340	France	1890
Canada	3288	Canada	2264	Venezuela	2183	India	1718
UAE	2945	Brazil	2217	Nigeria	2131	Italy	1568
Venezuela	2803	Korea,South	2174	Algeria	1842	Spain	1562
Norway	2786	Saudi Arabia	2139	Mexico	1710	Taiwan	940

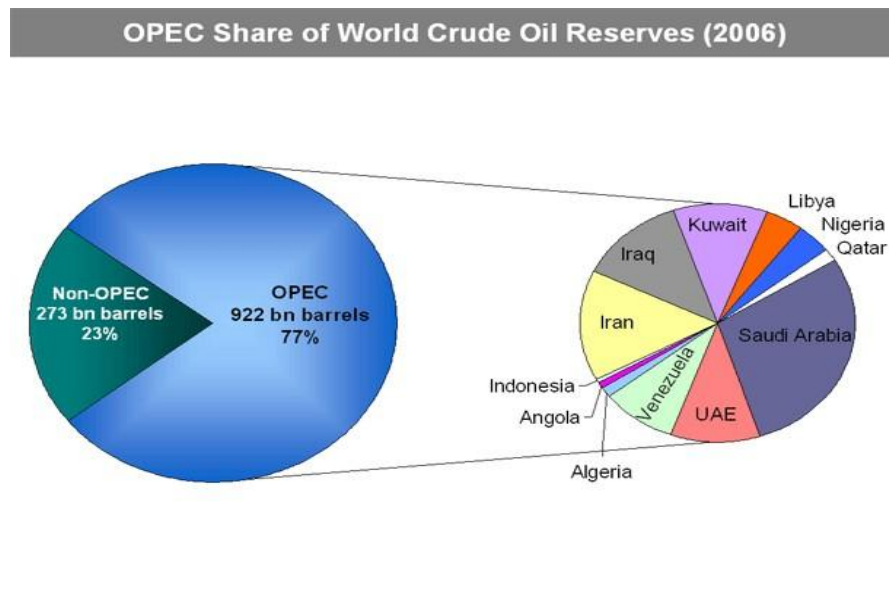
*Source: OPEC bulletin*

***Organization of the Petroleum Exporting Countries (OPEC)***

Members: Algeria (1969), Indonesia (1962), the Islamic Republic of Iran (1960), Iraq (1960), Kuwait (1960), the Socialist People's Libyan Arab Jamahiriya (1962), Nigeria (1971), Qatar (1961), Saudi Arabia (1960), United Arab Emirates (1967), Venezuela (1960).

OPEC Basket: the OPEC Reference Basket price — which was introduced on January 1, 1987 — is the arithmetic average of seven selected crudes. These are: Saharan Blend (Algeria); Minas (Indonesia); Bonny Light (Nigeria); Arab Light (Saudi Arabia); Dubai (United Arab Emirates), Tia Juana Light (Venezuela), and Isthmus (Mexico). Mexico is not a Member of OPEC.

OPEC, with near 80% of world crude oil reserves, has an unmistakable fascination in investigating the conceivable prospects for oil, from both interest and supply points of view, to help set up the nature, degree, and size of the difficulties and openings that may lay ahead.



Source: OPEC Annual Report.

### Global Price Scenario

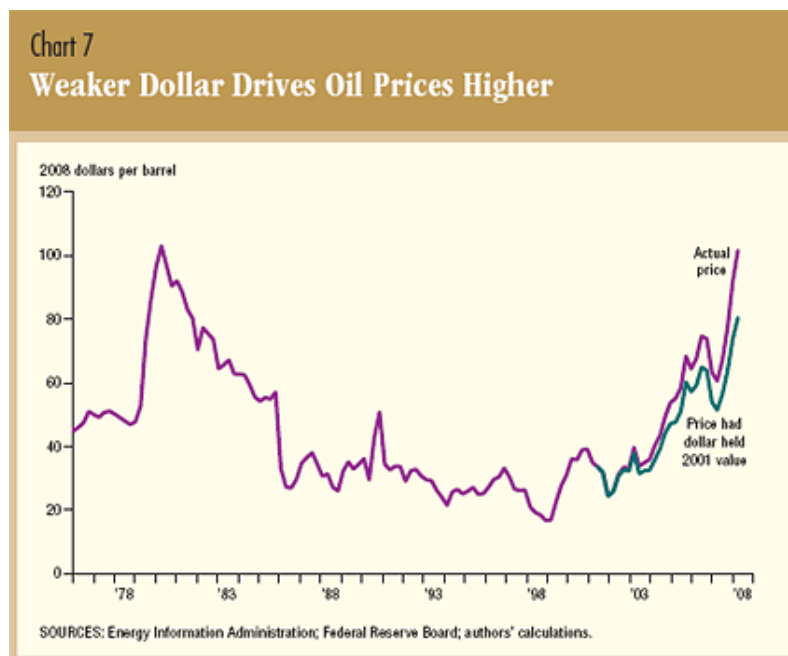
Till early September last year oil was trading below \$70 a barrel in the wake of US sub-prime mortgage fiasco. As a consequence of some half hearted US measures, the sub-prime pressures eased and the oil prices resumed upward flight. The measures did not prove effective enough and the crises erupted again pushing the US economy in turmoil. The depreciating dollar made the speculators move to some more attractive markets like gold and silver. The investment in the world oil sectors could not keep pace with the rising global demand for oil. Oil has broken through the landmark \$100 a barrel in early 2008 rather is setting new records almost everyday, driven by a slumping dollar, geopolitical instability and worries over a winter fuel supply crunch.

