UNIVERSITY OF PETROLEUM & ENERGY STUDIES
DEHRADUN

Harnessing Energy through Knowledge

Dissertation Report on

RISK ASSESSMENT AND MITIGATION IN CRUDE OIL TRADING : APPLICATION OF MONTE CARLO SIMULATION

Under Supervision of :

Dr. Sumeet Gupta

Associate professor

Head – Center for Infrastructure and Project finance

Submitted by :

Rahul Tiwari

MBA Energy Trading

SAP ID - 500020821

Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation

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Application of Monte Carlo Simulation Technique for the Assessment of various risk, in Crude Oil Trading.

3/30/2014

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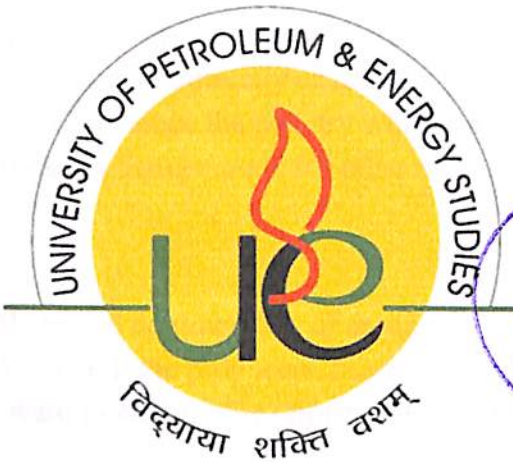

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Abstract

Crude oil is one of the most important sources of energy in the world. Every single entity in this world is somewhat affected by the crude oil directly or indirectly. Not a single country in this world can survive without crude oil but since the country which have deficit of crude and the country which have excess of it can exchange crude for other means, it gives a horizon for trading of crude oil.

Nowadays it is one of the mostly traded commodities of around the world. Thus trading of crude oil attracts various kinds of risks to both the producers, buyers as well as for traders. Many models in the past were put forward to analyze the impact of these risks on the trading and prices of the crude oil.

One such effort was made to make a Model of risk assessment using **MONTE CARLO SIMULATION TECHNIQUE.**

BONAFIDE CERTIFICATE

This is to certify that Mr Rahul Tiwari, student of University of Petroleum and Energy Studies, Dehradun, pursuing MBA(Energy Trading), has successfully completed his dissertation project. As a part of his curriculum, the project report entitled, "**Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation**" submitted by student to the undersigned in an authentic record of his original work which he has carried out under my supervision and guidance.

I wish him all the best.

Dr. Sumeet Gupta

Associate Professor

Head- Center for Infrastructure and Project Finance

College of Management & Economic Studies

University of Petroleum & Energy Studies

CERTIFICATE FROM THE GUIDE

This is certify that Rahul Tiwari, MBA-Energy Trading student from UPES, Dehradun have completed this dissertation on given project titled **"Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation"** under my supervision in partial fulfillment of the **MBA Degree in Energy Trading**. This project has not been submitted earlier to University of Petroleum & Energy Studies, Dehradun for the requirement or a course of study. To the best of my knowledge, he has made an earnest and dedicated effort to accomplish this project. I wish him all the best for his future endeavors.

Supervisor & Mentor

Dr. Sumeet Gupta

(Associate Professor)

(Head- Center for Infrastructure and Project Finance)

CERTIFICATE OF ORIGINALITY

This is to certify that the project titled **"Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation"** is an original work of the student Rahul Tiwari. It is being submitted in partial fulfillment for the award of the Master Degree in Business Administration in Energy Trading from University of Petroleum & Energy Studies, Dehradun for the fulfillment of the requirement of course of study. This report has not been submitted earlier in this University for the requirement of a course of study.

Signature of Supervisor & Mentor

Dr. Sumeet Gupta
(Associate Professor)

.....

Signature of Course Co-coordinator

(Professor Sonal Gupta)

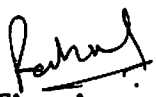
.....

ACKNOWLEDGEMENT

The success of any project largely depends on the encouragement and guidelines of many others who are involved directly or indirectly, apart from the efforts of the person carrying out the project . We take this opportunity to express our gratitude to the people who have been instrumental in the successful completion of this project.

This is to acknowledge; the assistance, guidance and support that we have received during the preparation of Dissertation Report. I place on record our deep sense of gratitude to all the Faculty Members, friends, classmates, etc.;without their able support the dissertation report would not have become a reality.I would like to thank my Mentor for dissertation **Dr Sumeet Gupta (Associate Professor, Head- Center for Infrastructure and Project Finance)**, his knowledge in the subject provided me great insight for making the report. Not but the least I would like to thank my friend **Ishan Wadhwa**, his help proved quite helpful in the making of this report.

I must also thank **Ms. Sonal Gupta** my course cordinator for her fervent support in our endeavor.



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DECLARATION

I, Rahul Tiwari the student of MBA Energy Trading of University of Petroleum & Energy Studies, (Recognized by UGC, Ministry of HRD, Govt. of India) do hereby declare that the dissertation project report entitled **"Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation"** that has been submitted by me as a requirement for the award of gaining knowledge in field of **Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation** was really good learning experience for me.

The project on **"Risk Assessment and Mitigation in Crude Oil Trading: Application of Monte Carlo Simulation"** is the original work done by me. Whatever information furnished in this project report is true to the best of my knowledge.

By

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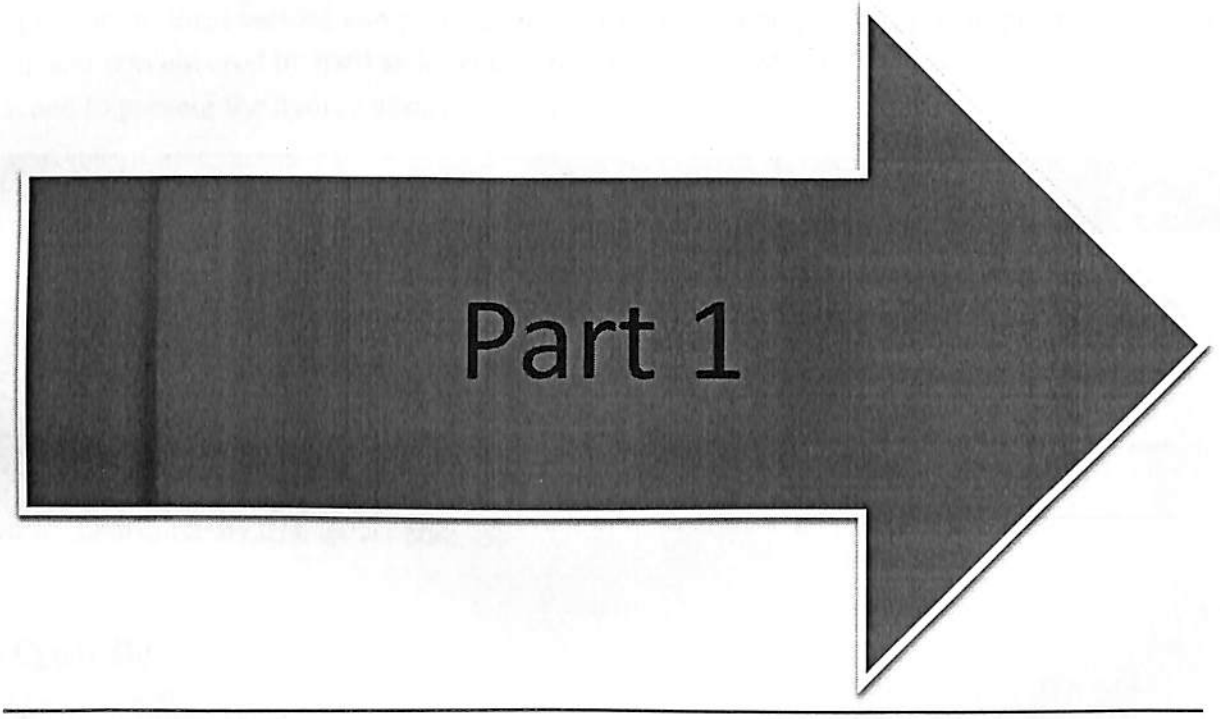
Abbreviations	Full Forms
NYMEX	New York Mercantile Exchange
MOPS	Means of Platt's Singapore
BRENT	Brent Blend, Forties Blend, Oseberg and Ekofisk
WTI	Western Texas Intermediate
RPO	Rubber Processing Oil
MTO	Multimodal Transport Operator
cbm	cubic billion meters
HVFO	Habitual Violent Felony Offender
NAFTA	North America Free Trade Agreement
SAFTA	South Asia Free Trade Agreement
ISO	International Standards Organization
NOC	No Objection Certificate
DWT	Deadweight
POL	Petroleum, Oil and Lubricants
GSP	Generalized System Preference
CCAI	Calculated Carbon Aromaticity Index
LCO	Light Cycle Oil
TSP	Total Sediment Potential
TSA	Total Sediment Accelerated
BPC	Bharat Petroleum Corporation
IOC	Indian Oil Corporation


Part 1

Chapter 1

Introduction of Crude Oil and its Products

1.1 Introduction of Crude Oil

The word oil is derived from the latin Petra (rock) and Oleum (oil). It consists of the natural compounds hydrocarbons in carbon & hydrogen. These hydrocarbons are trapped below the surface of the Earth, in porous rocks and in the form of oil and gas.

Hydrocarbons are derived from remains of the prehistoric terrestrial animals, marine organisms (plankton) and vegetation that have been washed away and buried below the Earth during the upheavals on surface from millions of years ago the Earth. In the course of both buried decomposed organic matter, carbon and hydrogen present in these, reacted under pressure and temperature to form various compounds, generally hydrocarbons. The oil is trapped in the porous rocks and was covered by hard sedimentary rocks that form above. They acted as 'ceiling' or attached to prevent the hydrocarbons to escape.

Name	Content	Phase
Methane	CH_4	Gas
Hexane	C_6H_{14}	Liquid
Octane	C_8H_{1o}	Liquid
Wax	$C_{2o}H_{42}$	Solid

Table 1.1: Light and Heavy Hydrocarbon Molecules

1.2 Crude Oil

Crude oil is a mixture of around 500 products chemical organic, mainly of the hydrocarbons (molecules composed of carbon & hydrogen). Crude oil is retrieved from underground reservoirs, normally 1000 - metres of 5000 at the bottom of the Earth. Crude oil can be of a variety & characteristics. It might be very fluid, very viscous and semi-solid. The color is black, dark brown, orange or light brown. It is called oil too.

1.2.1 Composition of the Crude Oil

The Crude oil consists mainly of hydrocarbons. Crude oil is composed of three main groups of hydrocarbons:

- paraffin wax
- naphthenes
- aromatic

It contains volatile hydrocarbons called olefins too.

- Chlorinated paraffins are straight-chain compounds, chemically stable. More light (CH4, C2H6) are gas. The heavier molecules are liquid (oil) or solid (wax).
- The naphthenes are composed of rings of carbon, with / without side chains. Saturated with hydrogen, Naphthenes are also chemically stable. Light Naphthenes are liquid and heavier could be solid.
- Aromatic are compounds with a cycle of six carbon atoms with alternating single and double bonds and six hydrogen atoms. They are relatively unstable.
- Olefins are double hydrocarbon chains linked, normally produced during treatment with high-temperature oil. olefins are unstable and polymerize easily say a large number of olefins can easily combine together to form large molecules of gelatin or plastic.

1.2.2 Classification of the Crude Oil

Various crude oils are often differentiated by their American Petroleum Institute (API) Gravity. API Gravity is expressed in (141.5 / SP. Gravity -. 131.5). As the density is in the denominator; API gravity is higher for light & low crude oil for crude oil heavy. A comparative idea of this unit of gravity can easily be obtained by comparison with water; water: figures of typical API gravity of the crude 10 API are as follows:

- Mumbai high gross: 40 API – the gross light
- gross Arabian: 34 API – the average gross
- Venezuelan crude : 15 API – the heavy crude

There can be a sub-category as heavy or light to medium. The other classification is based on the characterization of the factor, which depends on the API gravity and Boiling point.

