Crude Oil Price Fundamentals & Technicals - An Analytical Study

A Dissertation report submitted in partial fulfillment of the requirements for MS-Oil Trading (2005-07)

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DECLARATION BY THE GUIDE

This is to certify that the dissertation report on "***Crude Oil Price Fundamentals & Technicals - An Analytical Study***" submitted to the University of Petroleum & Energy Studies, Gurgaon, by **Parimal Srivastava**, in partial fulfillment of the requirement for the award of the degree of Masters of Science (Oil Trading) is a bonafide work carried out by him under my supervision and guidance.

This work has not been submitted anywhere else for any other degree/diploma.

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Executive Summary

In the absence of new government policies, the world's energy needs will rise inexorably. In the Reference Scenario, world primary energy demand is projected to expand by more than half between now and 2030, an average annual growth rate of 1.6%. By 2030, the world will be consuming 16.3 billion tonnes of oil equivalent - 5.5 billion toe more than today. More than two-thirds of the growth in world energy use will come from the developing countries, where economic and population growth are highest. The international energy prices that underpin these projections have been revised upwards from last year's Outlook. The average IEA crude oil import price is now assumed to ease to around $35 per barrel in 2010 (in year-2004 dollars) as new crude oil production and refining capacity come on stream. It is then assumed to rise slowly to $37 in 2020 and $39 in 2030. In nominal terms, the price will reach $65 in 2030. Fossil fuels will continue to dominate energy supplies, meeting more than 80% of the projected increase in primary energy demand. Oil remains the single most important fuel, with two-thirds of the increase in oil use Executive Summary 45 coming from the transport sector. Demand reaches 92 mb/d in 2010 and 115 mb/d in 2030. The lack of cost-effective substitutes for oil-based automotive fuels will make oil demand more rigid. Natural gas demand grows faster, driven mainly by power generation. It overtakes coal as the world's second-largest primary energy source around 2015. The share of coal in world primary demand falls a little, with demand growth concentrated in China and India. The share of nuclear power declines marginally, while that of hydropower remains broadly constant. The share of biomass declines slightly, as it is replaced with modern commercial fuels in developing countries. Other renewables, including geothermal, solar and wind energy, grow faster than any other energy source, but still account for only 2% of primary energy demand in 2030. The world's energy resources are adequate to meet the projected growth in energy demand in the Reference

Scenario. Global oil reserves today exceed the cumulative projected production between now and 2030, but reserves will need to be "proved up" in order to avoid a peak in production before the end of the projection period. Exploration will undoubtedly be stepped up to ensure this happens. The exact cost of finding and exploiting those resources over the coming decades is uncertain, but will certainly be substantial. Cumulative energy-sector investment needs are estimated at about $17 trillion (in year-2004 dollars) over 2004-2030, about half in developing countries. Financing the required investments in non-OECD countries is one of the biggest challenges posed by our energy-supply projections. The global oil-refining industry has an urgent need for more distillation and upgrading capacity. As a result of strong growth in demand for refined products in recent years, spare capacity has been rapidly diminishing and flexibility has fallen even faster. Effective capacity today is almost fully utilised, so growing demand for refined products can only be met with additional capacity. Upgrading capacity will be needed even more than distillation capacity, since demand will continue to shift to lighter products, while crude oil production is becoming heavier, with a higher sulphur content.

CHAPTER 1

INTRODUCTION

Oil is fungible and traded in world commodities markets, there is much uncertainty associated with projections of future patterns of oil trade; however, anticipated changes in the world's oil trading patterns—particularly, the shifting regional dependence of importing regions on producing regions—may have important geopolitical ramifications. In 2003, the OECD economies imported 17.9 million barrels of oil per day from Overproducers. Of that total, 11.3 million barrels per day came from the Persian Gulf region. Oil movements to OECD economies represented 57 percent of the total petroleum exported by OPEC member nations and 50percent of all Persian Gulf exports. By the end of the projection period, OPEC exports to OECD economies in the reference case are estimated to be about 3.2million barrels per day higher than their 2003 level, and almost 42 percent of the increase is expected to come from the Persian Gulf region. Despite such a substantial increase, the share of total petroleum exports that goes to OECD member nations in 2030 is more than 9 percentage points below their 2003 share in the reference case, and their share of Persian Gulf exports falls by more than 13 percent. The significant shift expected in the balance of OPEC export shares between the OECD and non-OECD economies is a direct result of the economic growth anticipated for then on-OECD nations, especially non-OECD Asia. OPEC petroleum exports to non-OECD economies increase by13.6 million barrels per day over the projection period, with more than 85 percent of the increase going to then on-OECD economies of Asia. China, alone, is likely to import about 8.4 million barrels per day from OPEC in 2030, 69 percent of which is expected to come from Persian Gulf producers. North America's petroleum imports from the Persian Gulf in the reference case increase by more than 40 percent from 2003 to 2030. At the same time, more than 40 percent of North America's total imports in2030 is expected to come from Atlantic Basin producers and refiners, with significant increases anticipated include oil imports from Latin American producers, including Venezuela, Brazil, Colombia, and Mexico. West African producers, including Nigeria and Angola, are also expected to increase their export volumes to North America. Caribbean Basin refiners are expected to account for most of the increase in North America's imports of refined products.

1.1. Indian Oil Scenario

Oil accounts for about 34 percent of India's total energy consumption, and has been growing gradually as a share of the country's fuel mix in recent years. The majority of India's roughly 5.4 billion barrels in oil reserves are located in the Mumbai High, Upper Assam, Cambay, Krishna-Godavari, and Cauvery basins. The offshore Mumbai High field is by far India's largest producing field. Normal output at Mumbai High is around 275,000 barrels per day (bbl/d), but an offshore gathering platform at the field was damaged in a fire in July 2005. India's state-owned Oil and Natural Gas Corporation (ONGC) expects to have repairs completed by March 2006. In the meantime some output has been rerouted through other gathering platforms. India's average oil production level (total liquids) for 2005 was 837,000 bbl/d, of which 632,000 bbl/d was crude oil. India had net oil imports of nearly 1.7 million bbl/d in 2005.

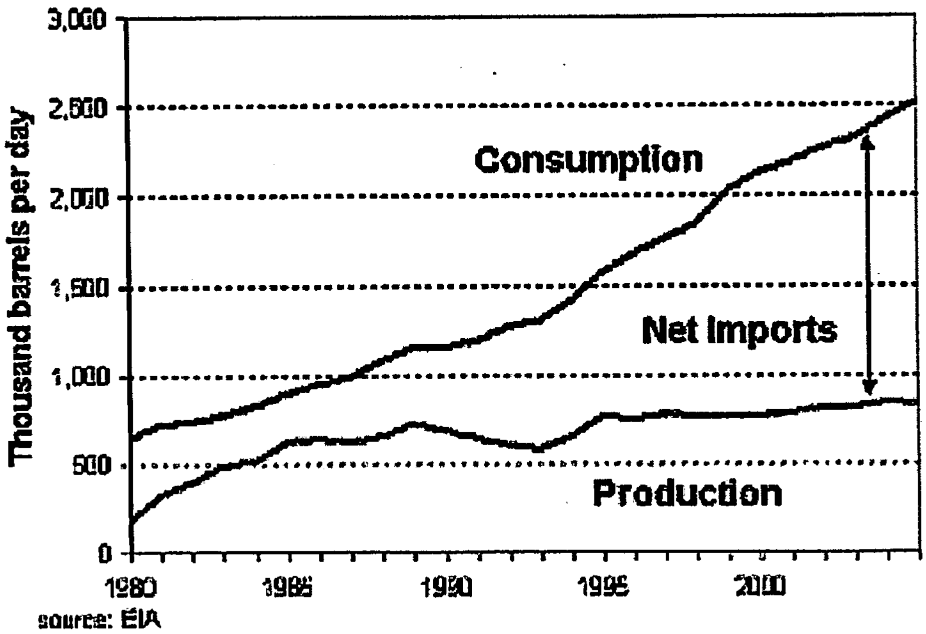

Figure: 1 India Oil Production and Consumption 1980-2005

Future oil consumption in India is expected to show strong growth, to 3.1 million bbl/d by 2010, from 2.5 million bbl/d in 2005. India is attempting to limit its dependence on oil imports somewhat by expanding domestic exploration and production. To this end, the Indian government is pursuing the New Exploration Licensing Policy (NELP), first announced in 1997, which permits foreign involvement in exploration, an activity long restricted to Indian stateowned firms. While the initial response to the 1999 tender was disappointing, with no bids received from the major multinational oil companies (causing an extension of the deadline for submission of bids), India proceeded with the award of 25 oil exploration blocks in early January 2000. The largest winner in the bidding round was India's domestic Reliance Industries, in partnership with independent Niko Resources of Canada, which received 12 blocks. British independent Cairn Energy, Russia's Gazprom, the U.S. firm Mosbacher Energy, and Geopetrol of France were all awarded single blocks in partnership with Indian firms. ONGC was awarded eight blocks, three of which it will hold in partnership with other public-sector Indian firms.