Modern economies keep running on oil, so it's essential to see how ongoing years—with their flooding costs—vary from the former two decades. A decent beginning stage is solid interest, which has pushed world oil advertises near limit. New supplies haven't stayed aware of this interest, energizing desires that oil markets will stay tight for a long time to come. A debilitating dollar has put upward weight on the cost of a ware that exchanges the U.S. cash. What's more, on the grounds that an extensive offer of oil generation happens in politically temperamental areas, fears of supply interruptions linger over markets. These factors have encouraged the enduring, here and there quick ascent of oil costs as of late. Their industriousness proposes the times of generally shoddy oil are finished and the global economy faces an eventual fate of high vitality costs. How they play out will shape oil advertises—and decide costs—for a considerable length of time to come.

### **Reasons for Oil Price Hike**

#### **1) Dollar Weakness:**

The vast majority of the dollar's value affect happened toward the finish of the period. With regards to alterations in oil utilization and generation, a declining dollar sets aside opportunity to reshape raw petroleum costs since desires don't move rapidly. Variables that push up desires for future costs, notwithstanding, additionally put upward weight on spot costs since business sectors will change until the point that financial specialists are detached among holding and moving the peripheral barrel of raw petroleum on the spot advertise.



2) **Demand:** Robust demand for crude and a weak dollar have fuelled the rally from a dip below \$50 at the start of 2007.

3) **Funds:** Since the Federal Reserve cut US interest rates in mid August last year and central banks pumped billions of dollars into financial markets to ease a credit crunch, oil and gold have risen.

### *Linear Regression Analysis of Consumption of Crude Oil in India*

The purpose is to see how consumption of crude oil depends upon production of crude oil, income, alternative fuel consumption (renewable), price of crude oil, index of industrial production.

#### **Data**

Year	Consumption	Production	IIP	Alternative	Price Oman	Income
1993	478540.55	194910	100	69.86	15.77	53318
1994	515843.55	215313.5	109.1	82.08	15.12	56863
1995	574754.55	256759.25	123.3	72.34	16.34	61166
1996	613535.8	237625.95	130.8	69.07	19.12	65796
1997	644403.85	246239.95	139.5	74.85	18.52	68463
1998	763195.05	241418.3	145.2	83.19	12.02	72696
1999	741406.25	238220.9	154.9	82.2	17.27	78071
2000	776515.6	235914.1	162.6	76.6	26.5	81229
2001	797061.45	234476	167	76.82	22.75	85457
2002	826155.6	242633.75	176.6	67.77	23.94	88639
2003	856410.45	240910.95	189	79.79	27.14	96069
2004	886811.3	249335.15	204.8	89.96	34.35	104077
2005	889870	242600.9	221.5	106.68	50.48	113673

Unit: Consumption and Production in Thousands Barrels

Price in Dollars

Alternative Fuel Consumption in Billion Kilowatt hours

Income in Billion Rupees.