1.3 Types of Crude Oil

1.3.1 The Light Crude

It has a low density; which makes it easier to transport and refine. Most refiners prefer light crude oil; because the light crude contains low sulphur content. Light crude is

chemically close to any finished products desired such as gasoline & diesel fuel and in general it requires less refining & processing; and is generally greater valuable and more expensive than the heavy oil.

1.3.2 The heavy Crude

It has high density; which makes it much more difficult to transport & refine. Gross heavy is cheaper to buy & usually cheaper to extract heavy crude produced from oil sands can cost around two times more than conventional drilling.

1.4 Distillation of Crude Oil

Crude oil derived from the wells contains a mixture of hydrocarbon & relatively low the amount of other material such as oxygen, nitrogen, sulfur, salt and water. The refining process removes most of these non - hydrocarbon substances and the oil breaks down into various components & mixed in the useful product.

1.4.1 The Atmospheric Distillation

The atmospheric distillation is first step in the refining process to separate the gross revenues by distillation under pressures greater than atmospheric pressure (The atmospheric distillation). Atmospheric distillation is made to separate the light by cuts heat the crude to 350 - 3700C at the near atmospheric pressures. These temperature light and white goods such as motor gasoline, kerosene, turbine aviation fuel (ATF) and diesel is distilled as materials first for processing. The residue left at the bottom of the distillation column after atmospheric distillation is called long residue. The next step in the distillation is vacuum distillation of the long residue.

1.4.2 The Distillation under Vacuum

The limitation of the distillation at higher temperatures because; deterioration of crude oil begins to temperatures greater than 370 ° C. 350^0C - gross in oil cracking high temperatures mean heavier molecules begin to break in more small molecules. The uncontrolled cracking in coke formation process and production of olefin results in unstable (double bond) hydrocarbon products. The vacuum distillation unit gives the vacuum gas oil in the form of distillate which is used as feedstock for cracking into the lighter products. Vacuum gas oil can form the base for processing into lubricating oils. In the vacuum distillation, the residuum from the atmospheric distillation is heated to approximately 350 - 370 ° C and distilled under vacuum.

Distillation Unit	Temperature	Product
	<35°C	Lighter and Butane
Atmospheric Distillation Unit	35°C-80°C	Gasoline
	80°C-140°C	Naphtha
	140°C-250°C	Kerosene
	250°C-350°C	Gasoline

	350°C-400°C	Light Vacuum Gas Oil
Vacuum Distillation Unit	400°C-500°C	Heavy Vacuum Gas Oil
	500°C +	For Bitumen Processing

Table 1.2: Atmospheric and Vacuum Distillation Unit Products

1.5 Products of Crude Oil

The crude oil is used to manufacture many products. When oil crude is refined in the refinery, and then it gives a lot of products such as gasoline, heating oil, LPG (liquefied petroleum gas), kerosene, diesel, etc. here's gasoline and heating oil explained; because it is used in the crack spreads to cover the price of crude oil.

1.5.1 Gasoline

Gasoline is a nonrenewable fuel derived from crude oil. Refineries in the United States can produce about 2 litres of essence of all 42 gallons of crude oil that is refined. The rest of the body turn into other petroleum products such as diesel fuel, heating oil, jet fuel and propane. Refiners seek to maximize the production of the gasoline each and every time.

After extraction of the primary process the octane gasoline must be strengthened because it does not meet the necessary specifications of the contracts. The octane of the gasoline is close to the 60 - 65 when it is made from crude oil, but the market demand is close to the 90 - 95.So it requires additional processing in order to increase the octane of gasoline. Refinery uses octane booster to do this process. This process involves the alkylation and isomerization. Under this refinery processes convert the paraffin straight-chain in isomeric chlorinated. The essence is to be traded on the New York Mercantile Exchange, Intercontinental Exchange, Tokyo Commodity Exchange bio (of Iranian Oil Bourse), Multi Commodity Exchange.

To understand how the price of crude oil affects the price of gasoline in a suite of example:-for example, in 2004, the price of gasoline was $ 1.85 per gallon when crude oil cost in the total cost of the product was nearly 47% on the. But in 2005 cost of the gasoline has increased due to the increase in the price of crude oil. At that time, the price crude oil is 53% of the total cost of gasoline. Now we can understand when oil prices increase the value of the finished product has also increased due to the crude oil prices play an important role in the final cost of the product and the oil is the matter first for gasoline.

1.5.2 Heating Oil

It is known as the fuel oil No. 2 in America. This oil is also the other important product that is produced by the refinery of the crude oil. It is a product of low viscosity and easily flammable. Heating oils are very similar to diesel fuel and the two products known as distillate fuel. It consists of a hydrocarbon of approximately 14 close range 20 carbon atoms. Heating oil should be stored in aboveground storage tanks. Sometimes the oil must be stored in the reservoirs of the underground storage; but not as much as the above ground storage tank. It is transported by tankers for household and industry.

The heating oil is traded on the NYMEX (New York Mercantile Exchange) and ICE (Intercontinental Exchange). The heating oil future contracts are available for the entire year. The dissemination strategy allows traders to manage price risk. The traders use heating oil to cover the price of crude oil.

The price of heating oils, must be paid by the consumer; depends on the price of crude oil (which is used as a feed stock); the cost of the production of heating oil and also the cost of marketing and distribution. The profit margin of the refiners, wholesalers and retailer is also included in the price of the oil. The proportion of the expenses of marketing and distribution was around 46% of the total cost of heating oil in 2001. Another important factor that affects the cost of heating oil is crude oil proportion is close to about 42% of the total cost of heating oil and the cost of the refinery processing is almost 12% of the total cost.

- The price of heating oil tends to increase in the winter. The reason is that demand for winter heating oil is increased at a speed high over the supply of the fuel. America's heating oil is used for the purpose of heating the Chamber. Demand for heating oil increased during the winter season. A homeowner in the Northeast could use 650-1000 gallons of oil heating in winter typical, while consuming very little in the rest of the year. (Source - EIA brochures).
- Crude oil prices play an important role in the price of heating oil. If a change in the price of crude oil directly affects the price of heating oil. The price of crude oil depends on its application and offers it and it is also affected by the other factor. The supply of crude oil is also influenced by OPEC and OECD policies.
- The operating cost also affects the price of heating oil. Operating cost varies from place to. The cost of operations is close to approximately 46% of the total cost of the cost of finishing. If a change is in what it strongly affects the cost of heating oil.

1.6 The Crude Oil Bench Marks

1.6.1 Brent Crude 0il

Brent crude is used as a benchmark for determining the price of crude oil. It is a light and oil raw; but not as sweet as WTI. The severity of API of the Brent crude oil Brent is close to the 38.06 and its density is close to the 0.835. Sulphur in the crude oil Brent is about 0.37%. Above all, it is used for the distillation of gasoline and middle distillate products. Contracts of the futures and options of crude oil Brent traded on the ICE (Inter Continental Exchange), NYMEX (New York Mercantile Exchange). The symbol of crude oil Brent is CL for trading of raw materials market. Earlier the Brent crude was traded on the auction on PEI, but now it must be exchanged electronically on the ice. A contract of the crude oil Brent is of 1000 barrel of crude oil. The contract price for crude oil Brent is recalled in the dollar per barrel.

1.6.2 West Texas Intermediate

West Texas Intermediate is of a very high quality and is great for a large part of gasoline refining. The API gravity of WTI is 39.6 degrees (which makes it a light crude oil); and it contains as approximately 0.24 percent of the sulphur (Which makes the crude soft). The ideal crude is refined in the United States; the largest country of gasoline consumption in the world. Most of the West Texas Intermediate crude oil is refined in the Midwest region of the country, with a little more refined in the Gulf region. Though WTI crude oil production is declining; it is still the main benchmark of crude oil in America. WTI is generally valued at a premium of about $ 2 per barrel for the OPEC basket price and about $ premium 1 barrel of Brent; although on a daily basis the price between these relationships can vary considerably.

Saudi Arabian Oil Types

Saudi Grade	API	Sulphur	Type	
Arabian Extra Light	39.4	1.09%	Light	Sour
Arabian Heavy	27.7	2.87%	Heavy	Sour
Arabian Light	32.8	1.97%	Medium	Sour
Khafji	28.3	2.85%	Heavy	Sour
Saudi Heavy	27.0	2.87%	Heavy	Sour
Saudi Light	34.0	1.97%	Light	Sour
Saudi Medium	31.0	2.35%	Medium	Sour
Wafra	24.5	3.80%	Heavy	Sour
Average	30.6	2.47%		

Diagram 1.1: Saudi Arabian Oil Types

1.6.3 Oman Dubai Crude Oil

Dubai Oman crude used by countries in the Middle East for the determination of the price of their crude. In the early days, the Middle East countries decide their price on the basis of the Brent, but Brent is light crude oil, while the countries of the Middle East crude oil contains high sulphur content and the API gravity, near the 15-17 API. Thus, the price is not determined on the basis of a petroleum crude Brent. Dubai Oman crude traded on the Dubai Mercantile Exchange. DME launched Dubai Oman crude oil future contract in July 2007.

1.6.4 Tapis

Tapis is a Malaysian crude oil used as a marker of gross price in Singapore. It is not only traded on the market like Brent and WTI, it is often used as a marker of oil to Asia.

1.6.5 Bonny Light

It's a nigerian crude oil of high quality having gravity high API and a low sulphur makes it highly desirable quality. There Brent as a marker.