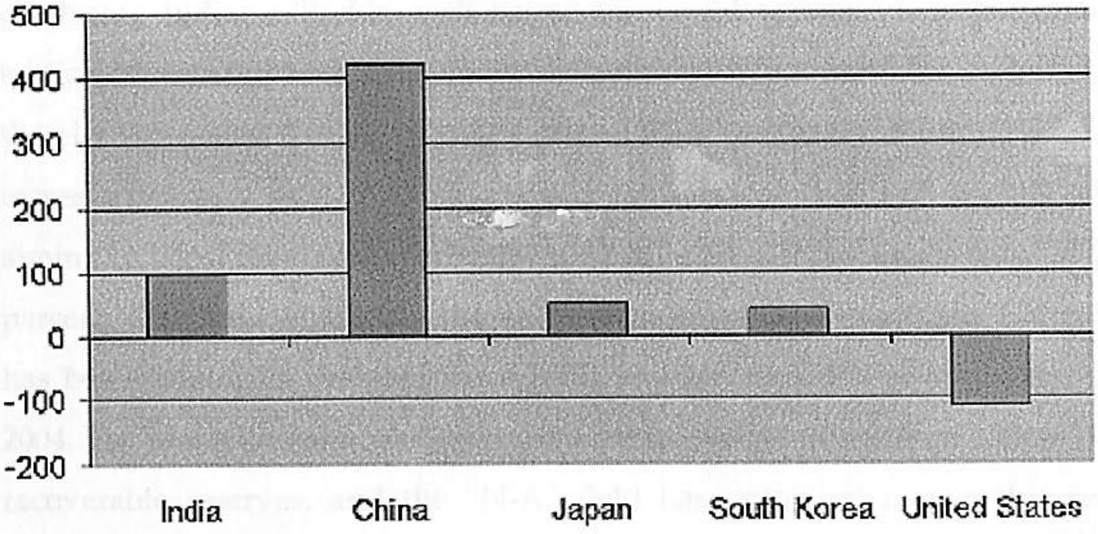

Figure: 2 Comparision -oil Demand Growth 2005

A second round of bidding, with a total of 25 blocks offered, concluded in March 2001. Sixteen of the blocks have been awarded to ONGC, and four blocks to Hardy Oil of the United Kingdom, in partnership with India's Reliance Petroleum. The others were either awarded to smaller independent firms or failed to receive bids. As with the first round, no bids were received from major international oil companies. Bids for the third round were received in August 2002, with a total of 27 blocks offered. Awards under this third round were made in February 2003, with domestic Indian firms receiving most of the blocks. Reliance Industries received nine offshore blocks, one adjacent to the Krishna-Godavari Basin. ONGC was awarded 13 blocks, five offshore and eight onshore. The Gujarat State Petroleum Corporation received one. Blocks offered during the fourth round in 2003 received relatively little foreign interest. Awards for 15 blocks were made in February 2004, with 14 going to ONGC and one going to Reliance Industries. A fifth round of bidding closed in July 2005, with firms receiving the 20 blocks offered in September 2005 including Cairn Energy, Niko Resources, and Italy's ENI.

Low drilling recovery rates are a major part of the oil supply problem for India. Historically, recovery rates have averaged only around 30 percent in currently producing Indian oilfields, well below the world average. It is hoped that allowing foreign investment will bring in technology that is not available to Indian state firms, thereby increasing overall recovery rates. ONGC currently is undertaking a project to increase recovery rates in the Mumbai High offshore field and several others as well, aiming to boost the overall recovery rate for its production assets from 28 percent to 40 percent. One area which has shown promise is western Rajasthan. Cairn Energy (UK) has been drilling in the area since 2001, and has reported several successful wells in 2004. The Mangala field has been estimated to contain as much as 320 million barrels of recoverable reserves, and the "N-A" field has estimated recoverable reserves of 80 million barrels. Cairn is continuing exploration in the area, and is planning to bring the field into production by early 2008, with an expected volume of 100,000 bbl/d. In February 2002, BG purchased a 30 percent stake in the Panna, Mukta, and Tapti offshore oil and gas fields, which had previously been held by Enron. A dispute between BG and ONGC (which owns a 40 percent interest in the fields) over which firm would operate them was resolved in February 2003 with a "joint operatorship agreement." Reliance Industries holds the other 30 percent stake.

1.2. Downstream/Refining

For most of the 1990s, India imported a large quantity of refined products, as it lacked the refining capacity to keep up with growing demand. In 1999, refinery construction allowed India to close the gap. At the end of 2004, India had a total of 2.3 million bbl/d in refining capacity, an increase of 1.1 million bbl/d since 1998. The largest single addition was Reliance Petroleum's huge Jamnagar refinery, which began operation in 1999. Jamnagar has since reached its full capacity of 660,000 bbl/d. Jamnagar sells its products through three of the state-owned firms, and also has a retail network of its own. Another major downstream infrastructure development is the construction of pipelines being undertaken by Petronet India, a company created by an agreement in

1998 between India's state-owned refineries. This construction is expected to add 500,000 bbl/d to India's current 325,000 bbl/d capacity for pipeline transportation of refined products. Pipelines between refineries and major urban centers are replacing rail cars as the main mode of transportation in India.

- Several multinationals have entered the Indian lubricants market, which was deregulated six years ago. Firms such as Shell, ExxonMobil, and Caltex currently hold over one-third of the market. While these operations are relatively small, they are seen as allowing the majors to study the Indian market, establish brand recognition, and prepare for the eventual deregulation of the Indian retail petroleum products sector. Still, a requirement that foreign firms invest at least $400 million before entering the downstream market has served to limit their entry into petroleum products retailing. Shell met this requirement in early 2004, and has opened its own retail outlets, though it has slowed its expansion due to the continuance of price controls on petroleum products.

- The Indian government officially ended the Administered Pricing Mechanism (APM) for petroleum product prices in April 2002. Prior to this deregulation, the Indian government had tried to offset the effects of price changes in crude oil by maintaining an Oil Pool Account, which was to build financial reserves when crude oil prices fell and release them back as increased subsidies when crude oil prices rose. In practice, though, the April 2002 reforms have not completely removed government influence on petroleum product prices. Subsidies have been maintained on some products, such as kerosene, which is commonly used as a cooking fuel by low-income households in India. State owned downstream companies also still must submit proposed price changes to the Ministry of Petroleum and Natural Gas for approval. This has, in practice, limited movements in retail prices in response to fluctuations in world oil prices.

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The previously planned sell off of government stakes in Hindustan Petroleum (HPCL) and Bharat Petroleum (BPCL) appear unlikely to move forward in the near future. The policy of the new Congress-led government is to avoid most further privatizations of public companies which are making a profit. India is planning to set up a strategic petroleum reserve equal to 15 days of the country's oil consumption. The state owned refiner Indian Oil Corporation (IOC) is likely to take the lead in the development of the reserve, which would be paid for by the Indian central government by means of a tax on petroleum product sales.

1.3. Present Pricing Status

Starting from April 2002, the vestiges of the controlled era in the form of APM (administered pricing mechanism) were officially dismantled. However, substantial government control on the sector prevails till date. The following section discusses the key implications of dismantling of APM on the petroleum pricing in the country.

1.3.1. Pricing of Domestic Crude

With the dismantling of APM, the price of indigenous crude has been linked to international prices, which implies that the price received by domestic crude oil producers is linked to international prices (as against the pooled price in the APM regime which was the weighted average of international prices and the domestic cost of Composition of exports and imports of petroleum products. In effect at the time of dismantling of the APM, domestic refineries were to pay international crude prices even for crude procured from domestic producers. Revenues of domestic crude producers, on the other hand, are over and above what would have been on the basis of their costs.

1.4. Global Oil Scenario

World oil demand grows from 80 million barrels per day in 2003 to 98 million barrels per day in 2015 and 118 million barrels per day in 2030. Demand increases strongly despite world oil prices that are 35 percent higher in 2025 than in last year's outlook. Much of the growth in oil consumption is projected for the nations of non-OECD Asia, where strong economic growth is expected. Non-OECD Asia (including China and India) accounts for 43 percent of the total increase in world oil use over the projection period.

To meet the projected increase in world oil demand, total petroleum supply in 2030 will need to increase by 38 million barrels per day, to 118 million barrels per day, from the 2003 level of 80 million barrels per day. OPEC producers are expected to provide 14.6 million barrels per day of the increase. Higher oil prices cause a substantial increase in non-OPEC oil production—23.7 million barrels per day, which represents 62 percent of the increase in total world oil supplies over the projection period. The estimates of production increases are based on current proved reserves and a country-by-country assessment of ultimately recoverable petroleum.

The oil price reflects a reassessment of the willingness of oil-rich countries to expand production capacity as aggressively as envisioned in last year's projection. It does not represent a change in the assessment of the ultimate size of the world's petroleum resources but rather a lower level of investment in oil development in key resource-rich regions. Several factors contribute to the expectation of lower investment and oil production in key oil-rich producing regions, including continued strong worldwide economic growth despite high oil prices, and various restrictions on access and contracting that affect oil exploration and production companies' costs.

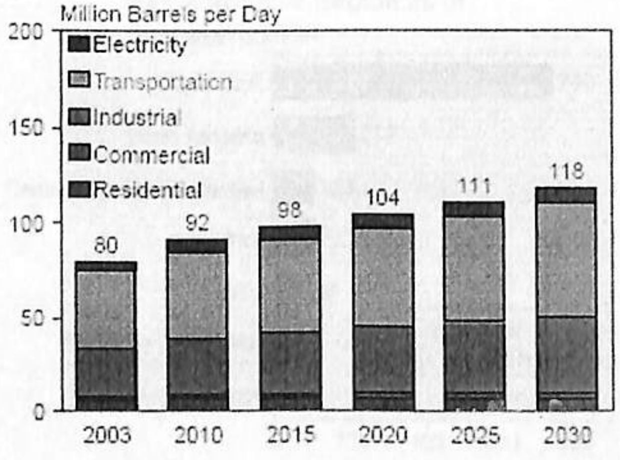
OPEC production was projected to increase by 24.0 million barrels per day between 2002 and 2025. An increase in OPEC supply of only 11.8 million barrel per day over the same period. The resulting increase in world oil prices dampens world demand in the mid-term and makes previously uneconomical resources in non-OPEC regions more likely to be produced. Non-OPEC supplies of both conventional and unconventional resources (including biofuels, coal to- liquids, and gas-to-liquids) are expected to increase as a result. In 2003, world production of unconventional resources totaled only 1.8 million barrels per day, unconventional resource supplies rise to 11.5 million barrels per day and account for nearly 10 percent of total world petroleum supply in 2030.

In all the cases, world oil prices are expressed as the average price of imported low-sulfur, light crude oil to U.S. refiners. world oil prices increase from $41 per barrel in 2004 to $57 per barrel in 2030 (all prices in real 2004 dollars unless otherwise noted), and oil demand rises to 118 million barrels per day in 2030. In the low and high world oil price cases, prices in 2030 are $34 per barrel and $96 per barrel, respectively, accounting for the substantial range of uncertainty in the world's future oil markets. In 2030, oil demand in the two alternative price cases ranges from 102 million barrels per day in the high price case to 128 million barrels per day in the low price case. World oil trading patterns change substantially over the projection horizon, as China and the other countries of non-OECD Asia fuel their growth in oil demand by taking an increasing share of the world's oil imports. China's petroleum imports are expected to grow fourfold from 2003 to 2030, with much of the increase coming from Persian Gulf suppliers. In 2003, China imported 0.9 million barrels per day of oil from Persian Gulf OPEC members, and in 2030 its Persian Gulf imports total 5.8 million barrels per day. The rising dependence of China on Middle Eastern oil supplies has geopolitical implications both for relations between the two regions and for the oil-consuming world as a whole.