#### **Methodology**

The method used for regression analysis is estimation by least squares. Consumption of crude oil depends upon production of crude oil, income (GDP), price, consumption of alternative fuel, index of industrial production, no. of vehicles registered in India and net imports. However because of unavailability of data and sampling fluctuations we are not taking into account no. of vehicles registered and net imports. Hence in the model, consumption of crude oil is the dependent variable and price Oman (price Oman, sour crude, is used as a proxy for the price of Indian crude basket as Indian crude basket consists of sweet and sour crude, of which sour crude has a major share), production of crude oil, income (GDP), consumption of alternative fuel, index of industrial production are independent variables. However, to prevent the error of

autocorrelation, we will run a separate regression wherein consumption of crude oil will be the dependent variable and income that is GDP will be the independent variable. We have taken a time series annual data from 1993 to 2005.

**Results**

**(Consumption of crude oil as dependent variable and IIP, alternative fuel consumption, production of crude oil, price as dependent variable.)**

Total Observations 13 Degree of freedom 8  
 R Squared 0.9839 Adjusted R Squared 0.9759  
 Sum of Squared Residuals 3.7921e+09  
 Regression F (4, 8) 122.54  
 Significance Level of F 0.00000000

Source	SS	df	MS	
Model	2.3235e+11	4	5.8087e+10	Number of obs = 13
Residual	3.7921e+09	8	474015104	F( 4, 8) = 122.54
Total	2.3614e+11	12	1.9678e+10	Prob > F = 0.0000

R-squared = 0.9839  
 Adj R-squared = 0.9759  
 Root MSE = 21772

consumption	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
production	-0.4958196	.5170738	-0.96	0.366	-1.688194 .6965547
iip	5574.248	416.6307	13.38	0.000	4613.496 6535
alternative	-204.4483	899.2901	-0.23	0.826	-2278.215 1869.318
priceoman	7084.591	1421.646	-4.98	0.001	-10362.91 -3806.27
_cons	320200.8	184141.4	1.27	0.240	-121719.6 419759.9

**(Consumption of crude oil as dependent variable and income as independent variable)**

Total Observations 13 Degree of freedom 11  
 R Squared 0.8946 Adjusted R Squared 0.8850  
 Sum of Squared Residuals 2.4892e+10  
 Regression F (1, 11) 93.35  
 Significance Level of F 0.00000000



Source	SS	df	MS	Number of obs =	13
Model	2.1125e+11	1	2.1125e+11	F( 1, 11) =	93.35
Residual	2.4892e+10	11	2.2629e+09	Prob > F =	0.0000
Total	2.3614e+11	12	1.9678e+10	R-squared =	0.8946
				Adj R-squared =	0.8850
				Root MSE =	47570

consumption	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
income	7.217351	.7469852	9.66	0.000	5.573247	8.861454
_cons	150999.1	60385.56	2.50	0.029	18091.38	283906.8

### *Linear Regression Analysis of Crude Oil Prices*

To see how price of crude oil depends upon demand and supply of crude oil.

**Data** (million barrels):

	Demand	supply	Price WTI
1996-1	6679.4	6561.1	19.64
1997-1	6633	6678	22.84
1998-1	6687	6939	15.98
1999-1	6903	6813	13
2000-1	6997.9	6888.7	28.81
2001-1	7029	7020	28.72
2002-1	6993	6885	21.57
2003-1	7182	7146	34.19
2004-1	7489.3	7471.1	35.18
2005-1	7641	7569	49.47
2006-1	7668	7668	63.23

### **Methodology**

The method used for regression analysis is estimation by least squares. Price of crude oil depends upon World crude oil demand and World crude oil supply. Hence in the model, price of crude oil( Price of WTI is taken as proxy for price of crude oil as WTI is US crude oil and US crude oil is largely traded ) is the dependent variable and demand for crude oil and supply of crude oil are independent variables. We have taken a time series quarterly data from 1996 to 2006.

**Results**

Total Observations 44 Degree of freedom 41  
 R Squared 0.7836 Adjusted R Squared 0.7731  
 Sum of Squared Residuals 2370.38  
 Regression F (2 , 41) 74.25  
 Significance Level of F 0.00000000

Source	SS	df	MS	Number of obs = 44
Model	8585.57723	2	4292.78862	F( 2, 41) = 74.25
Residual	2370.38062	41	57.8141616	Prob > F = 0.0000
Total	10955.9579	43	254.789718	R-squared = 0.7836
				Adj R-squared = 0.7731
				Root MSE = 7.6036

pricewti	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
demand	.0043154	.0102576	0.42	0.676	-.0164002	.025031
supply	.0322373	.0102228	3.15	0.003	.011592	.0528827
_cons	-229.1491	21.59551	-10.61	0.000	-272.7621	-185.536