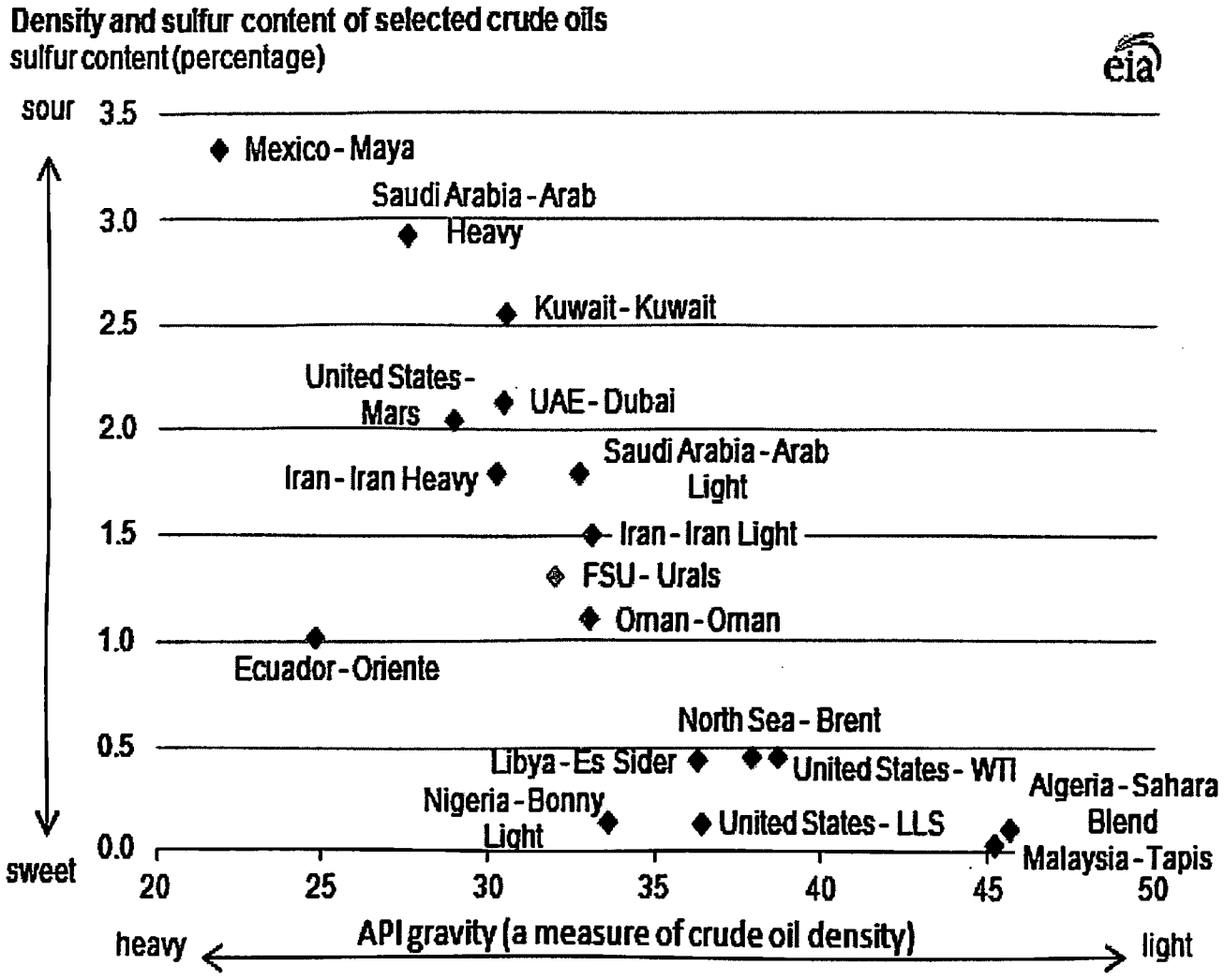
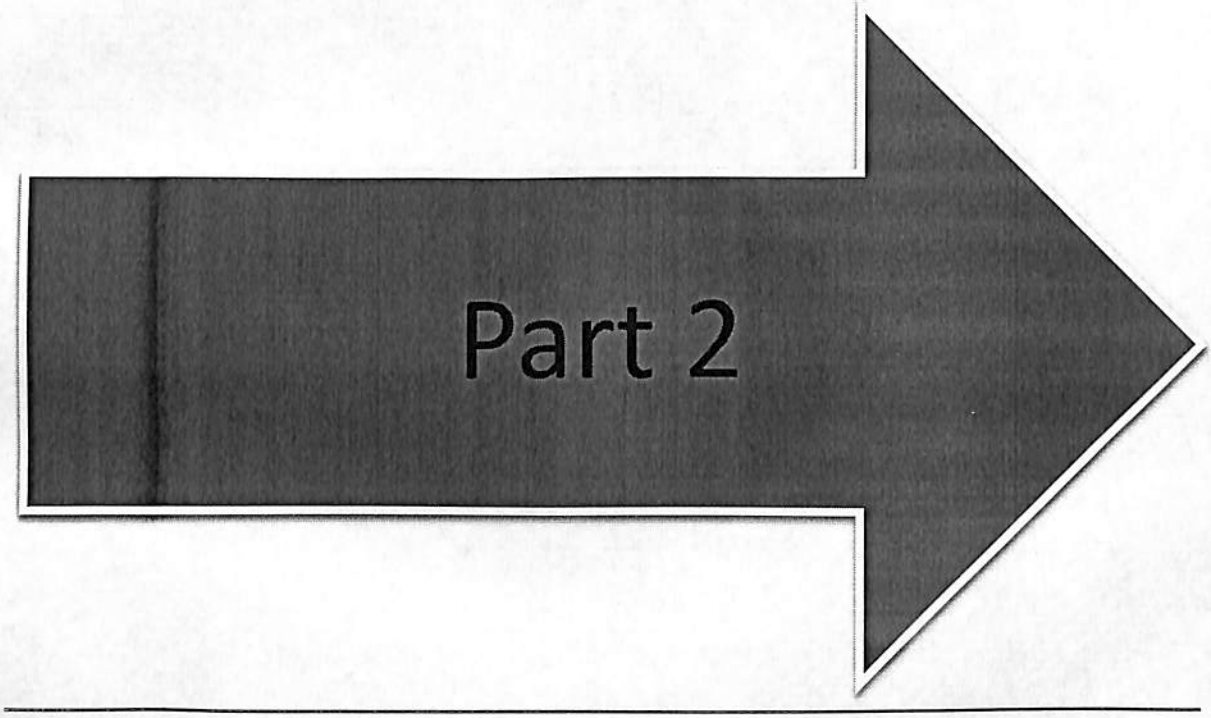


Diagram 1.2: Density & Sulfur Content of Crude Benchmark


Part 2

Chapter 2

2.1 Introduction:

Crude oil has been the backbone of the global economy since the beginning of the last century. Consumption has increased to no rebound during this period. The impact of crude oil in the world is so that people cannot imagine life without the products that gives, directly or indirectly. Our daily lives, industries, economy, GDP, etc countries countries are completely dependent on crude oil products directly or indirectly. For the same reason by the end, he had drawn several wars between nations and countries are trying to build the Strategic Petroleum Reserve (SPR) to protect a little variation in the supply of crude oil.

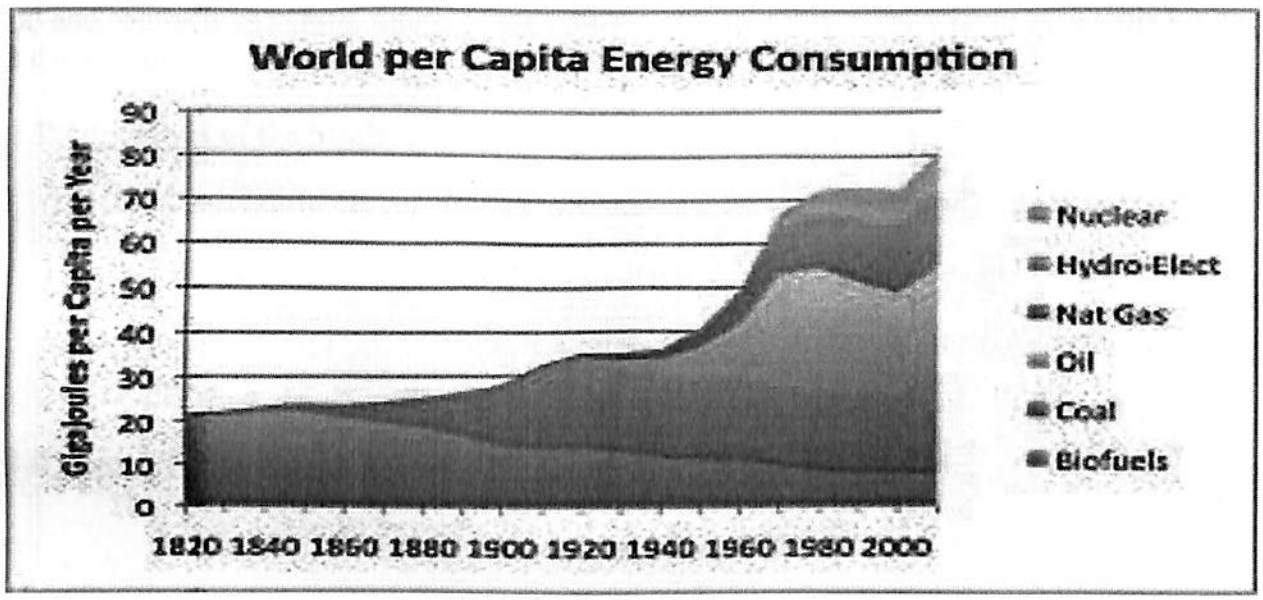


Diagram 2.1: World per capita energy consumption

The dependence of countries on crude oil and the increase in demand of it attracts the fluctuations of the oil prices gross therefore involves different types of risks which are linked, which can have adverse effects on the economy of the country and the economy of the world. Some of these risks are currency risk, geopolitical risk, the risk of supply, the economic scenario, risk goods, basis risk, etc.

While some of them may be minimized by the use of various tools cover others may be provided and the appropriate measures can be taken to reduce the loss. The market is volatile risk assessment becomes very important for traders, the industry and the overall economy of the country. Different models have been developed on the evaluation of the price of crude oil.

2.2 Rationale for The Study

Crude oil is the main source of energy for a country. Developing countries is totally dependent on the price of crude, directly or indirectly. GDP and the economy of all countries are severely affected by the change in the price of crude oil. The growing dependence of countries on crude oil made the largest well traded today in the world. The impact of crude is much more that it has become the focal point of all decision-makers. The gross deficit countries are more and more depending on the negotiation of crude to meet its domestic needs. Countries around the world as the India and China are one of the largest consumers of crude, but their domestic production is sufficient to meet its domestic needs and to maintain growth rate needs are increasingly depending on the crude import. Even developed countries like the United States, Canada, etc also depend heavily on crude oil to meet their national needs. The growing demand and exposure of countries towards crude oil to meet energy demand have increased volatility in prices and therefore risk. Different types of risk instruments was used by traders to reduce the risk to crude oil and contracts as before, future, swap, options, etc. are some of the widely used tools for the same purpose.

2.3 Objectives of the Study

- To identify different risk factors involved in the trade of crude oil.
- To identify the important templates available for the risk assessment.
- To use MONTE CARLO SIMULATION MODEL to find out the risks in trading of crude oil.

2.4 Research Methodology

- **Type of research: -.**

  Research descriptive and analytical methodology will be applied to know the risks associated with the trading of crude oil.

- **Primary data: -.**

  Primary data will be collected in the form questionnaire completed by people of the industry energy.

- **Secondary data: -.**

  To learn various risk factors and data that will help to calculate the cost overruns, delay factors etc possible secondary data source will be following: -.

  - Various Web Sites of Oil Company.
  - Available paper research on management risks of project of the oil industry.

- Websites various companies involved in the oil industry.

➢ **Sample size:-.**

- The sample size for the application of the factor analysis should be large. As mandated by (Bell) and (cabbage, 1987), the size of the sample required for the factorial analysis 08 h 01 which means that for each a variable, there must be at least 8 respondent. The sample size will be so determined.
- Before answering the questions, respondents will be given a presentation on a few minutes of the vulnerability and the concepts of risk and on the ultimate goal of the research so that all have the same perception about the concepts and have less confusion and misunderstandings.

➢ **Statistical tool:-.**

- The use of SPSS for data analysis and interpretation in both primary and secondary discovered during the course of the completion of this project.
- Monte Carlo Simulation technique will be used to predict the effect of various risks.

2.5 Review of the Literature

There is vast amount of literature review available for the reference of the project. Better use of all the information has been used from the review of the available literature. Books about derivatives and risk management have provided great help in the understanding of the concept of trading in derivative products. Books like Energycopia (Volume IV - Energy Trading) by Dr. Parag Diwan, management of derivatives and risk by John C Hull, manual trading of oil by David Long, etc needs special mention to the assistance provided by these books was huge for the end of this project.

Without forgetting the concept and understanding that has been provided by numerous works of research of both national and international writers. Research gave a good overview of the subject. Research gave the direction and the right way to proceed and conclude the project. Each research paper is unique in the sense that they have been written with the problem faced by all aspects of the commercial crude oil for example string for refiners, traders, importers, etc. and are affected by the change in the price.