1.5. Global Oil Demand

World oil consumption rose by about 1.2 million barrels per day in 2005, after an increase of 2.6 million barrels per day in 2004. The non-OECD countries accounted for 1.1 million barrels per day of the 2005 increase, and the OECD as a whole accounted for 0.1 million barrels per day. Unlike in 2004, when China's oil use increased by 0.9 million barrels per day, its demand rose by only 0.4 million barrels per day in 2005, despite continued strong economic growth. In the United States, a 0.4-percent decline in oil demand in 2005 resulted from a combination of high prices, hurricane-related disruptions, and a mild winter. It was the first decline in U.S. demand since 2001. Growth in world oil demand averages 1.4 percent per year over the 2003 to 2030 period, as the world continues to experience strong economic growth. World oil prices in 2025 are 35 percent higher than in 2005, and as a result world oil demand grows more slowly in this year, to 111 million barrels per day in 2025, as compared with 119 million barrels per day in the 2005 reference case. In 2006, total demand for petroleum liquids rises to 118 million barrels per day in 2030. Much of the world's incremental oil demand is projected for use in the transportation sector, where there are few competitive alternatives to petroleum; however, several of the technologies associated with unconventional liquids (gas-to-liquids, coal-to-liquids, and ethanol and biodiesel produced from energy crops) are expected to meet a growing share of demand for petroleum liquids during the projection period. Of the projected increase in oil use in the reference case over the 2003 to 2030 period, one-half occurs in the transportation sector. The industrial sector accounts for a 39-percent share of the projected increase in world oil consumption, mostly for chemical and petrochemical processes.

Figure 26. World Oil Consumption by Sector, 2003-2030



1.6. The Composition of World Oil Supply

Total world oil demand was then estimated on the basis of that price path and assumptions about future economic growth. The assumed price path was also used to estimate future non-OPEC production of conventional oil and production of unconventional liquids from both OPEC and non-OPEC countries, based on estimates of the total petroleum resource base. Finally, the level of OPEC conventional production that would be needed to balance world oil markets for the assumed reference case price path was calculated by subtracting non-OPEC conventional supplies and total unconventional supplies from total world oil demand. The likelihood that OPEC producers would supply this residual demand at the assumed price path was then evaluated, based on estimates of total OPEC oil resources and the apparent preferred production levels of key OPEC members. If the OPEC production level required to balance the global market appeared too high, the assumed oil price path was adjusted upward, and a new iteration of demand and supply estimates was derived. Conversely, if the required OPEC production level appeared too low, the oil price path was adjusted downward for the next iteration.

Figure 29. World Proved Oil Reserves by Geographic Region as of January 1, 2006

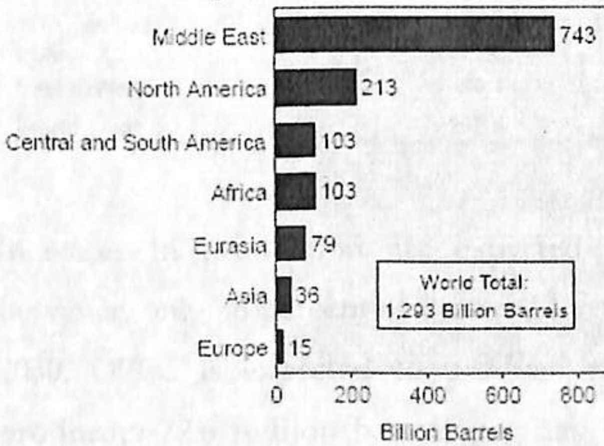


Figure: 3

It is important to note what this approach did and did not assume. A business-as-usual oil market environment was assumed. Disruptions in oil supply for any reason (war, terror, weather, geopolitics) were not assumed. It was assumed that all non-OPEC oil projects that show a favorable rate of return on investment would be funded. For the period out to 2030, there is sufficient oil to meet worldwide demand. Peaking of world oil production is not anticipated until after 2030. In 2006, world oil supply in 2030 exceeds the 2003 level by 38 million barrels per day.

Table 3. World Oil Reserves by Country as of January 1, 2006 (Billion Barrels)

Country	Oil Reserves
Saudi Arabia	264.3
Canada	176.8
Iran	132.5
Iraq	115.0
Kuwait	101.5
UAE	97.8
Venezuela	79.7
Russia	60.0
Libya	39.1
Nigeria	35.9
United States	21.4
China	18.3
Qatar	15.2
Mexico	12.9
Algeria	11.4
Brazil	11.2
Kazakhstan	9.0
Norway	7.7
Azerbaijan	7.0
India	5.8
Rest of World	66.1
World Total	**1,292.5**

Increases in production are expected for both OPEC and non-OPEC producers; however, only 38 percent of the total increase is expected to come from OPEC areas. In 2030, OPEC is expected to produce 45.3 million barrels per day and non-OPEC producers 72.6 million barrels per day in the 2006. Over the past two decades, the growth in non-OPEC oil supply has resulted in an OPEC market share substantially under its high of 52 percent in 1973. In 2003, OPEC produced 39 percent of the world's oil supplies. High oil prices, new exploration and production technologies, aggressive cost-reduction programs by industry, and the emergence of unconventional resources contribute to the outlook for continued growth in non-OPEC oil production.

About 62 percent of the increase in petroleum demand over the next 25 years will be met by increased production from non-OPEC suppliers. Non-OPEC production in 2030 is projected to be almost 24 million barrels per day higher than it was in 2003. The OPEC production capacity in 2010 are slightly less than those projected in 2005, reflecting a shift toward non-OPEC supply projects as a result of the higher prices assumed in 2006. The high world oil price case assumes that OPEC members might pursue significant price escalation through conservative capacity expansion decisions rather than undertake major production expansion programs. Such behavior would tend to raise world oil prices, and in this scenario OPEC suppliers increase their production capacity by only 4 million barrels per day between 2003 and 2030, in contrast to the reference case, where OPEC increases production capacity by 18 million barrels per day.

Table 4. Estimated World Oil Resources, 1995-2025[a]
(Billion Barrels)

Region	Proved Reserves	Reserve Growth	Undiscovered	Total
OECD				
United States	21.4	76.0	83.0	180.4
Canada	178.8	12.5	32.6	223.9
Mexico	12.9	25.6	45.8	84.3
OECD Europe	15.1	20.0	35.9	71.0
Japan	0.1	0.1	0.3	0.5
Australia/New Zealand	1.5	2.7	5.9	10.1
Non-OECD				
Russia	60.0	106.2	115.3	281.5
Other Non-OECD Europe/Eurasia	19.1	32.3	55.6	107.0
China	18.3	19.6	14.6	52.5
India	5.8	3.8	6.8	16.4
Other Non-OECD Asia	10.3	14.6	23.9	48.8
Middle East	743.4	252.5	269.2	1,265.1
Africa	102.6	73.5	124.7	300.8
Central and South America	103.4	90.8	125.3	319.5
Total World	1,292.5	730.2	938.9	2,961.6
OPEC	901.7	395.6	400.5	1,697.8
Non-OPEC	390.9	334.6	538.4	1,263.9

Figure: 4

Chapter 2

Review of Literature

Very little research has been found on the Fundamental and Technical analysis of crude oil. However, some authors have made attempts to explain what lies behind the fundamental and Technical analysis of crude oil.

Xun Luo(2007) analyzed the fundamental of crude oil prices. In his studies he has listed some factors that are nymex trading, demand and supply, geopolitics, information from EIA & API, weather conditions, market expectation, inflation effect. The study was a statistical or quantative study.

David Keller, CMT, Bloomberg LP (2006) studied various technical analysis tools for crude oil and natural gas prices. The tools that were used were Fibonacci retrenchment, Support/Resistance, Relative Strength Index (RSI), Oscillators, Moving Average Convergence/Divergence, Trend Following.

Wayne D. Purcell (1999) studied Technical analysis tools that are popular and useful in energy market. He has studies various applications of bar chart technical analysis tools. He used support, resistance, channels, gap rally and trend line.

According to Jack D. Schwager [1], "Fundamental Analysis uses economic data about supply and demand while technical uses past price data. Many traders use fundamental analysis to evaluate their decisions while technical analysis to time their needs. Observation of different traders reveals that both techniques should be used wisely to attain success."

Jack D. Schwager,[2] states that " Bar Charts are by far the most common of all charts. Used in combination the charts provide a telephoto effect. The monthly and weekly charts provide a market perspective. The daily, weekly, monthly charts can be used to determine both long term and short term trends."

Again, according to Jack D. Schwager, [3] "Technical Analysis by comparison is the study of price activity more specifically price patterns to identify favorable trading opportunities. Hence by studying the price patterns the technical analyst looks for price behavior that suggests possible initiation, conclusion, and continuation of a trend."

According to Michael C. Thomsett,[4] "Fundamental Analysis performs the valuable service of leading everyday investors into better investment decisions while allowing them to learn at their own pace through the use of worksheets, forms, graphs, charts, checklists, examples, definitions, sidebars, and step-by-step examples."

Martin J. Pring[5] is of the opinion that, "they never sell for what they are worth but what people think they are worth". This statement is applied to any traded security. "It is important that market participants look ahead, anticipate future developments, and take action now."

Brown and Jennings[6] (1989) showed that technical analysis has value in a model in which prices are not fully revealing and traders have rational conjectures about the relation between prices and signals.

Frankel and Froot [7] (1990) showed evidence for the rising importance of chartists.

Neftci[8] (1991) showed that a few of the rules used in technical analysis generate well-defined techniques of forecasting, but even well-defined rules were shown to be useless in prediction if the economic time series is Gaussian. However, if the processes under consideration are nonlinear, then the rules might capture some information. Tests showed that this may indeed be the case for the moving average rule.

Taylor and Allen[9] (1992) report the results of a survey among chief foreign exchange dealers based in London in November 1988 and found that at least 90 per cent of respondents placed some weight on technical analysis, and that there was a skew towards using technical, rather than fundamental, analysis at shorter time horizons.
In a comprehensive and influential study Brock, Lakonishok and LeBaron[10] (1992) analyzed 26 technical trading rules using 90 years of daily stock prices from the Dow Jones Industrial Average up to 1987 and found that they all outperformed the market.

Blume, Easley and O'Hara[11] (1994) show that volume provides information on information quality that cannot be deduced from the price. They also show that traders who use information contained in market statistics do better than traders who do not.

Neely[12] (1997) explains and reviews technical analysis in the foreign exchange market.

Neely, Weller and Dittmar[13] (1997) use genetic programming to find technical trading rules, and find strong evidence of economically significant out-of-sample excess returns to those rules for each of six exchange rates, over the period 1981–1995.
Lui and Mole[14] (1998) report the results of a questionnaire survey conducted in February 1995 on the use by foreign exchange dealers in Hong Kong of fundamental and technical analyses. They found that over 85% of respondents rely on both methods and, again, technical analysis was more popular at shorter time horizons.

Neely (1998) reconcile the fact that using technical trading rules to trade against U.S. intervention in foreign exchange markets can be profitable, yet, long term, the intervention tends to be profitable.

LeBaron (1999) shows that, when using technical analysis in the foreign exchange market, after removing periods in which the Federal Reserve is active, exchange rate predictability is dramatically reduced.

Lo, Mamaysky andWang (2000) examines the effectiveness of technical analysis on U.S. stocks from 1962 to 1996 and finds that over the 31-year sample period, several technical indicators do provide incremental information and may have some practical value.

Fern´andez-Rodr´ýguez, Gonz´alez-Martel and Sosvilla-Rivero[18] (2000) apply an artificial neural network to the Madrid Stock Market and find that, in the absence of trading costs, the technical trading rule is always superior to a buy and- hold strategy for both "bear" market and "stable" market episodes, but not in a "bull" market. Beating the market in the absence of costs seems of little significance unless we are interested in finding a signal which will later be incorporated into a full system. Secondly, it is perhaps naive to work on the premise that "bull" and "bear" markets exist.

Lee and Swaminathan (2000) demonstrate the importance of past trading volume.

Neely and Weller (2001) use genetic programming to show that technical trading rules can be profitable during US foreign exchange intervention.

Cesari and Cremonini (2003) make an extensive simulation comparison of popular dynamic strategies of asset allocation and find that technical analysis only performs well in Pacific markets.

Kavajecz and Odders-White (2004) show that support and resistance levels coincide with peaks in depth on the limit order book and moving average forecasts reveal information about the relative position of depth on the book. They also show that these relationships stem from technical rules locating depth already in place on the limit order book.

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Chapter 3

Research Methodology

Research Objectives

1. To study the major fundamental factors that affect prices.
2. To study the technical factors that affect prices.
3. To attempt to use the knowledge of fundamental & technical factors to interpret & view prices.

Research Design & Methodology

The research plan will involve:

1. Use of EIC framework will be used to create a fundamental view of- prices.
2. The technical review of the crude market will be based on analysis of prices, volume & other market generated technical data.
3. The fundamental & technical views will then be integrated to create a complete perception of crude prices.

Tools of Fundamental Analysis

Economy, Industry and Commodity Framework

Tools of Technical

(i) Prices
(ii) Volume
(iii) Market sentiment
(iv) Momentum

Limitations Of Research Study

(i) Scope confined to analysis of fundamental & technical factors affecting prices & list to create a model for interpreting market action.

(ii) The project is not an attempt to create a pricing model.

(iii) There is no exclusive one tool to analyze prices, and consequently the study cannot be exhaustive.

Chapter 4

Fundamental Analysis

4.1 Overview

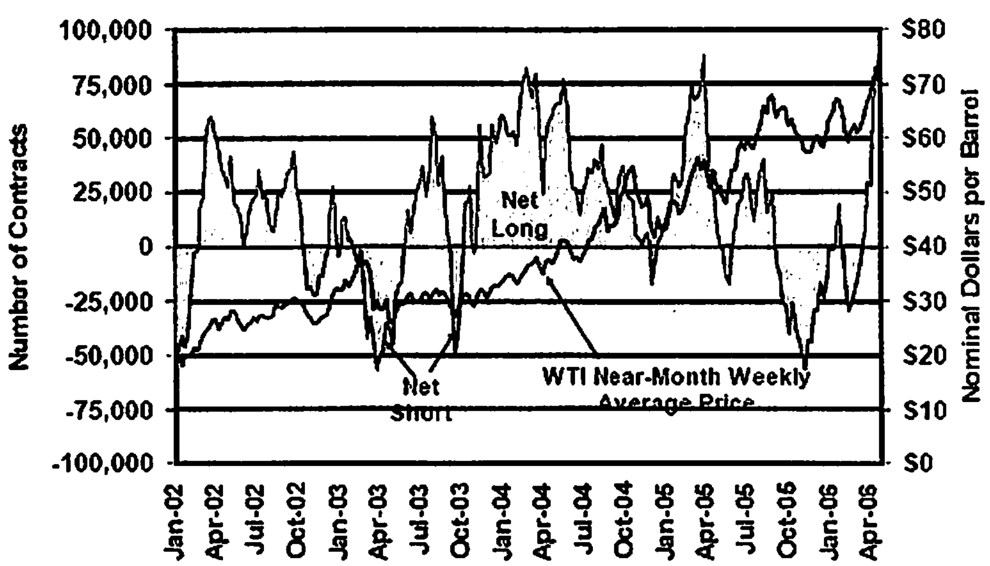
This chapter examines crude oil prices from the perspective of two fundamentals. One is supply-and-demand balance and the other is a geopolitical factor. They are the **basic** fundamentals of crude oil price. This fact is straightforward to understand: Supply-and-demand balance largely dictates virtually all commodity futures price. While the strategic role of oil for almost every country determines that oil price is bounded to be tied tightly with the geopolitical factors.

Few will argue that the recent decades are interesting times for energy industry. This observation is true for both traders and investors. On the traders' side, for example, the deregulation of natural gas in the United States in the early 1990s is slowly but inexorably moving into Europe and Asia. Natural gas deregulation has strongly fostered competition, as well as called for needs for risk management. On the investors' side, a significant phenomenon is that for many of today's hedge funds, commodities were the hot tickets from 2000 to 2005, as their prices began to rocket, fuelled In reply to: large part by China's boom.

"Unlike oil, gas can't readily be moved about the globe to fill local shortages or relieve local surpluses. Forecasts of freezing U.S. temperatures in winter or heat and hurricanes in summer can send prices jumping, while forecasts of mild weather can do the opposite. Last December, amid a cold snap, gas soared to a record 15.378 a million British thermal units on the New York Mercantile Exchange, or Nymex. This month, prices fell below 5 in the absence of major hurricanes and with forecasters talking about another warm winter. Yesterday, gas for October delivery settled at 4.942 a million BTUs on Nymex, off four cents."

4.2 Speculative Activity

EIA analysts believe that the change in the relationship between prices and Organization for Economic Cooperation. The wholesale price spread is the difference between the wholesale price of gasoline and the spot price of crude oil. and Development (OECD) commercial inventories is related to changes in the level of surplus production capacity, which declined sharply due to the acceleration of global oil consumption growth in 2003 and especially in 2004. Available evidence suggests that increases in speculative activity in futures markets are a result of the high level of current oil prices and the high uncertainty surrounding the value of future oil prices, not the other way around. In times of ample spare capacity there is little motivation for commercial producers and users of energy to shed risk, or hedge, since there is little perceived risk. With little desire to shed risk, there is only a small role for those who wish to take on the risk, the speculators. In contrast, when excess capacity declined and market participants perceived that OPEC members would no longer maintain stable prices in the environment of geopolitical risk, market participants became increasingly less certain of the path of future oil prices. The increased uncertainty regarding the path of future oil prices has caused commercial producers and users of energy to increase their desire to hedge. With the increased desire to shed risk, there has been a much larger role in the market for those prepared to bear this risk, the speculators. Although changes in the net position of non-commercial participants in WTI futures contracts appear to be in relation to changes in WTI spot prices in the very short run, the overall trend of increasing WTI spot prices is independent of the participation of speculators in the market.



"Net Position of Non-Commercial Participants in WTI Futures Contracts Since 2002 vs. WTI Spot Price"

Source: NYMEX Commitment of Traders Report. Commodity Futures Trading Commission. Graph includes data up to May 2, 2006.

Figure: 5

EIA believes that the shift in the relationship between prices and OECD commercial inventories is better explained by changes in the level of surplus production capacity. OPEC's change in behavior that came as a response to the Asian financial crisis and overproduction in the face of lower demand, shifted crude oil to a new price level. Production restraint by key OPEC member countries shifted the price base while market participants simultaneously perceived a growing likelihood or risk of increasingly scarce incremental crude oil supplies. Futures market long-term contracts shifted up to a new, higher, level of roughly $30, reflecting these new long-term expectations. Still, inventory levels and crude oil spot prices continued their inverse relationship (i.e., falling inventories correlating with rising prices), as shown by the January 2000-April 2004 trend line. Beyond April 2004, there is an apparent reversal in the price/inventory relationship. While the correlation is not strong, prices appear to increase with increasing inventories, as shown by the May 2004 to March 2006 trend line . This fact alone appears confusing to some observers, who may attribute this shift to the activity of speculators.

Several different factors have caused the increase in crude oil prices since 2002. The disconnect between non-OPEC supply growth and rising demand growth has raised production expectations from OPEC suppliers at a time when geopolitical uncertainty inside of OPEC member countries is at heightened levels. The increased upstream risk has combined with constraints in the downstream to hinder the smooth provision of available supply to demand centers. Weather anomalies have created an added risk to oil production in hurricane-prone regions, and the weak US dollar has masked the oil price rise in some regions that would otherwise have induced lower oil demand. The new role of speculative money in the market is more a function of a shift in the inventory and price relationship.

4 .3 The Energy Information Administration

The EIA is a statistical agency of the U.S. Department of Energy and was created by Congress in 1977. Its mission is to provide policy-independent data, forecasts, and analysis to promote sound policy making, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. Energy products covered by EIA are:

Petroleum

Including crude oil, gasoline, heating oil, diesel, propane, jet fuel, and other petroleum based products.

Natural Gas

Including crude oil, gasoline, heating oil, diesel, propane, jet fuel, and other petroleum based products.

Electricity

Including sales, revenue and prices, power plants, fuel use, stocks, generation, trade, and demand & emissions.

Coal

Including reserves, including production, prices, employment and productivity, distribution, stocks and imports and exports.

Nuclear

Including Uranium fuel, including nuclear reactors, generation and spent fuel.