2.6 Reports and Reviews:

S.No & Theme	*Author & Year*	*References*	*Findings*
A. Crude Oil Pricing			
1. Energy Prices	Paul Bolton	House of Commons Library Standard Note: SN/SG/4153	Household gas and electricity prices were generally in an upward trend of the course of the eight years after a decade of falling prices. The cost of heating oil has increased by a higher amount. It has been lower prices in recent years, but they have smaller than price increases. In the dynamics of long-term pressures on prices all seem to be on the rise.
2. Peaking of World Oil Production: Impacts, Mitigation & Risk Management	Robert L. Hirsch	NETL Publication " Oil Peaking 2003"	The peak of world oil production presents US and the world with an unprecedented risk management problem. Tip is approached; liquid fuel prices and price volatility will increase dramatically and without mitigation in a timely manner the political and social cost economic will be unprecedented.
3. World Oil: Market or Mayhem	James L. Smith	Journal of Economic Perspectives- Volume 23, Number 3- Summer 2009- Pages 145-164	Phenomena can occur early or late in the life cycle of a particular resource and may report the scarcity or surplus, the beginning of the

			rapid rise of prices or the arrival of the plateau - all prices depending on the underlying structural relationship and the settings in the economy. For the world oil market, the essential insight is that while oil is constantly used the world is not running out of oil (Adelman & Watkins 2008). Despite global consumption (and consequent exhaustion) by 700 world billion of oil: market or Mayhem? 161 billion barrels of crude oil during the last quarter of a century, the remaining fuel stock have doubled from 7oo billion barrels in 1980 to 1400 billion barrels - and now stands at its highest level. The reserve ratio divided by annual production also increased by a multiple of 29 years in 1980 at age 45 in 2008. Thus, in the other, we say that we are a small fraction of the remaining oil reserves every year it several decades ago.
B. <u>Risks Related to Crude</u>			
1. Review of Issues Affecting the Price of Crude Oil	Petroleum Resource Branch Energy Sector, Canada	Natural Resource Canada, 2010	The oil prices are affected by the combination of various complex factors. Traditional factors such as levels of crude stocks levels of spare capacity,

			technological advances, the marginal cost of production, weather seasonal and serious and all offers and demand, OPEC production strategies and continue to be important in determining the general direction of the price of crude oil. However, in recent years, new emerging factors such as the devaluation of US dollars had an effect more and more on the price of oil. Geopolitical events and the nationalism is not new, have gained increasing influence as well.
2. How to Reduce Costs and Manage Risk in the Upstream Oil & Gas Industry		An Oracle White Paper – 2011	The upstream petroleum industry is today facing waves unprecedented additional cost and regulatory challenges as it tries to navigate the benches of the management of the risks to the preservation of its bottom line. Risk factors historical - namely commodity prices, geopolitics, etc - is facing the industry have become more complex. Oil and gas price movements are now attached to macroeconomic influences more than they are physical supply and demand; who coverage by derivative financial instruments related to raw materials - a key risk management tool - a

			proposal for a decision maker. A "brain drain", aka "The Grand crew change" was a crucial issue in a few years earlier for oil and gas companies see their pool of qualified personnel decrease; He will be back with a vengeance that the activity continues to bounce back with the economic recovery. Socio-political concerns also change the playgrounds of these emerging issues as nationalism resources and restrictions on foreign investment. An increasing trend is observed in many nations to capture more rent on development of hydrocarbons - both on pulses economic as well as through market intervention to promote other sources of energy for the environment and energy security reasons.
3. Reducing Risk in Oil and Gas Operations	Roberta Bigliani	White Paper 2013	Oil and gas companies face risks from volatility of raw materials, which are less related to the supply and demand for basic, but more to global pressures to socio-economic factors increased health, safety and the environment resulting from major accidents past and recent negative impact on the environment, the image of the industry and its social lease. However, the risks associated with damage to

			the assets, business interruption, pollution, injury to persons and damage to the intrinsic properties of petroleum and gas normal. Then, there is an additional risk of non-compliance and of significant cost overruns for major construction projects, so common in the industry today.

Table 1.1: Reports & Reviews

Chapter 3

Why oil is Traded?

Over the last twenty years oil has become the largest commodity market in the world. During this period, the oil trade has evolved mainly physical activity into a sophisticated financial market. In the process, it has attracted the interest of a wide range of participants which include now banks and managers of funds as well as the major traditional oil companies, the self-employed and the physical oil traders. In addition to being the largest commodity market in the world, oil is also the most complicated. The different trades oil physical market types of petroleum crude and refined products, and the relative values of each category are continually changing in response to changes in supply and demand both on a global approach and at the local level. The industry has therefore developed a complex set of locking of the markets not only to establish prices across the spectrum of petroleum crude and products qualities, but also to allow buyers and sellers to adapt to changes in relative prices, where they can occur. The initial impetus for the expansion of the oil market came to change the structure of the oil industry. Prior to 1973, the oil trade was a marginal activity for most companies that only have used the market to solve the imbalances of supply and demand that could emerge. Trading volumes were generally small and generally identify, and prices are much less transparent than they are today. And the industry has been dominated by the major integrated oil companies that have little use for external markets, either as a way to get supplies or as a basis for the fixing of prices.

However, the structure of the oil industry has changed irreversibly in the 1970s with the nationalization of the interests upstream of the major oil companies in the Middle East and elsewhere, and trade has become an essential component of the supply and marketing of any oil company activities. Having lost access to large volumes of oil equity, major oil companies have been forced to buy their former host Governments arm length and the physical basis of the international oil market have increased rapidly. With more oil being traded, external markets have begun to fix the price of internal transfers and third party sales and companies began to buy and sell oil if opportunities exist outside their own supply, which fuels the growth of the market. But the driving force behind the rapid growth in the oil trade is the great variability in the price of oil. Daily price movements of $ 1 / barrel are not uncommon and prices change frequently up to 5o cents / barrel. As there is no obvious price oil lower or higher than the value of a barrel of oil can double or halve in the space of a few months. As a result, everyone involved in the industry is exposed to the risk of very large changes in the value of the oil they produce, transport, refining or purchase, and a range of new markets have evolved to provide hedging instrument effective against the complex combination of the risk of relative and absolute prices that characterize the oil company. This has not only generated a large volume of activity in its own right, but also attracted other liquidity of the financial markets and raw materials.

3.1 Characteristics of Oil Trading

Many of the characteristics of the oil market are derived from the nature of the oil itself. Despite the introduction of highly standardized paper trading instruments, oil remains a physical commodity. Like other raw materials markets, the oil market is ultimately to the transport,

treatment and storage of essential raw material, as it moves from the producer to the consumer. However, it is a slow process, because crude can take several months to move from the wellhead by the refinery to pump sales. As a result, prices change often because the oil law is not in the right place at the right time. This is very different from that of the financial markets, where assets may be moved instantaneously from one place to another if necessary.

3.2 Transport, Processing and Storage

One of the most important characteristics of the oil, is that it is a liquid. As a liquid, it requires treatment for transport, treatment and storage facilities. And it is these elements that provide the building blocks of basis for the physical oil market.

3.2.1 Transport

Oil is piped on board vessels or pipelines. On the international market, oil moves almost exclusively on ships and is therefore the size of the ship that made the basic bargaining unit. In the case of crude oil, the quantities are usually large and depend on the capacity of loading and unloading terminals, the duration of the trip and the relative cost of shipping in general. In the North Sea, which is the market most active gross worldwide water based, 500,000 barrel cargoes are the norm. But for stocks more - letters from Africa from the West or the Middle East, the oil travels often in very large crude carrier (VLCC) which can take up to 2 million barrels at a time. As a result, the extent of financial exposure associated with the negotiation of crude oil can be very important indeed.

The refined products, however, are usually negotiated in much smaller quantities. Movements of long-distance expeditions may as large as 60,000 tons (about 500,000 barrels, according to the type of product); but most of the trade is conducted in the small vessels holding 20 – 30,000 tons. And many of the most active product markets deal in much smaller quantities, the barges in size between 1,000 and 5,000 tonnes. As products are generally traded ex - refinery and often sold to distributors who may not have the ability to receive or store large quantities, basic bargaining unit must be much lower than in the international crude market. And the setting of the size of the bargaining unit, the mode of transport often determines the terms of trade. Crude oil is usually sold near the point of production and the transfer of title as the oil flows from the loading terminal in the ship. Once loaded, yet the oil can be negotiated on the water or on the point of discharge. Therefore, the same cargo of oil may be priced differently according to the point of sale. Refined products are traded on a variety of terms depending on local circumstances, but it is important to realize that several markets can co-exist for the same product in the same place with prices that reflect the different modalities of delivery or parcel sizes.

The oil is also transported and traded by pipelines. The most important pipelines markets are the United States where the access is guaranteed by law to those who want to use. In most cases, the oil is negotiated on a taxable basis - a number of barrels per day over an agreed period, such as fifteen days or a month - and oil is sold free in pipeline (FIP) at designated locations. But in the case of West Texas Intermediate, which constitutes the

basis of sweet light crude NYMEX futures contract, the oil is also sold in multiples of 1,000 barrels available or delivered to Cushing, Oklahoma storage facilities.

3.2.2 Processing/Treatment

Oil is not normally used in the raw state. Crude oil must be processed by a refinery in order to transform it into a marketable product, such as gasoline, fuel oil or fuel oil. The only exception is crude oil with low sulphur content which is sometimes directly burned in power plants. Oil is therefore traded twice, first as a refinery, and on the other hand as a finished product. Although the crude and product markets have rather different characteristics, they are inextricably linked by technology and the economy of the refining process.

Crude oil markets operate between the producer and the refiner. The characteristics and behavior of the crude oil market depend therefore on preferences and the needs of the refinery as well as the composition and the nature of the offer. Because there are many different types of crude oil, their relative value depends on the combination of products that can be obtained from them. In general, gross-which give a greater proportion of light products of greater value as gasoline, naphtha, kerosene and heating oil may require a higher price than those who had a high yield of the residual fuel oil. But there is no method to assess given crude price since each refinery has a different configuration and its market value will depend on who is a candidate at the time. And refiners in different regions may have very different views on the price that they are willing to pay.

Product markets work between the refiner and the mixer or the wholesaler. They are typically much more localized than the crude oil markets, because most of the refineries are positioned close to the end user, and their treatment facilities are adapted to the needs of local consumers. As a result, prices for refined products can vary significantly from one market to another, reflecting the local structure of the demand for petroleum products, the configuration of the refineries, and regional specifications of the quality of the product.

3.2.3 Storage

The oil must also be stored on his journey from the well to the pump head. As oil is a liquid, which requires the construction of storage tanks at each stage of the supply chain. Stocks are necessary in any undertaking which produces, manufactures, and markets a physical commodity such as oil, and the fluctuations in the level of stocks held at different points along the supply chain play an important role in determining the evolution of prices in the oil market. But stockholding is also costly because it binds liquidity and storage facilities are expensive to rent or build. Oil companies are therefore trying to keep their stocks closer to the minimum level of functioning that circumstances permit.

A surprisingly large amount of oil is necessary simply to fill the supply chain from the wellhead to the customer. In addition, stocks are necessary to keep the system flowing since deliveries are generally made in quantities and the separate stocks are managed in the meantime. In addition, companies must hold additional shares as an insurance policy against unforeseen interruptions in supply or increase in the demand of their customers.

And finally, companies often build stocks for purely speculative reasons, either to take advantage of an upward trend or to minimize losses of a trend downward.

3.3 Demand, Supply and Stocks

The behavior of prices in a commodity market is strongly influenced by the fundamental forces of demand and supply. Although the prices change frequently for other reasons more ephemeral, especially now that bargaining and information online services screens play an important role in operation on the day the day of the oil market, the role of fundamentals in shaping the course of prices must not be forgotten.

3.3.1 Demand

Demand for oil, like other commodities, mainly depends on the State of the global economy. Despite the improvement of energy efficiency as a result of increases in prices of the 1970s and early 1980s, demand for oil remains closely linked to the growth of economic activity. Over the past five years, world oil consumption has increased at an average annual rate of a little less than 2 percent, adding approximately 1.3 million barrel to the global demand each year.

Demand for oil is growing rapidly in the newly industrialized countries of the rim in Asia - Pacific, where economies have grown very quickly indeed, but the pace of growth has slowed down considerably in 1998 due to the financial crisis before bouncing back in 1999. From 1993 to 1997, the average annual rate of growth of demand for oil in Asia (excluding China) was slightly more than 7 percent. In contrast, oil demand in industrialized OECD countries has increased more slowly, averaging only 1.5 per cent in the course of the same period, some countries out of recession. And demand for oil in the former Soviet Union has continued to fall as the economy contracts and old energy-intensive industries, are no longer viable. However, the OECD countries still consume more than half of the world's oil and it is in these countries that the oil markets are more developed and less constrained by Government controls.

Demand for oil is also highly seasonal. The peak demand of heating such as kerosene, diesel and residual fuel oil fuels obviously comes in winter, while peak demand for transportation such as gasoline and diesel fuels is in the summer. In addition, other products such as bitumen, which is used for the construction of roads, also display a seasonal trend that may also affect oil price behavior at certain times of the year. Although the gradual transition towards a greater share of fuels in the canon of global demand has reduced the annual variation in global consumption of oil, there is still a difference of 3 to 4 million barrel between the peak of the winter and the hollow of the summer of demand.