For crude oil fundamental analysis, EIA data is a must-read, if not more emphasized. These data sets are published on daily, weekly, monthly and annual basis. The daily data include the spot prices of crude oil and petroleum products in the U.S. and selected international areas, as well as futures price at NYMEX. EIA archived the historical data of these daily prices. For WTI, the historical data could be back-traced to March 30, 1983. The weekly publications include: This Week in Petroleum, which is generally released on Wednesdays and contains analysis, data, and charts of the latest weekly petroleum supply and price data; Weekly Petroleum Status Report, which reports the petroleum supply situation in the context of historical information and selected prices; and several other reports, mainly about price information. The monthly publications include: Company Level Imports, which is about imports data at the company level collected from the EIA-814 monthly imports report; Petroleum Marketing Monthly, which is of monthly price and volume statistics on crude oil and petroleum products at a national, regional and state levels; Petroleum Supply Monthly, which details supply and disposition of crude oil and petroleum products on a national and regional level. The data series describe production, imports and exports, movements and inventories;

Prime Supplier Report, which measures primary petroleum product deliveries into the U.S. where they are locally marketed and consumed. At last, the annual publications include: U.S. Crude Oil/Natural Gas/Natural Gas Liquids Reserves Annual Report, Petroleum Supply Annual, Petroleum Marketing Annual and Refinery Capacity Report.

What is really valuable of the EIA data repository is that not only raw market data are provided; a researcher could also get access to a compilation of frequently updated analyses and forecasts. There are great quantities of analyses of other economic fundamentals about crude oil.

4 .4 Supply-and-Demand Balances

For the global oil industry, oil trade represents the close connection between two main centers of activity: upstream exploration and production, as well as downstream refining and marketing. The interactions between the upstream and the downstream largely determine crude oil supply-and-demand balancing dynamics. Mechanisms of such interactions are as following: Upstream parties are the major sellers of crude oil, and their productions are valued by downstream demand; While downstream parties are the major buyers of crude oil, and the cost of their feedstock is determined by the upstream supply. Operational decisions about combining output from various fields to create a specific crude oil export stream with certain characteristics are constantly tested in the market against the requirements of refiners for specific feedstock to meet final demand for a changing combination of products. The downstream marketing prices of the petroleum products, such as heating oil, gasoline, propane, aviation oil and kerosene are also determinants of crude oil price. Due to the extensive vertical integration of the oil industry until the early 1970s, these decisions used to be largely kept under the umbrella of major oil companies.

There have been several profound changes in the upstream-downstream structure since 1970s. Increased crude price volatility since the early 1970s in combination with other price-affecting factors, OPEC output quotas for example, signaled oil-importing developing countries such as South Korea, India, and Brazil to invest in refining capacity to mitigate both refined product volume and price risks. These same trends also created an incentive for governments in oil-exporting countries, notably Iran, Kuwait and Saudi Arabia, to build refineries in order to capture the value added in turning crude oil into refined products. Other global trends of oil companies include privatization and large mergers among majors. These trends are finally challenging the long established dominance of big national oil companies in the top tiers of the international oil industry. While the largest state-owned companies are still playing a critically important role, the private sector companies are now becoming more important rivals. As of today, global upstream and downstream composition has been quite different from what it was in the 1970s.

Clearly, the extent to which up stream's or down stream's capacities are utilized during a certain time period greatly determines the crude oil price level and volatility of that period. In the case that the upstream has limited surplus in capacity, such as running tight on daily productions or lacking of new explorations when the supply-demand in market is barely balanced, a small portion of decrease in crude oil production would cause a significant price hike. For this reason, the market players will prefer to pay crude oil future contracts with higher premium. On the other hand, when the downstream has limited surplus in capability, such as fully operating refineries, oil transport ports and storages, an instability factor in these facilities will trigger significant increases of the petroleum products price. Such increases will subsequently affect crude oil price in an indirect manner, making bulls in the futures market.

From 2003 to 2006, surplus global oil production capacity, which was as high as 5.6 million barrels per day in 2002, plummeted to 1.8 million barrels per day in 2003, and has been around 1 million barrels per day during most of 2004 to 2006. As demand has increased rapidly during the same period, the world has dipped into the surplus capacity that had been built up earlier. While some productive capacity has been brought online, it has been insufficient relative to demand growth. As a result, surplus capacity is extremely limited, dramatically reducing the ability to respond to any sudden surges in demand or disruptions in supply. The situation is similar downstream, where global refinery utilization has increased from an annual average of 85 percent in 2002 to 90 percent in 2005. This increase in refinery utilization has also reduced the system's flexibility to respond to any disruption in refinery production, either from hurricanes or other events. Increases in refinery utilization rates may also make crude oil markets more responsive to seasonal patterns for refined products. All these factors composed the first cluster of pulling-up forces for crude oil price during the 2003-2006 period.

This chapter also argues that strong growth in the world economy, and particularly in China and the United States, has fueled the need for more oil, thus putting upward pressure on prices. That is, strong global oil demands are the other cluster of factors causing oil prices to rise in recent years. Asia Pacific and the United States are world's largest oil consumption regions, and the main oil consumer in Asia Pacific is Japan and China. As of 2006, the U.S. ranks first in daily oil consumption; Japan ranks the second, and China the third. All these three counties' economy is in good shape from 2003-2006, with China being the particular. As a result, after averaging annual growth of just under 1 million barrels per day between 1991 and 2002 (under 0.9 million barrels per day for 2000-2002), world oil demand grew by 1.5 million barrels per day in 2003, 2.6 million barrels per day in 2004, and at least 1.1 million barrels per day in 2005. This greater-than-historical growth came even as oil prices more than doubled.

4 .5 Geopolitical Factors

Just as the lack of surplus capacity is related to the growth in global demand, the impact on prices due to geopolitical risks is related to the lack of surplus capacity. If surplus capacity were sufficient to make up for any reasonable likelihood of a loss in supply, then the risks would not have as great an impact on price. However, because there is very limited surplus capacity, concerns about potential or existing supply problems in

Nigeria, Iran, Iraq, Venezuela, and elsewhere, have exacerbated price increases related to the supply-and-demand factor above. Or put another way, these risks to supply would not be putting as much upward pressure on prices if fundamentals were not tight to begin with.

The risks brought by geopolitical factors include instabilities of a nation's government and/or domestic economy; such nations do not necessarily to be an major crude oil exporter. For example, Singapore has strategic geographical location on the strait of Malacca, a main ocean waterway where 11.7 million barrels of crude oil passing by daily (2004 data). As a result, failure to crack pirate activities in the strait of Malacca by Singapore and other neighboring nations' law-enforcement departments will sometimes bring a up curve in the crude oil futures price. In another example for Venezuela, a disastrous two-month national oil strike, from December 2002 to February 2003, temporarily halted the whole nation's economic activity. Because Venezuela continues to be an important source of crude oil for the U.S. market. Both the instant effect of oil output volume collapse and aftermath effects as inflation and unemployment became fundamental drivers for a price hike of WTI future contact during the period, November 2002 to March 2003. That price hike is clearly reflected that although Venezuela's national strike ended in February 2003, the following U.S. invasion to Iraq, started on March 20, 2003, kept the crude oil price at its local peak for another week. During the period of 2003-2006, the forces exercised by geopolitical factors to global crude oil market are clearly pull-up ones. Besides the situation of Venezuela as described above, the U.S. invasion to Iraq successfully toppled the regime of Saddam Hussein in a short time frame, however the following insurgent activities in the war-torn country have been put the Middle East in long-time instability. During the same period, the conflicts between U.S. and Iran, the world's fourth largest oil exporter in 2004, have never really come to a rest. In year 2003-2004, some analysts even believed that a U.S. invasion to Iran had been planned and military actions of none-regular attacks, such as missile assaults might be taken. In Nigeria, it is not uncommon for oil producing and transporting facilities to be vandalized and result in sharp drop in oil output. In May 2005, Gasoline gushing from a ruptured pipeline exploded as villagers scavenged for fuel in Nigeria, killed up to 200 and caused a 50% drop in the nation's oil output for a week.

- An interesting question is: how to determine the magnitude of a individual geopolitical factor's influence to global crude oil price? This question is not NP-hard, but a very difficult one if precise quantitative results are to be derived. In a gross level, a practical approach could be using short-term events of a specific geopolitical factor to gauge the corresponding factor's magnitude of influencing power. An example is shown below, about the world's biggest oil exporter: Saudi Arabia. On February 24, 2006, Islamic extremists took a bold daytime attack on the world's largest oil-processing facility, called Abaci close to Saudi Arabia's main export terminals on the Gulf coast. Although the attack was defeated at the security road lock and did not affect the oil-processing facility's daily production at all, future contract 1 of WTI (to be delivered in March 2006) had a 3.4% price increase the next day. This is a terrific example of the magnitude of Saudi oil's influencing power to the global market. One hedge fund manager anticipated that the fall of the House of Saud would generate a 262 per barrel price in the year of 2006.

4.6 Market Expectations

Market expectations could have radical influences on the price. Intuitively one of its mechanisms could be described as follows. Before the release of key actual statistics in each period, each player takes action to maximize his expected profit according to her expectation of price. When players' expectations are highly correlated, the collective action of these players can practically change the actual determinants of the price. Therefore neglecting the market expectation could lead to non-ignorable mistakes in a certain price prediction model. It seems reasonable that the market expectations during a given time period may be more relevant to determining prices during that period than are the actual statistics that only become know much later.

There are quite a few literatures, which introduce practical approaches about making use of market expectations. For example, three ways are described to incorporate expectation in a model:

- Price is a function of estimates for concurrent-season statistics. Expectation is used for concurrent-season data. i.e., using expectation to explain price variations that have already taken place.
- Price is a function of concurrent-season actual statistics and expectation for the following season. i.e., using expectation to predict price variations that have not happened yet.
- Price is a function of concurrent-season estimates and expectation for the following season. Expectations are used for both concurrent- and following-season data. i.e., using expectation to explain both happened-already and going-to-happen price variations.

It is important to realize that expectations for a coming season can often have a stronger price impact than do prevailing fundamentals. This is particularly true during the later half of a season when the fundamentals for the given season are well defined due to players' action results and not subject to significant variation. Players foresee the trend of the market in the next period clearly and take effective action to protect his/her next period's profit. In another word, under some circumstances expectation for the following period plays the dominant role in Price-determination.