Prices play an ambivalent role in the determination of oil demand. In the short term, they seem to have very little impact on the level of oil consumption, except in markets such as electricity where it is in direct competition with other fuels. In most markets, oil consumers cannot easily respond to price increases, since it requires investment, either in a new car or a new boiler. As a result, the impact of the rise in prices may take years to filter through. But longer term, there is no doubt that prices have a significant impact on the level of oil consumption. The effect of prices on demand is clearly demonstrated by

comparing the impact of the Government's tax from consumers about the amount of oil consumed per head of the population in countries with lower levels of economic development. For example, in the United States, which imposes yet very low taxes on petroleum products, consumes almost twice more oil per capita than the United Kingdom and France, who receive much higher taxes. And petroleum products either are not taxable, or even subsidized in many developing countries helps to explain the very high rates of growth of demand for oil made in recent years, although this is changing.

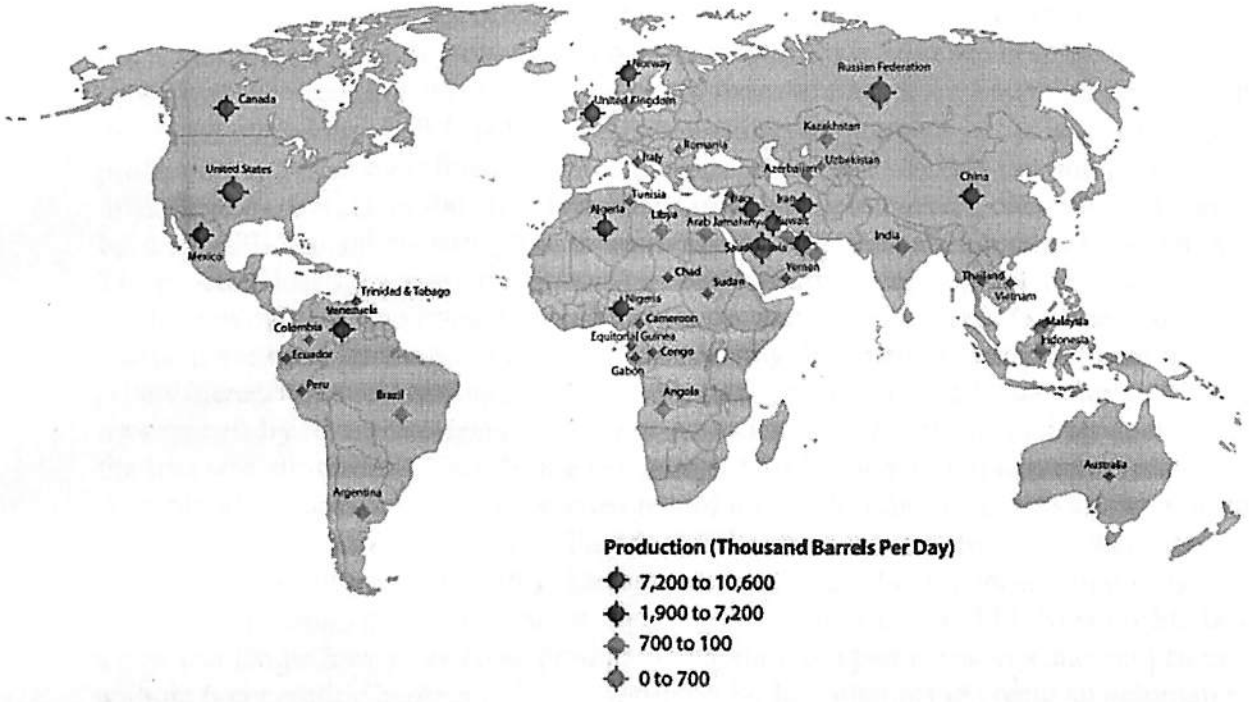


Diagram 3.1: Global Oil Production

3.3.2 Supply

Corresponding to the supply of oil of the application has become much more difficult since the oil industry has ceased to be well integrated. Most oil producers simply to maximize their production, subject to the technical constraints of the field, in order to get a quick return on the very large sums of money that they have invested in the development of the oil field in the first place. And because their operating costs are generally much lower than the sunk investment costs, they continue to produce the oil prices reach very low levels. In the North Sea, for example, most fields have operating costs less $5/barrel and are unlikely to be locked up in less that the price fall below this level. Accordingly, the responsibility of retaining their capacity below production lies with eleven other members of the Organization of the petroleum exporting countries (OPEC), who committed to maintain prices above their marginal cost of production in order to extract what they consider a fair economic rent for oil. So far, they have succeeded, although competition for the market shares between OPEC members often forced prices downwards, until the decline in revenues were finally restored a sense of discipline to the organization. OPEC has been particularly successful in the first half of the 1980s when Saudi Arabia was prepared to play the role of producer of single booster, but it has become more difficult to balance the market after the Saudis refused to continue to reduce production at the end of 1985. However, OPEC rediscovered the

benefits for collective action in 1999 when low prices persuade Saudi Arabia, the Venezuela and non-OPEC Mexico to cooperate on output cuts to bring the market to balance and reduce high inventories.

Two factors have made it the self-appointed harder OPEC. First of all, it is the continuing expansion of production of oil outside OPEC. Although oil prices have initially planned to slow the development of oilfield non - OPEC, this wasn't the case. By encouraging technological developments and forces companies to reduce costs, the fact oil prices it is easier to develop new fields of oil outside of OPEC countries. As a result: the use of gross OPEC continues to grow more slowly that OPEC wants to see despite oil consumption. Secondly, it is the seasonality of demand for oil. As a supplier residual on the world oil market, OPEC potentially facing strong fluctuations in the level of production required by refiners at different times of the year. This is not only, it is difficult to keep track of the underlying level of demand, but is also difficult to manage because OPEC members struggling to agree on how to allocate production between them. The problem has been temporarily "resolved" in November 1993 by means of a fixed production quota over a much longer time period, leaving the market to manage the seasonal variation in demand for crude. But growing demand has made the fixed quota seems increasingly relevant and OPEC is struggling to retain production after investments by foreign companies in some countries of OPEC stimulated production and the Iraq was allowed to export limited amounts of oil for humanitarian purposes. Accordingly, global stocks have reached record levels after the Asian economic crisis and the price of crude fell near $10/bbl. Faced with the prospect of even lower prices if production has not been cut, OPEC has negotiated new production targets that were successful in eliminating excess stock, pushing prices back on $30/bbl. Now OPEC face a new challenge: how to increase production enough to replenish stocks and cut prices without precipitating another collapse of prices. So far, attempts to create an automatic adjustment mechanism in response to price changes have failed to get broader support within the Organization.

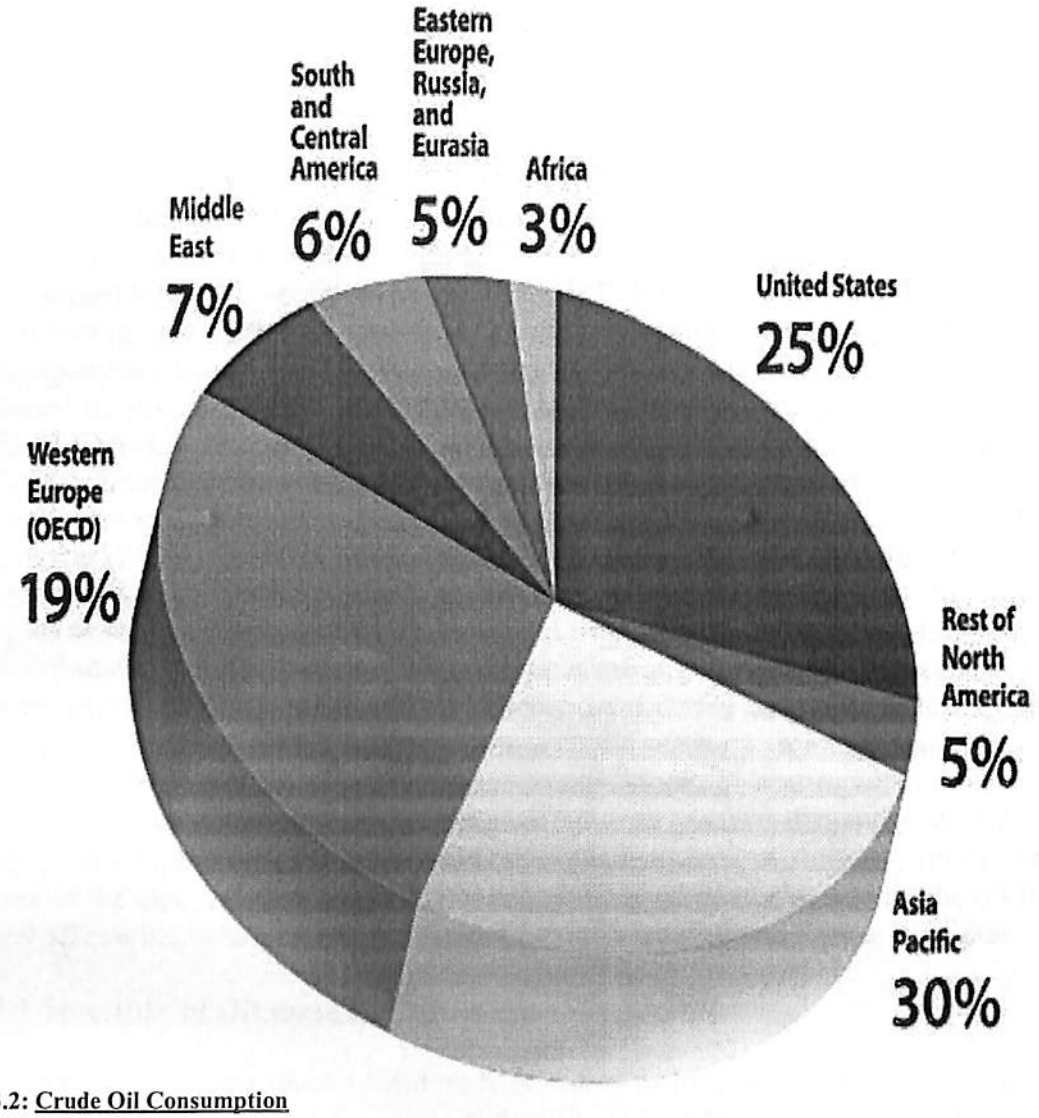


Diagram 3.2: Crude Oil Consumption

3.3.3 Stocks

The level of stocks held by the global oil industry has declined since the early 198os and was probably close to an acceptable minimum level in 1996 and the end of 1999 and early 2000. The reduction is due in part to the transfer of the responsibility for strategic stocks of oil companies to their Governments, partly due to changes in the structure of the demand for oil, and partly due to the improvement of the efficiency of the operations of the company.

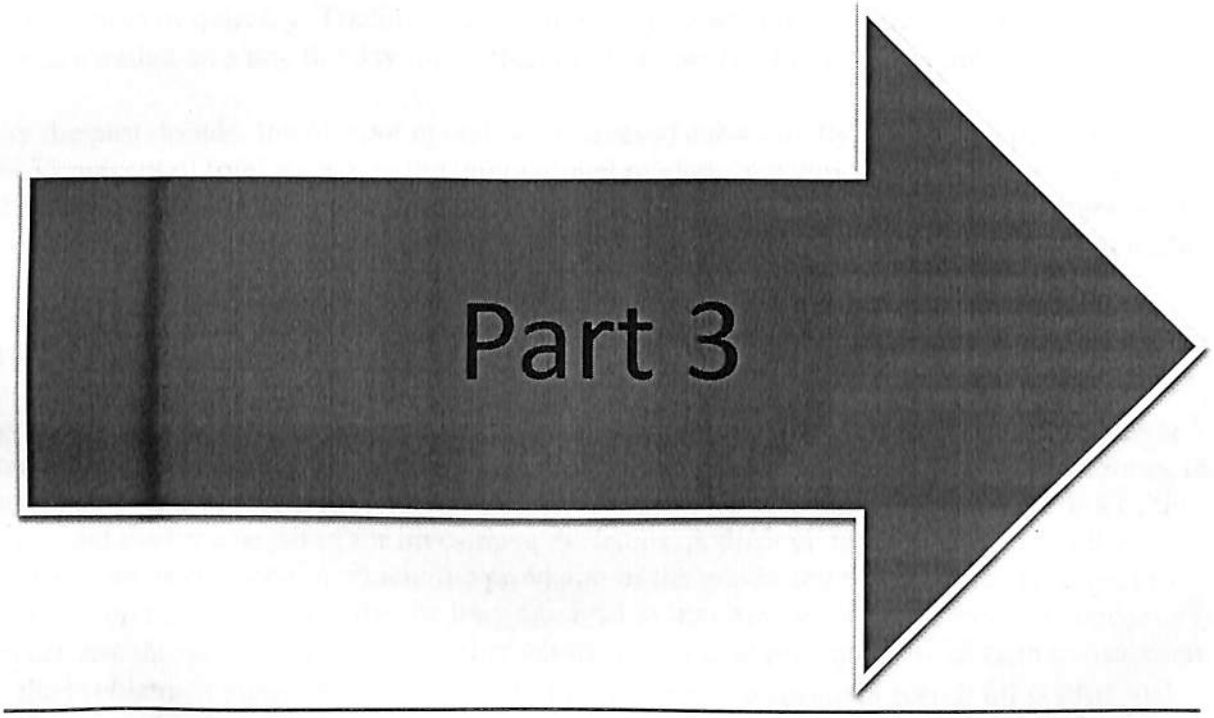
By the end of 1994, the seasonally adjusted level of OECD industry stocks fell as companies reduced their stockpiles of operation after the introduction of 'political' just - in-time inventory management. " But demand has continued to grow and the coverage term provided by total OECD industry stocks has fallen to only 54 days at the end of December 1995, just below the minimum level historic exploitation of the stock of 55 days. Therefore, prices increased sharply in 1996 that cold boosted demand and supply behind expectations due to problems with the new fields non - OPEC and delays in the

case of Iraqi "oil-against - help". However, the price of oil fell in 1997 with the resumption of Iraqi exports, increasing competition among members of OPEC for market shares and the consequences of the Asian economic crisis, and industry stocks increased again, reaching 58 days of coverage during the first half of 1999. Since then, the industry stocks fell sharply after OPEC braked production, falling to a new low of only 53 days of coverage at end of the second quarter of 2000.

A detailed study of the U.S. oil industry published by Exxon ", showed that the United States had held a total of 89 days of oil stocks at the beginning of 1981, measured in terms of consumption from the front." Of this total, the value of seven days has been organized by the Government in the Strategic Petroleum Reserve (SPR), and 82 days of sentencing held by the companies. According to Exxon 58 of 82 days of the value of company stocks were minimum operating stocks. More than a third of the minimum operating stocks (20 days of the value) occupied the pipelines and tankers carrying oil, filled the refineries that process, and provided that 'funds of tank' for storage facilities. The38 remaining days of the value of stocks represented the oil transit through the system, of which a quarter (1o days of sentencing) was in the form of crude oil and three quarters (28 days' worth) was in the form of refined products. Companies must hold more stocks in the form of products than crude for two reasons. Firstly, the different types of refined products must be separated from each other and move along their own distribution channels, which simply increases the amount of oil in the supply chain once it crossed the refinery. And, on the other hand, refineries are not flexible enough to vary the performance of their products in line with the seasonal variation in demand. For this reason, refiners are forced to build up unwanted stocks of heating oil and the residual fuel oil when they increase tracks to meet peak summer gasoline demand, then the reverse occurs during the winter it is this involuntary constitution of stocks by the refiners that creates the characteristic seasonal pattern of the level of stocks held by the oil industry and affects the behavior of prices in the forward-looking and futures markets).

3.4 Structure of Oil market

Markets that require standardized trade instruments to generate cash and to improve the transparency of prices, and oil is no exception. But since oil is nature products - standard, the industry has chosen a small number of "reference" or "Markers" qualities of crude oil and refined products to provide the physical basis for a much more "paper" market dealing derivatives such as the front and futures contracts. Although the choice is often arbitrary and problems may occur due to unexpected changes in the underlying physical market, the industry has always found ways to adapt contracts since the rest of the market depends now from their continued existence. The most important instrument of negotiation of derivatives is New York (NYMEX) Mercantile Exchange Sweet Light Crude contract. It is generally known as "WTI" since West Texas Intermediate crude yet actually underpins the market despite the introduction of notes to delivery over the past years. NYMEX WTI is the most negotiated actively market the oil in the world and provides not only a price marker corresponding to the sector supports in a whole, but also one wide range of other, more sophisticated, derivatives such as options and swaps.


Part 3

Chapter 4

The Crude Oil Market

4.1 An Overview of Current Trading Markets

Products of petroleum crude and petroleum are negotiated in one of two categories: contract (referred to as forward sales) or by the cash transactions. A sale of contract committed the buyer and the seller for the oil trade over a period of time defined and often fixed prices. In the past, this period could be as far as three years. More recently, both the duration of the contract and the price were much more flexible. The cash sales, on the other hand, relate to operations in the short term, usually involving a cargo of oil per transaction, each agreement concluded at a price agreed for fast lifting or delivery. Trading spot can therefore be defined as a process by which cargoes of oil are traded on a day the day rather than the framework of long-term contracts.

Over the past decade, the oil spot operations increased substantially, by 10 - 15 percent to about 30 - 35 percent of total traded on the international market. In addition, a new wave of cash transactions that point the price of spot market-price contract has emerged. These offers were virtually non-existent before the 1980 of, now include about 50 - 55 per cent of the total trade.

4.2 The Underlying Forces behind The Development of Spot Markets

The main problem with the cash transactions, it is that neither the producer nor the consumer cannot predict the price and quantity and are therefore unable to plan the activity. Of course, the magnitude of this problem is different for different products depending on the volatility of the market and the time required for investment decisions. A difficult market situation in the petroleum industry is one in which: the provision of the goods and thus its price is subject to manipulation and the other is that he long ago lead to investment for producers and consumers, who can use this product to produce other goods. Face the unpredictability of cash transactions and the problems it poses for planning, both producers and consumers search for contractual arrangements that provide predictability in the price and quantity on a fixed period of time.

While futures contract to facilitate the planning and management of the company, they remove the flexibility. For futures contracts are normally carried out for long periods of time and at a predetermined price. When business conditions are relatively stable, the rigidity of these contracts is acceptable. But when markets become unstable, the rigid contracts may impede effective business operations. The attempt to balance the advantages and disadvantages of the two systems gave rise to two approaches to trading. In the short and medium terms, the producers and consumers are flexible arrangements - combine the two place and contract negotiation in their portfolios in order to keep flexibility while preserving the predictability. The composition of such a portfolio may vary between the entities and business at the time.

Accordingly the trade industry will undergo periodic changes between spot and contract negotiation.

Looking for flexible contracts eventually leads into the futures market. These markets will be indirectly a contract negotiation with the flexibility of prices and options of transferability of contracts, while allowing to be based on long-term supply and fix the price conditions. After future market are incorporated into overall business practices, buyers and sellers are better off if they return to long - term contract, because this type of trade can be combined with the activity of the futures market to keep the necessary flexibility to cope with the evolution of the business environment. The measurement of the return to the negotiation of long-term contracts will depend on the extent in which the futures markets have developed.

4.3 Different stages of development of oil cash markets

Cash in oil transactions have existed as long as the industry itself. Today, however, the spot market normally refers to spot trading in Rotterdam, port of New York and a few other centers. These markets were established in the past two decades. They have developed four distinct steps, which are explained below.

Step 1: Functioning as secondary market spot market

Almost all oil companies are faced with the problem of the adequacy of their exit from the refinery to the current demand of the market for various products. They have a lack of certain products and the surplus of others. The company can balance the deficits and surpluses of storage and / or shipping facilities. But often, it is more economical to balance by the Exchange or the sale and purchase of certain products on the spot market. This is mainly the function that the cash market served in its early stages of development in the 1950s and 1960s.

The role of the market in cash at this stage can be described as a residual trade channel oil. The main channel for oil supply was the integrated system of the major oil companies: each company has its own supply of crude oil and had the capacity to refine it. Petroleum products outside this system closed, either released this due at the rate of the imbalances between the production of refineries and the demand of the market, or refined independently of it, formed the basis for operations in cash. The volume of transactions in cash was limited to about 5 percent of the total trade, while 95 percent remaining was based on contracts specifying price and quantities of relatively long periods.

Step 2: Passage of a Residual of a Marginal Market

After the oil price shocks of 1973-1974, the spot market has begun to play a marginal role in the oil trade, small but significant negotiation to the small and insignificant trading the residual market. The meaning is, of course, in terms of impact on the (contract) main market. When spot prices serve as the residual role, it essentially follows the price of contracts (usually with a discount or a premium) without significantly affecting those prices. But when the spot market serves a marginal role, he becomes an indicator of general market conditions. The costs and revenues of production or processing of the marginal barrel form the basis for decision-making in many areas of planning - particularly in the refining operations.

The offset of the cash price of a residual to a marginal market is produced in 1975-1978, when the low spot price used as an indicator of the weakness of the market by the oil industry and the Governments of consumer countries (to define price control policies). The change accelerated after 1979, when it has been shown that the spot market could play this role in both narrow and soft market conditions.

Step 3: Update on Major

Despite the importance of the cash transactions to planning and industry pricing policies, their volume remains low during the second phase of the development of the market. It was only after 1983 that place and place - bound trade began to grow significantly. Between 1983 and 1985, cash and spots - related transactions have increased to reflect 80 - 90 percent of international traded oil. Several factors have contributed to this rapid development. Firstly refining capacity surplus forced refiners to fight for their survival. Refiners have been forced to use the most economical way to get crude oil. They increased their production from the refinery to the point where the marginal barrel of product price covered the marginal cost of operation. This resulted in a change of regime of contract term to identify the purchase of crude to take advantage of flexible (decrease) cash price more rigid contracts. Refining for the spot market has also become a common practice. Secondly, as the OPEC members have started to lose their market share, they began to engage in what is called cash-related sales to regain lost sales. These included related cash price variable capital contracts sales, barter and returned net price offerings.

Step 4: Parallel Function with Futures Markets

Markets in oil futures have developed in response to instability of spot prices. The first generation of oil futures, including a contract for crude oil on the New York Cotton Exchange and gasoil contract in the NYMEX introduced in 1974.

None of the first generation contracts drew the oil industry, and everything falls into oblivion. The most important reason for this failure is that the oil prices are not fluctuating as expected. The international crude oil spot prices remained between $10.30 and $10.40 per barrel during the period from October 1974 to December 1975. Price stability has been strengthened in the United States by the law on the energy policy and conservation, by limiting the annual increase in the price of crude oil, led to a reasonable foreseeability of the oil prices.

Introduced March 1983 on NYMEX crude oil contract is one of the most significant contracts. He expanded the potential of futures oil trading and significantly intensified interaction between futures and cash markets. Indeed, it was after the introduction of this contract that the oil industry has begun to take seriously the future. The importance of this agreement was:

- Its spot market, it is - to-, crude spot market, being one of the largest markets in commodities in the world.
- The complementary role of this contract by providing crude contracts industry requirement before use effectively futures contracts of petroleum for purposes of coverage.

- The fact that it is soon developed in a signaling channel of price for crude oil traders, especially in the United States.

4.4 Interactions with the Contract Markets

Although it is no longer the case, since nearly two decades, the pricing policy of the major oil companies has been associated markets contracts, while Independents have followed the guidelines of the spot market. Since the 1970s contracts have been signed between the major oil companies and the Governments of the oil producing countries, which had taken over the production of crude oil. Companies would then refine crude in their refineries or resell to their clients to third parties, including independents and public enterprises in the consumer countries. Thus, the major oil companies are the main path of negotiation of the contract on the oil market. Independents on the other hand have purchased some of their requirements in large companies, but were mainly based on the spot market.