Some traders actually follow this concept in practical trading decision-making. A 2005 article of the Federal reserve bank of San Francisco predicts the crude oil price by using "futures-spot spread", which uses the spread between the current futures prices and the spot price to predict movements in the future price of WTI crude oil at NYMEX. The central idea of the article is that oil traders are knowledgeable about the industry; as a result, they are trying best to make sound investments, making the price-driving force of expectations a factor as strong as the spot price.

4 .7 Weather Conditions

Oil supply disruption in the Gulf of Mexico severely hurt the prospects for non-OPEC supply growth and had both short and long-term impacts on the WTI price. The Gulf of Mexico region is an important source for U.S. production of crude oil and natural gas. In 2004, crude oil production from the Federally-administered Outer Continental Shelf (OCS) fields was about 27 percent of total U.S. production. Texas, Louisiana, Alabama, and Mississippi also contribute significant onshore and State-administered offshore oil and natural gas production. Seasonal storm-related disruptions to oil and natural gas production are difficult to predict, primarily due to the uncertainty involved in predicting the location and intensity of future tropical cyclones. Severe storms that threaten the Gulf producing region do not happen every year, and long-lasting shut-in production resulting from storm damage is generally rare. Last year's hurricanes were an anomaly that destroyed existing fields, transportation infrastructure, and projects under construction. Many of these have only recently returned to operation or have been significantly delayed. The possibility of another disruption this summer is an always-present upward risk to EIA's price forecast.

Hurricanes Katrina and Rita hit at the heart of the US refinery industry US Gulf Coast states have 8.05-mmb/d of refining capacity, or46% of US distillation capacity, and the highest concentration of upgrading capacity 75 days after the hurricanes, over 90mmbbls of crude oil and over 175mmbbls of products have been removed from the market At its peak the hurricanes closed down 30% of the US refinery Capacity, at the turn of the year 775-kb/d of capacity is likely to Still be affected Hurricanes have put pressure on policy makers remove Limitations, but companies are still reluctant to invest in an Industry with poor investment returns Hurricanes Katrina and Rita hit the Gulf of Mexico region in late August and late September 2005 respectively, causing significant damage to regional oil production and refining facilities.

In early September, the loss of crude oil production in the Gulf of Mexico region was estimated at around 1.4 million barrels a day, accounting for over 90 per cent of normal regional production and around 20 per cent of total US production. Similarly, in the same period, around 87 per cent of gas production in the region was shut-in. Gas production in the Gulf accounts for approximately 17 per cent of total US production or 14 per cent of US supplies.

In an attempt to ease upward pressure on prices, the International Energy Agency announced, in early September, the release of a total of around 63 million barrels of crude oil from emergency reserves for market consumption. In a meeting held in Vienna on 19 September 2005, OPEC members also agreed to make available to the market the spare production capacity of 2.0 million barrels a day for a period of three months starting 1 October 2005, if required.

By the end of October 2005, the market took up approximately 42 million barrels of crude oil from the IEA emergency reserves. Additionally, the United States has made loans from its Strategic Petroleum Reserve available on request. Including the loaned volumes, the total additional oil for market consumption was around 54 million barrels by the end of October. Because of the severity of the damage, reconstruction is expected to take longer than recent similar events.

For example, in 2004, Hurricane Ivan caused extensive damage to production infrastructure in the Gulf of Mexico region, including damage to offshore pipelines. However, despite this, recovery following Hurricane Ivan was relatively speedy. After one month of reconstruction, the loss of crude oil production was reduced to below 0.5 million barrels a day. This time, damage to offshore production infrastructure, while considerable, has been relatively less of a barrier to production recovery. The main issue has been damage to pipelines and onshore processing and refining facilities. As of late November, the loss of regional crude production remained at around 0.6 million barrels a day, or about 41 per cent of normal regional production (as reported by US Minerals Management Services).

Natural gas production remained at 68 per cent of the normal level of production. While complete recovery of energy infrastructure from hurricanes Katrina and Rita could run well into 2006, significant recovery should have occurred by the end of 2005 (as noted by US Energy Information Administration).

According to the United States Minerals Management Service, the estimated total amount of US oil and gas production lost over the period from 26 August to 23 November 2005 was 91.7 million barrels of crude oil (equivalent to around 17 per cent of yearly production of oil in the Gulf of Mexico) and 474 billion cubic feet of natural gas (approximately 13 per cent of Gulf production). This compares with a total loss of 43.8 million barrels between September 2004 and February 2005 from Hurricane Ivan. The impacts of hurricanes Katrina and Rita could also spillover beyond the short term. US Minerals Management Services suggests that destruction of older facilities nearing the end of theirs production life is likely to lead to a permanent loss of regional production capacity. In October, Chevron announced that the storm damaged Typhoon tension leg platform may be abandoned. In addition, the losses of drilling rigs and higher insurance charges will increase development costs and defer the startup of new fields.

Disruption to US refining capacity reached a peak of around 5.0 million barrels a day in September as a result of hurricane damage and precautionary shutdowns. Offline capacity was in excess of 3.5 million barrels a day in early October, before falling to under 1.0 million barrels a day in early November. Reflecting the disruptions caused by hurricane activity, the national average gasoline price in the United States reached a high of US$3.07 a gallon in early September. Since then, gasoline prices have declined gradually. In late November, the national average price was at US$2.20 a gallon, compared with around US$1.95 a gallon in the same period of the year.

Chapter 5

Technical analysis

RSI

The RSI's full name is actually rather unfortunate as it is easily confused with other forms of Relative Strength analysis such as John Murphy's "Relative Strength" charts and IBD's "Relative Strength" rankings. Most other kinds of "Relative Strength" stuff involve using more than one stock in the calculation. Like most true indicators, the RSI only needs one stock to be computed. In order to avoid confusion, many people avoid using the RSI's full name and just call it "the RSI." Calculation

$$RSI = 100 - \frac{100}{1 + RS}$$

$$\text{Average Gain} = \underline{(\text{Total Gains}/n)}$$

$$\text{Average Loss} = (\text{Total Losses}/n)$$

$$\text{First RS} = (\text{Average Gain}/\text{Average Loss})$$

$$\text{Smoothed RS} = \frac{[(\text{previous Average Gain}) \times 13 + \text{Current Gain}]/14}{[(\text{previous Average Loss}) \times 13 + \text{Current Loss}]/14}$$

$$n = \text{number of RSI periods}$$

To simplify the formula, the RSI has been broken down into its basic components which are **the Average Gain, the Average Loss, the First RS,** and the subsequent **Smoothed RS's.**

Crude oil RSI is shown below

Relative Strength Index Analysis

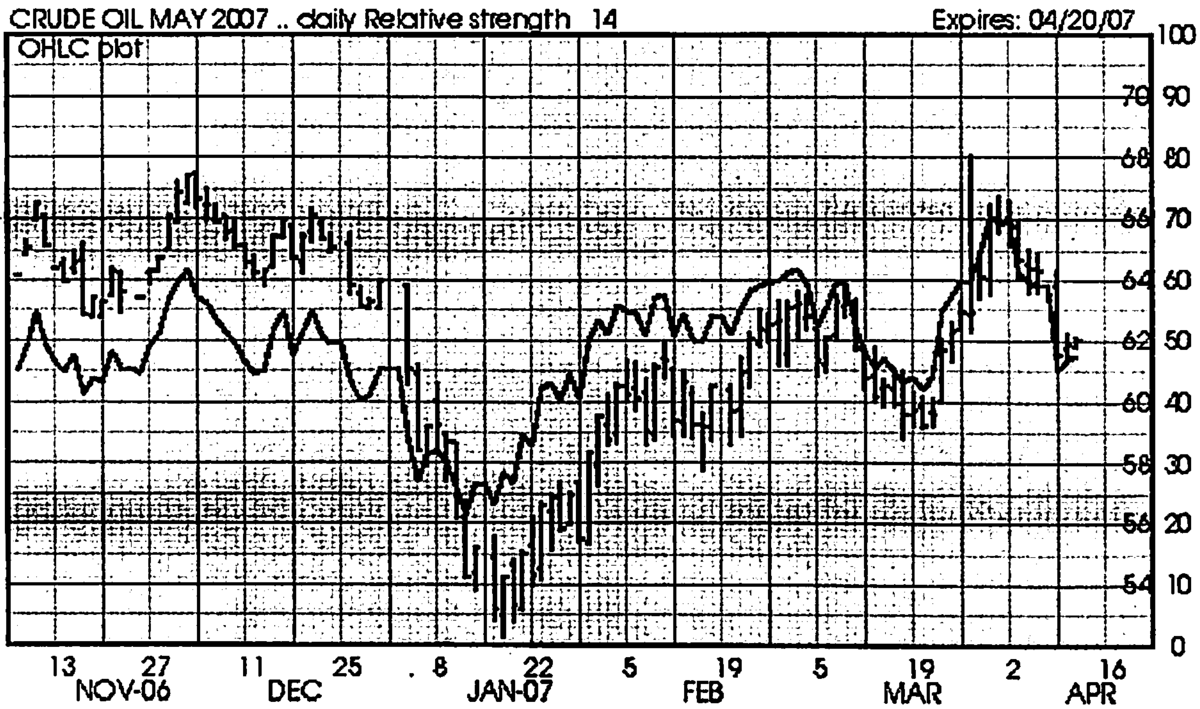


Fig 6.1 RSI Index Of Crude (Nov06- Apr 07)

INTERPRETATION

RSI Index Vs prices

The RSI index is a technical tool which helps the trader, to decide as to which he has to carry on the same position as to which he has made. Suppose the Trader is long in crude and the RSI Index is showing 60-65% ,thus the Trader should be aware that the Market can go against him and he should SQUARE OFF his position

Same would be the case if the Trader has gone Short in Crude and the RSI Index is showing 30-65% then the Trader should be aware that it's the time to reverse the position and the market can go in bullish mode. The current Prices are at 47% RSI and this Point of time it does shows any clear position but as it has fallen from 60% and the RSI has started increasing again this gives the signal to go LONG in Crude Oil