The interface between the majors and the self-employed in the retail market offers useful exposure for the interaction between the spot and the contract market. These interactions are based on two principles: (a) the relative position of the marginal and average cost curves less slack against the tightening of the market; and (b) the difference between the weighted average cost of supplies for the majors and independents. These two are the main vehicles by which cash and contracts price interact to cause an equilibrium price at the retail level.

One of the basic principles of economic theory is that, for a producer to maximize profits, it should expand or limit the production at the point of the proceeds of the sale of the last (marginal income) unit is equal to the cost of producing it (marginal cost). Although long-term oil industry decisions are guided by these principles, their decisions in the short term are much more limited. Oil companies have to serve customers and market share to protect. Therefore, it cannot change its level of supply freely. However, the marginal cost of the offer may change every day, and the company shall do its best to meet its obligations on the market while trying to maximize his profit. In weak market conditions, the average cost for each company remains constant up to the level of committed service. It's basically the take-or - pay contracts traditional requiring the company to buy a specified amount of stock at an agreed price. Beyond the level of the contractual offer, the company can go to the cash market and buy additional crude at a cheaper price. As a result, its marginal cost is less than the average cost. As he bought more on the spot market, the average cost of its crude supplies will be reduced but remains above the gross cost of the task. Thus, an independent company which has some contractual obligations of a major may acquire its supply of crude oil at a lower average cost more depending on the supply of the spot market. Under strict conditions, the opposite conditions prevail: the marginal supply of crude oil will be purchased on the spot market at a price higher than the market price.

On the basis of his blend of task and contract, and products under certain regulatory constraints in most countries and the oil company must set its retail price sufficient to cover its price and weak to compete with the other companies retail stores. The price would be, in terms of costs, will depend on the average cost weighted of the task and the contract products. This is true both for large companies and independent. However the weight is different for each group. The contract price has a weight higher in case of majors, while spot prices have a weight in the case of the self-employed. It is the main vehicle that brings balance in the retail market.

In the future, the process of interaction will remain essentially the same, but the number of players increases. Trading spot is no longer restricted to independent oil companies, many majors, oil companies owned by the State and OPEC producers are getting involved in the place or identify related business. As a result, the market is becoming increasingly fluid. The imbalance in the market will show quickly and need to be supported as quickly. This is the contract interactions / one-time are more effective that a larger number of entities are learning to use the spot market.

4.5 The Market of Crude Oil

A market formerly based long term structure, rigid trade agreements has been replaced by a more effective system allowing buyers and sellers a more flexibility in commercial relationships that respond better to their respective needs.

Considering that cash and futures market was established for a long time the institutional structures for many products, they are relatively new to the oil industry. Their uses, but have grown rapidly and are now well developed part of the market. Today, it is on markets to cash and Futures than the world market of oil - producers, refiners, distributors, traders, consumers, investment banks, hedge funds and so on — market signals receives competitive determined that inform buyers and sellers on the current and future supply and demand conditions. In sum, the interactions of well informed on the spot markets and futures traders ensure that the global price of crude correctly reflects its market value.

4.5.1 Spot Market against Future Transactions

The term "spot markets" is used to describe the operations that involve the purchase in the short term and the sale of a product, such as crude oil and refined products. On the crude oil market, "spot" contracts generally involve the delivery of crude oil in the months to come, for example, a contract signed in June for delivery in July. Cash markets are often referred to as the 'physical market', because they involve the purchase and sale of physical volumes. These markets consist of many buyers and sellers, including refiners, traders, producers and carriers, transactions throughout the supply chain - from straight oil through the refinery. These markets offer the advantage of allowing buyers and sellers, for example, refiners and distributors, to more easily adjust their crude supplies to take account of supply and demand in the short term in the two markets in products and markets crude oil.

A futures contract, unlike a cash transaction, deals purchase or future sale of petroleum crude and petroleum products. More precisely, it is a contract that carries the obligation for the delivery of a specified quantity of crude in the future. The contract specifies the volume, type or quality of crude oil, the price, the future time in which crude is bought or sold, and the specific location at which it must be delivered. The purchase and sale of futures contracts occurs on organized markets. As the vast majority of traders "liquidate" their positions (IE. to cancel a contract before time should require that the Professional makes delivering or taking delivery of crude oil), the term transactions may rarely result

in actual delivery. Accordingly, the futures market is often referred to as the "financial market".

The underlying crude futures contracts are often called 'marker' or gross "reference". A common example of marker crude West Texas Intermediate is, which is the underlying main crude futures traded on the New York Mercantile Exchange, or NYMEX. These organized exchanges allow the competitive interaction of thousands of traders independent, both commercial as well as financial institutions. These interactions, in turn, give rise to public reports futures prices that reflect the best estimate of the market today of what future conditions of supply and demand and, therefore, the price will be. Futures prices are linked to the physical market prices, because term of positions which are not closed to behave either upon delivery or receipt. Thus, the closure "in the term" price for a month given must be equal to the price of 'physical' to trading on time in the futures contract ends. With delivery, futures prices effectively become a physical price at the time when the contract term to maturity. Thus, for example, the closure "in the term" price for delivery in June must be equal to the price 'spot' for oil in June. If prices differ, a trader would buy on the market where the price is lowest and sell immediately in the market where the price is higher and make a profit. No one wants to let these opportunities of profit on the table.

Prices in the spot market transactions described above are often linked to the price of crude oil on organized markets (for example, NYMEX) with, for example, of price adjustments to reflect differences in the quality of the crude oil is traded, and the location of the transaction on the spot market. In fact, even the OPEC countries often based their prices on prices driven on organized markets, with appropriate quality and other differences. The benefit of these provisions is that the physical crude oil price will be set at the level of the market at the time of delivery. This protects buyers against dramatic price fluctuations that may occur while crude oil was in transit at its end markets.

The futures markets provide a number of benefits for the global oil market. First, the crude oil futures markets provide information on future expectations regarding the conditions of supply and demand. Secondly, these expectations are transparent, i.e., known on the market, in the form of a series of price futures for crude to be delivered on different dates in the future. Finally, producers of crude oil, traders, refiners, and others are able to use the financial contracts on markets to manage risk, facilitated, in part, by the growing participation of the number of investors without commercial interest in the oil industry (i.e., not the ability to produce, refine, store or sell physical volumes of crude and petroleum products).

As described above, the futures markets to gather valuable information about the expectations of the market about supply and demand future conditions of the physical market--conditions that will ultimately determine the price of oil. If, for example, the price today of a futures contract on oil for delivery of oil in three months is $ 65 per barrel, this price "Futures" represents thousands of buyers and sellers of the best estimate of what the price of oil will be the physical delivery in three months. And if in this hypothetical situation, the (spot) current price was $ 60 per barrel, the futures market would be revealing the fact that it is the current market expectations that prices are expected to increase in the course of the near future. It is based on the information of thousands of commercial participants and sophisticated financial institutions, futures

prices are told producers and consumers that the crude oil market is likely to remain tight for the foreseeable future.

Of course, the real price of crude in the future may be different from those anticipated by future today's prices. Because it is the best estimate of the market today that oil will be $ 65 per barrel in three months does not necessarily as oil in three months, $ 65 per barrel. Expectations about the future supply and demand for change, for example, due to temperatures colder than expected or unexpected political events that could cause temporary disturbances of the offer, it will be current and projected price.

This negotiation process, namely the competition between the different actors of the market on the futures markets, is beneficial because it provides information on the transparent prices for those who can respond to this information, for example, put extra oil in storage or take action to reduce their consumption in the future. To illustrate, when the prices of futures contracts with delivery beginning dates delivery dates later than the market consensus is for a lower prices in the future. This provides an economic incentive to dip into stocks today - thus soften price today. On the other hand, when the prices of futures with first delivery dates are lower than those of delivery later, the market consensus is for a rise in the price in the future. This gives the economic incentive to stockpile if futures prices higher than the cost of storage. This allows to save for the future on offer when prices say it is most needed. In short, the futures market prices provide information about supply and demand future conditions expected that producers and consumers can act today. The effect of these actions is to increase the supply of crude oil from the price relatively periods down to periods when crude oil prices are expected to be higher. These actions, in turn, tend to improve the price fluctuations.

Finally, the futures markets allow participants in the industry to manage the risks that they carry in the production, refining, and crude oil transactions and petroleum products. They do so by allowing, for example, for an oil producer to lock prices for its future production on the futures market or to use other instruments to limit price fluctuations, it realizes. The fact that these markets are highly liquid, with thousands of merchants, allows users of throw risk at the lowest possible cost and prices that reflect all the information placed on the market by the trade. Benefits for consumers now producers risk encourages investment in future supplies.

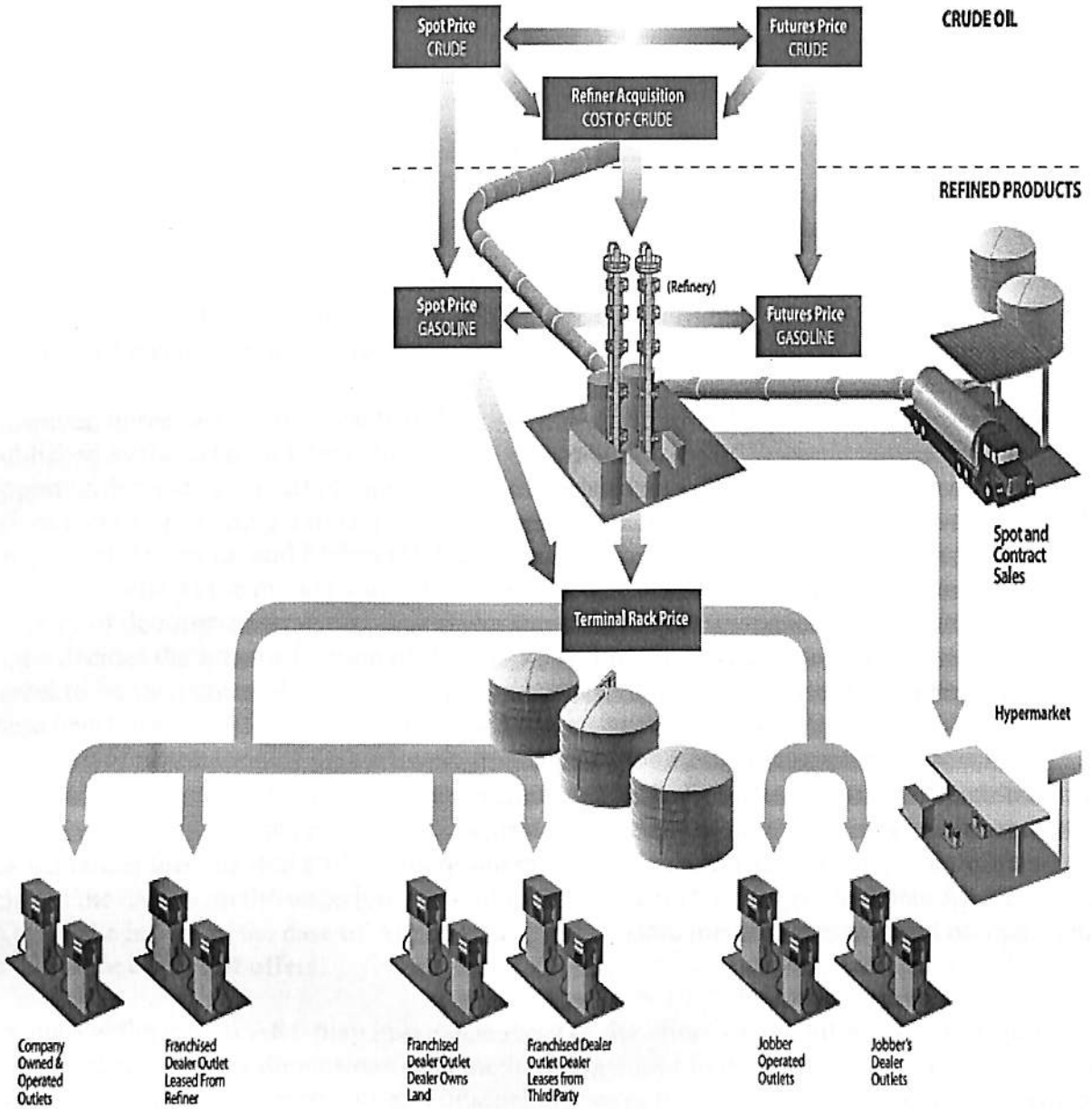


Diagram 4.1: Gasoline Distribution System & Valuation Flows

Chapter 5

AGENCIES REPORTING OIL PRICES

The oil price-reporting agencies play an important role in the process of discovery of the prices of the petroleum industry. Price of these agencies assessments form the basis of long-term contracts, future market, derivatives markets and transactions on the spot market contracts. The main objective of these rating agencies is to act as a mirror for the trade by their methodological structure of physical transactions.