MOVING AVERAGE

- **Short Term**
- **Long Term**

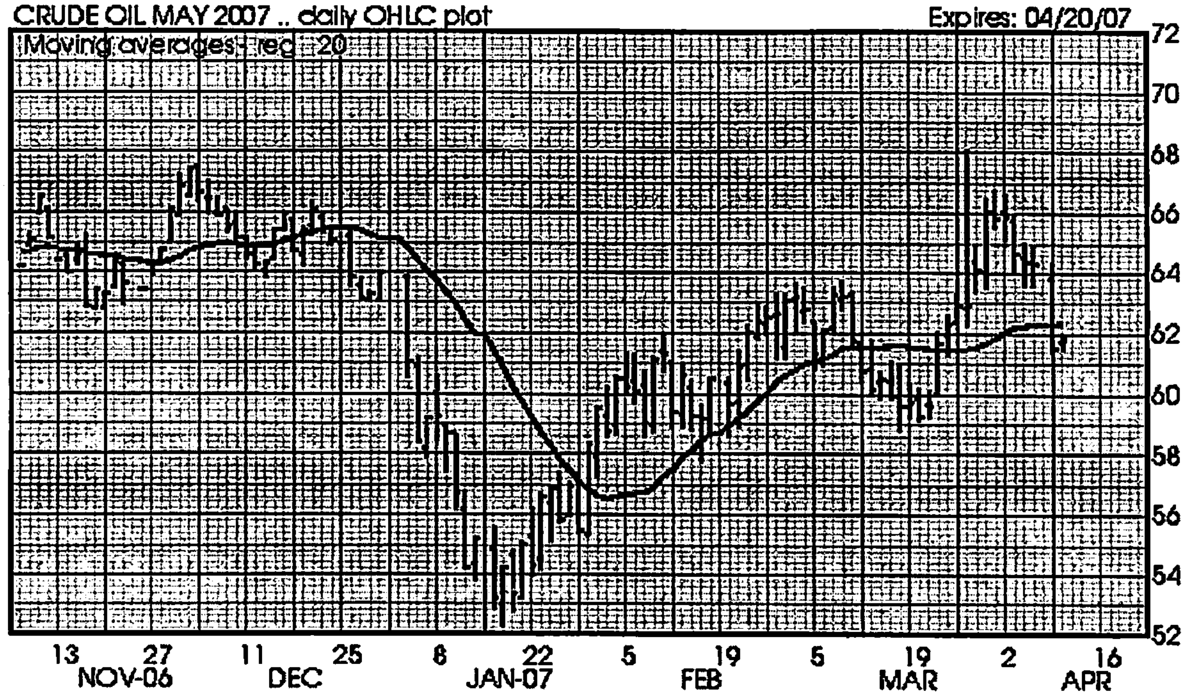


Fig 6.2 Moving Average Short term

20 Day Moving Average vs. Price

The Short term outlook clearly shows that the Current Prices has fallen below the 20 day moving average, so the current trend for making any position in crude oil futures is to sell the futures with the weak strength, that is the trader should follow strict stop loss.

Long Term

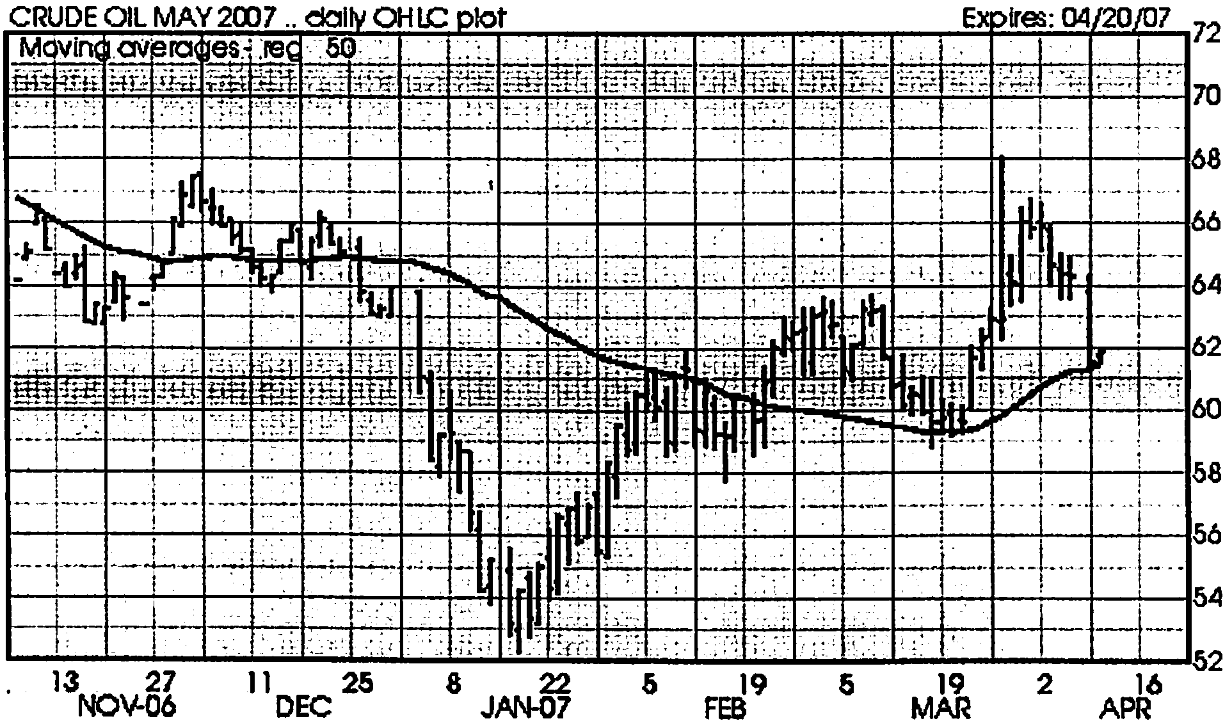


Fig 6.3 Moving Average Long term

50 Day Moving Average vs. Price

The Medium Trend of Crude Oil shows that the current Prices are above the Moving averages which mean that the prices are expected to increase and the Trader can go LONG in futures. But the stop loss should be kept in mind that as soon as the current price goes below the Moving Average, the trader should Square off the Position

Commodity Channel Index

There are 4 steps involved in the calculation of the CCI:

- Calculate today's Typical Price (TP) = (H+L+C)/3 where H = high; L = low, and C = close.
- Calculate today's 20-day Simple Moving Average of the Typical Price (SMATP).
- Calculate today's Mean Deviation. First, calculate the absolute value of the difference between today's SMATP and the typical price for each of the past 20 days. Add all of these absolute values together and divide by 20 to find the Mean Deviation.
- The final step is to apply the Typical Price (TP), the Simple Moving Average of the Typical Price (SMATP), the Mean Deviation and a Constant (.015) to the following formula:

$$CCI = \frac{\text{Typical Price - SMATP}}{0.0015 * \text{Mean Deviation}}$$

CCI is Shown in following ways

- Medium term
- Long Term

Medium Term

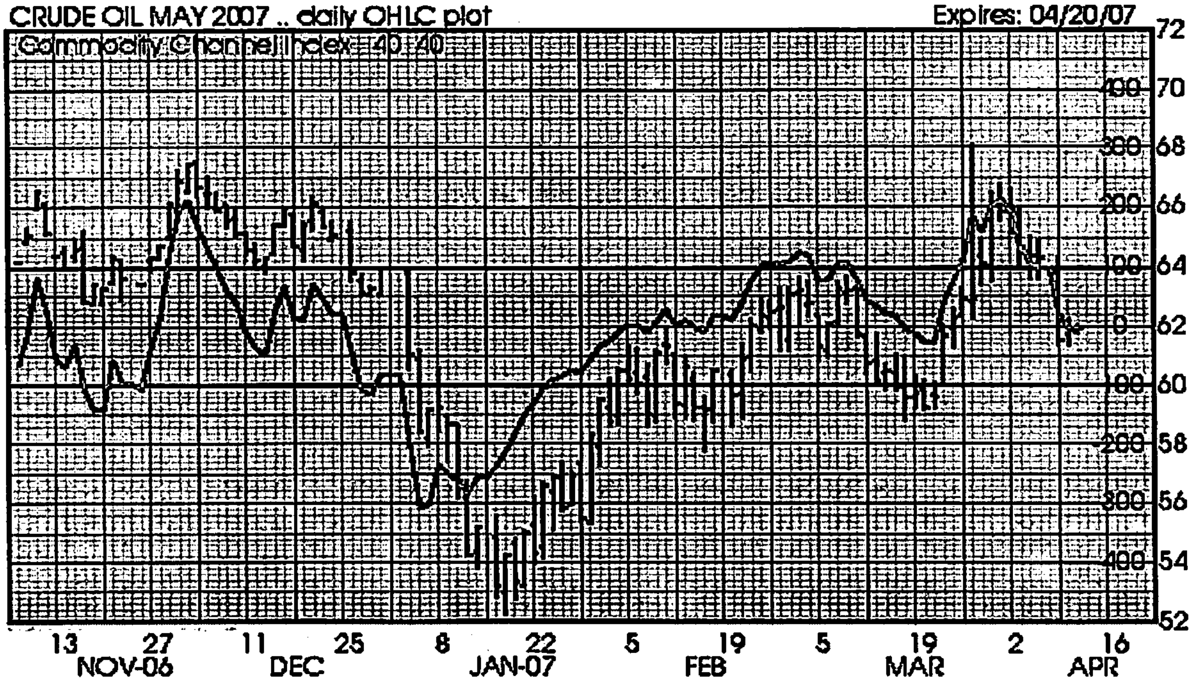


Fig 6.4 40 Day Commodity Channel Index

40 Day Commodity Channel Index Vs Price

The CCI index reflects the point (-100/+100) which are the indicators that helps the trader to make a position as to enter in an Uptrend or Downtrend. As it is clear from the above chart that as soon as the Price crosses the 100 index there the price tends to Increase and as soon as the prices falls below the -100 marks the prices starts to fall.
This chart also help the trader to ascertain whether there is Overbought/Oversold position in the market

Long Term

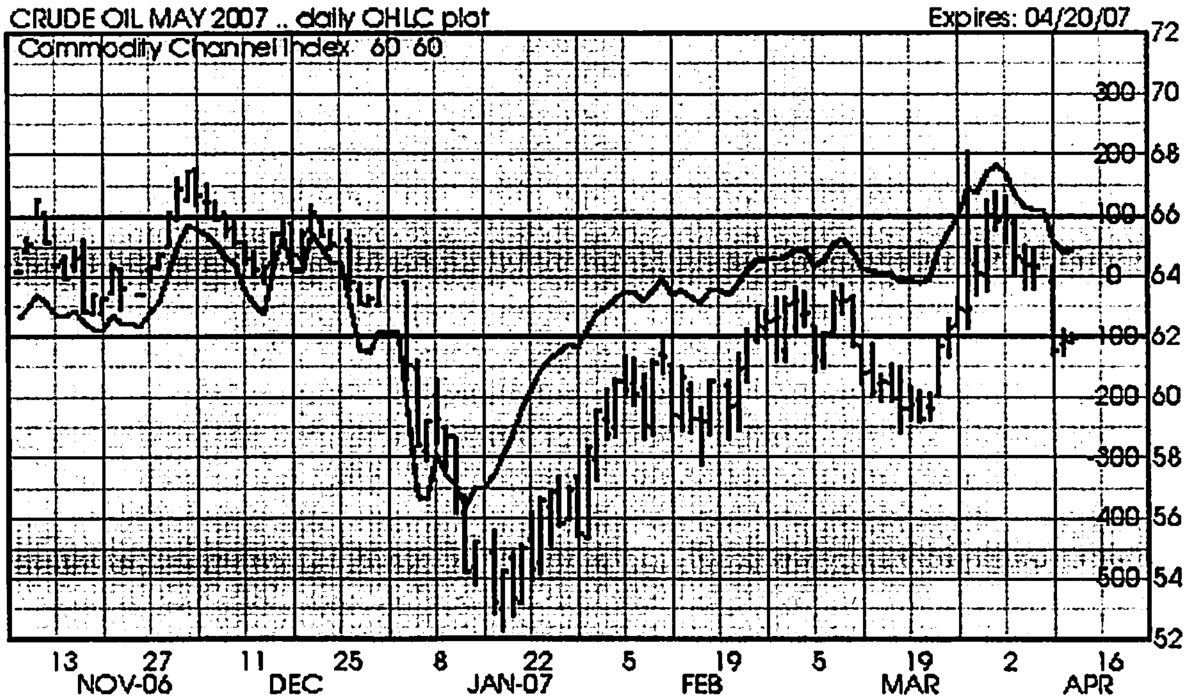


Fig 6.5 60 Day Commodity Channel Index

60 Day Commodity Channel Index Vs prices

This CCI index reflects the long term behavior of Crude Oil. As soon as the crude Oil prices touch the -100 the prices started falling and it continued to fall. The situation between the -100and + 100 does shows the clear position as to which way the market is going to perform

Conclusion

The impacts of oil shocks also depend on whether they are temporary or permanent. A permanent shock should change the equilibrium real rate of interest and equilibrium output. In a forward looking world real interest rates will rise more if the shock is seen to be permanent, and hence output will decline more in the short run for a given monetary response. Hence the inflation consequences of a permanent shock are likely to be smaller than those of a sustained but temporary shock. Analysis of oil price shocks undertaken on the assumption that financial and labour markets are myopic and do not use rational expectations of the future will give misleading results, especially as they will be unable to distinguish between the effects of a shock that is expected to be permanent and one which is expected to be temporary.

The oil intensity of output also affects the impact of oil shocks, and this has declined significantly over the last 20 years. As a result, we would expect oil shocks to have less impact now than in the 1970s. The output effects of an oil shock also depend upon the behaviour of oil exporting countries. If they do not spend revenues quickly output effects in the OECD will be larger in the short run. This may indeed help to explain why the impact of the 1970s oil shocks on output seemed large: spending of oil revenues on goods and services then tool place more slowly than it has since 1985. Models and tools that cannot take account of this difference may produce misleading results.

These conclusions indicate that great care should be taken in using 'ready reckoners' for the effects of oil prices on output and inflation. Such estimates should be seen as conditional on the assumptions made by the investigator and on the tools used in the analysis.

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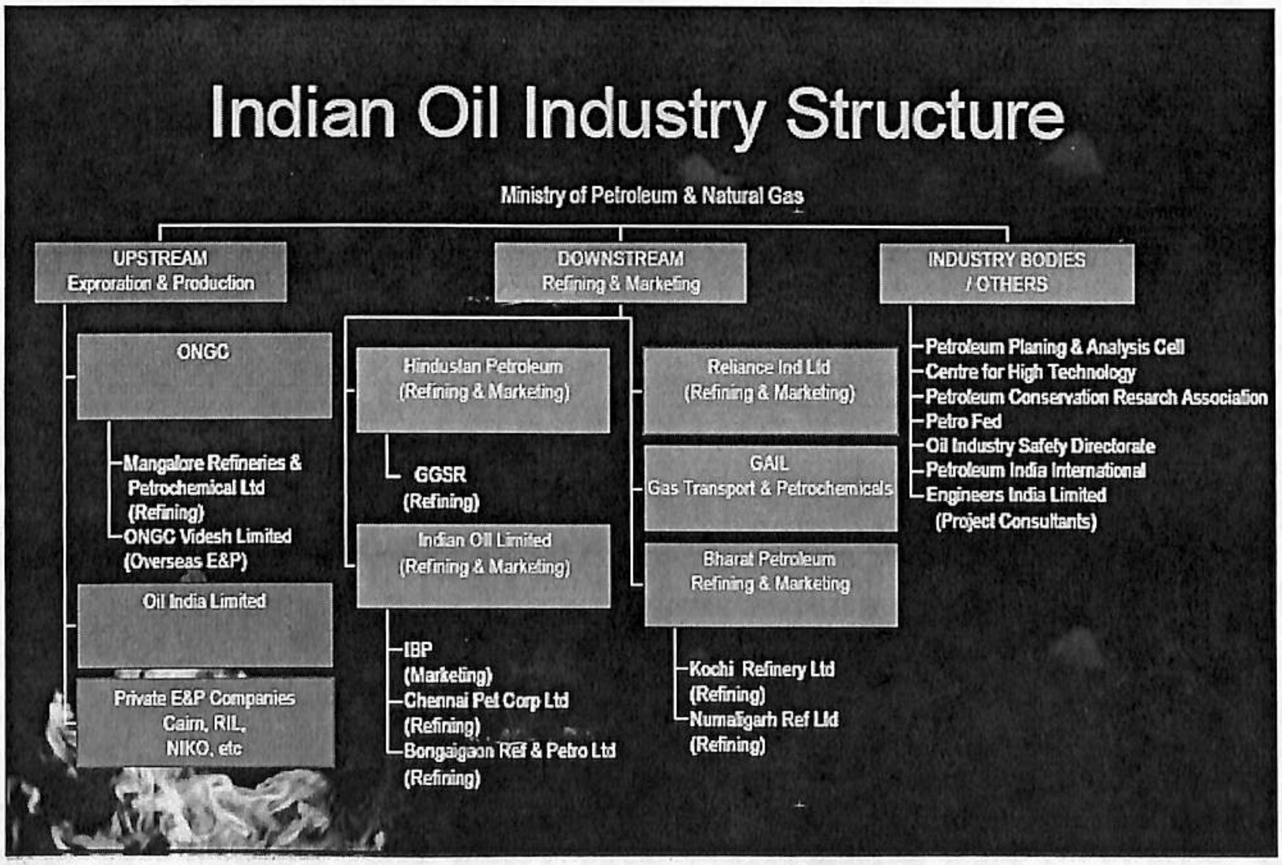
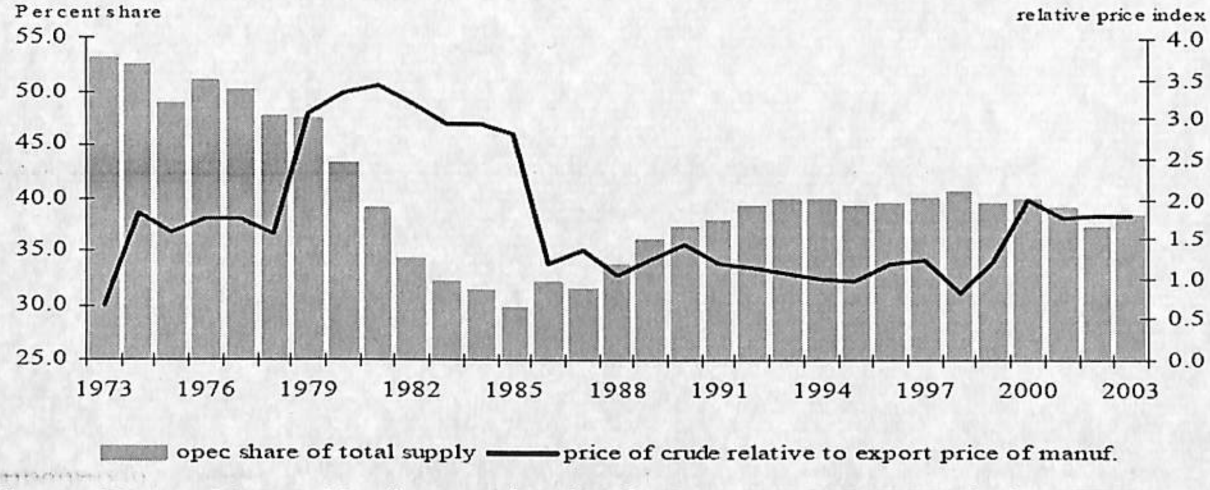
Appendix i



Indian Oil Industry Structure
Ministry of Petroleum & Natural Gas
UPSTREAM
Exproration & Production
DOWNSTREAM
Refining & Marketing
INDUSTRY BODIES
/ OTHERS
ONGC
Mangalore Refineries & Petrochemical Ltd (Refining)
ONGC Videsh Limited (Overseas E&P)
Oil India Limited
Private E&P Companies
Cairn, RIL, NIKO, etc
Hindustan Petroleum (Refining & Marketing)
GGSR (Refining)
Indian Oil Limited (Refining & Marketing)
IBP (Marketing)
Chennai Pet Corp Ltd (Refining)
Bongaigaon Ref & Petro Ltd (Refining)
Reliance Ind Ltd (Refining & Marketing)
GAIL
Gas Transport & Petrochemicals
Bharat Petroleum
Refining & Marketing
Kochi Refinery Ltd (Refining)
Numaligarh Ref Ltd (Refining)
Petroleum Planing & Analysis Cell
Centre for High Technology
Petroleum Conservation Resarch Association
Petro Fed
Oil Industry Safety Directorate
Petroleum India International
Engineers India Limited (Project Consultants)

Appendix ii

Chart I.3 Movement of oil prices and OPEC's share of world oil supply



Sources: IEA Annual Statistical Supplements to the Oil Market Report 2002, 1998; NiGEM database; NIESR calculations