However, agreements with a value of hundreds of millions of dollars a day depend on these published evaluations and the nature and structure of oil reports to create new business opportunities and new markets and affect the strategies of oil traders. Thus agencies reports of prices more as providing a mirror for the oil markets; the reflection in the mirror can affect the image itself (Horsnell and Mabro (1993:155)). Indeed, in their attempt to identify the price that accurately reflects the market value of the oil barrel, price reporting agencies (PRA) enter the territory of decision-making that may affect the structure of the market. Taking for example, Platts decides the time of fixation of the oil, the width of the window of the Platt, the size of the parcel to be exchanged, the delivery process, and the time of delivery of the contract. ARP take these decisions on the basis of regular consultations with the industry. In return, ARP influence strategies of negotiation of the various actors and their return policies. In this respect, new markets and contracts can emerge to cover risks arising from certain decisions which were made by ARP. While even when price assessments are based on the observed transactions and mathematical formula, but still an important element of the decision-making is involved as it implies the choice on the underlying assumptions of the methodology. Analysts ARP select how to build the index (in the case of Argus) and how to enable methodologies based on non - tenders in the event of lack of offers.

To analyse the role of ARP play in the discovery of the prices on the oil market, it is important to consider three primary dimensions - the methodology used in the evaluation of the price of oil; the accuracy of price assessments and internal measures that the ARP to implement to protect their integrity and to ensure an effective evaluation of the price process. Various price reporting agencies have a fundamental difference in methodology and the philosophy underlying the pricing process. As a result, different agencies may produce different prices for the same reference. It might be possible that price surveys are based on a mechanical methodology of transactions; two services survey of prices could still publish different for the same crude prices because their mechanical identification of price could be different.

The use of PRA a large number of parameters to identify the price of oil which may include the system of weighted average volume, offers low and high carried out, and the market on close (MOC). In January 2oo1, Platts has ceased to use the average weighted by volumes and replaced it with the OMC method. In this technique, Platts defines a time window, called the window Platts, and deals made inside this window of time are used to evaluate the price of oil. Prices are estimated on the basis of offers concluded between two participants, or default, on offers and the. Assessment will also make use of information of financial on spreads and derived layers. Thus, the OMC can be considered a structured system to collect information on the basis of which

Platts assesses the daily price of benchmark physical keys. This technique can be compared similar to a market futures where traders make offers and deals, but with two major differences: the parties behind the requests and offers are known, and Platts decides on what part of the information to be considered in the assessment because the information moves through the Platts. After going through all these assessments, the prices are then passed to the market through a variety of channels. The main reason for switching to the OMC is that a system of averaging to determine prices could lead to evaluations that accuse the actual levels of the market that offers made at the beginning of a period of assessment at a level that is not reproducible, could mathematically to drag prices down or upwards (Platts (, 2010a: 7).

But these two methods: volume - weighted average as well as MOC have received their share of criticism. Although the method of the average weighted by volumes allows the inclusion of a large number of transactions and therefore more representatives, the method has been criticized as it may result in an index that is out of step and does not reflect the real price of the contract in force at the end of the day. This would be particularly the case day with high volatility. Averages weighted by trade may also be distorted by the model of the liquidity of the securities on the day... A major weakness in all assessments average weighted by trade, is that they accuse the market price. They always reflect a price that was rather than the price which is. (Platts 2010b: 6).

The main criticism of the MOC methodology is that the Platts window often lack sufficient liquidity and can be dominated by a few players that could hinder the process of price discovery. For example, Argus, Platts main competitor, argued that U.S. markets of crude methodology MOC could work if the industry poured liquidity into the window. Without this liquidity, the methodology is left to assess the value at the close on the basis of bids, offers and other related factors. This means that the derived an assessment of MOC price can diverge considerably from a weighted average of all transactions in the trading day.

This divergence expected given that the average price is different from the price of postage and the convergence of the two is just a statistical accident, if never happens. Argus has conducted a study on the market of crude oil to the United States in 2007 that compares the spot market volume of trade within the window with the volume negotiated throughout the day. The study concludes that the volume of trade within the window of Platts is only a very small fraction of the daily traded volumes. This applies to a wide variety of U.S. crude. Argus argues that this low liquidity and the absence of participant magnitude raise serious questions about the effectiveness of the discovery of the American oil market price.

A response to this criticism is that if some market participants believe that prices in the window do not precisely reflect the price of a barrel of oil at the margin, then participants should enter in the window and exert their influence on the price. However, in some markets, there could be some barriers to entry preventing such a mechanism of adjustment to take place. For example, in the context of Dubai, participation (in the window) requires skilled and experienced sales staff. And most national oil companies that represent end users in Asia are not allowed to participate in speculative operations. For the same reason, producers of the Middle East will not participate in the market of partials. Even the independent commercial buyers without these restrictions in Asia are reluctant to participate in the partial trade for fear that this could threaten relations with producers in the Middle East. It is important to note that if such obstacles that have experienced and professional staff and the qualified firms with the logistics necessary to perform physical

operations can be considered as natural barriers, other obstacles arise due to policy and strategic choices which limit the activity of trade in the window to a small group of so-called professionals.

The market participants are under no legal or regulatory obligation to report their offers of PRA or other organization for that matter. If participants choose to share information will depend on their willingness, their reporting policies, and their interest to do so. In the United States, the system is voluntary, but a possible interpretation of the Sarbanes-Oxley Act is that companies must declare all or nothing, and cannot selectively disclose information. Many companies have political reports that don't bind to report offers which take place at a certain time of the day, or in some regional markets. In some markets such as the United States, privacy issues require that concern do not publish the names of counterparties to an agreement. To ensure sufficient reporting takes place, ARP, as confidentiality agreements signed Argus to facilitate the reporting of transactions in the United States if companies can have interest to communicate prices without such agreements. Since the market participants have different interests and different positions, some traders may have the incentive to manipulate prices by feeding false information to reporters that there were regulatory efforts aimed at limiting this type of behavior. In the United States, the Commodity Futures Trading Commission (CFTC), the Federal Energy Regulatory Commission (FERC), and the Federal Commission on trade (FTC) adopted regulations that prohibit misrepresentation. In the EU, the directive on market abuse also aims to play a similar role, although its impact on the price reports is not yet clear. As indicated earlier, Platts relies on a more structured for the collection of information system. However traders may undertake abnormal offers in Platts window by accepting higher or lower priced offers turning down offers in an attempt to influence the evaluated price. The losses suffered by these operations can be more than offset by the conclusion of other contracts such as swaps. Thus, ARP must ensure that the information received are correct and accurate and that the transactions in the window are genuine, otherwise all of the price discovery process will be compromised. For example, Platts will not knowingly publish a bid or offer is not in the range of the market. In addition, when tenders are lifted or offers are affected, it is a process secondary to ensure that there is not gap and if that gap is detected in order to ensure that the process of evaluation of the price is not affected. There are also other mechanisms to avoid the influence of non - repeatable offerings. In a liquid market, false statement may be fewer problems that journalists could observe concluded deals and confirm information obtained by both parties. At the same time, journalists will make use of the regular flow of information from the markets futures and option to gre. In contrast, in illiquid markets, a small number of recorded transactions or a few bids and can strongly influence the pricing process. At a time when journalists cannot observe active buyers, sellers or operations to determine the price or anything just where such agreements do not exist, ARP is based on a variety of information sources sources or talk about market make intelligent assessments. In such circumstances, the journalist will look at offers and proposals of other markets, comparisons with similar gross but with trading activity, analyze before curves, the market of survey opinions and to assess spread markets to reach an assessment of prices. In fact, in some cases, as in illiquid markets, the assessment of the price could be more precise in the absence of transactions; these transactions were intended to manipulate the price of oil.

In some cases, the ARP can retrospectively correct the errors of assessment not previously identified. There are some cases where traders may challenge the evaluated price reached by an ARP. There is no evidence to suggest that this problem is widespread, but from time to time these disputes filter media. For example, at 29 April 2010, Platts has assessed the value of the

cash and June July BFOE spread at least 0.68 $ per barrel. Some brokers in the market said that the differential Platts assessment is inaccurate. On the basis of the information provided by the futures market and the PFE, these brokers have argued that the value of the goodwill would have been less 0.94 $ per barrel. When that value is more precise, what is important to note that if these disputes on price evaluations never arise there is no supervisory or regulatory authority which to investigate these claims and counter-claims.

In order to safeguard the pricing process, PRA seek to verify the accuracy of the information they receive and when they are unable to do so, they reserve the right to exclude data and information. In this way, they guard against false data of distorting their assessments. They also undertake many procedures, both within their own organizations as well as to external participants. For example, Platts has control over the parties that can participate in the window. The companies behind each purchase and sale must be clearly identified by an assessment of the operational and financial performance and recognizable on the market.

5.1 Brent and Price of Identification Market

The market North Sea Brent assumes a central step in the current price of oil system. In this system, the prices generated in the complex Brent are the main criteria of price, because on the basis of these prices 7o percent of international trade in oil is directly or indirectly price. Market Brent includes only the cash at the beginning of the 198os (known as dated Brent) and physical markets before informal. As the years passed, the market Brent gained in complexity and is currently composed of a large number of layers comprising a term and highly liquid markets swaps on which a variety of financial instruments are traded actively by a wide range of actors. We can say that the market Brent was not pre - designed and grew more complex depending on the needs of the market participants.

There are a number of factors that have favoured the choice of reference Brent. Mainly of the geographical situation of the North Sea which is close to the centers of refining in Europe and the United States gives it an advantage over other sites. The introductions of the tax rules on the British North Sea in 1979 to condition oil companies with the incentive to trade and re-Exchange their production on the spot market, which gave rise to an actively traded Brent spot market. Brent is the raw water and is transferred by tankers for European refiners or, when arbitration allows, across the Atlantic ocean to the United States. In addition, in the mid-198os, the volume of production of the Brent system was quite assured that sufficient cash to physical trade. Although the volume of production, although that important, is not the determining factor in a crude to emerge as an international reference due to similar physical liquidity bases could also be found in other regions of the world, especially in the Gulf countries, which constitute the largest physical basis in the crude oil markets. An important factor is the legal, regulatory and taxation to operate at our any particular cue point. Brent has the British Government to supervise and a solid legal regime. Another determinant, is the diversification of ownership one of the most important factor determining. The underlying commodity futures / futures should be available from a variety of vendors. Monopoly in production increases the likelihood greenhouse and manipulation, more and more turn the exposure to the risk of buyers and merchants who would be reluctant to enter the market. Monopoly of production prevented the development of a complex market structure in other markets with a greater physical basis, such as the Mexico. Also most of the OPEC countries are mere salespeople and therefore OPEC crude has not yet and do not meet this criterion of diversification of ownership. This is in contrast the market Brent

which has always been characterized by a large number of companies entitled to the production of Brent. Enlargement of the definition of the index of reference to other types of crude oil over the years has strengthened this aspect and has resulted in a higher degree of diversification of ownership. Another important aspect is the degree of concentration in physical delivery infrastructure. Here, the degree of concentration is much higher. As in the case of the pipeline network Forties (FPS) that collects liquids oil and gas over 50 fields by a complex set of pipelines is 100 % BP opportunity.

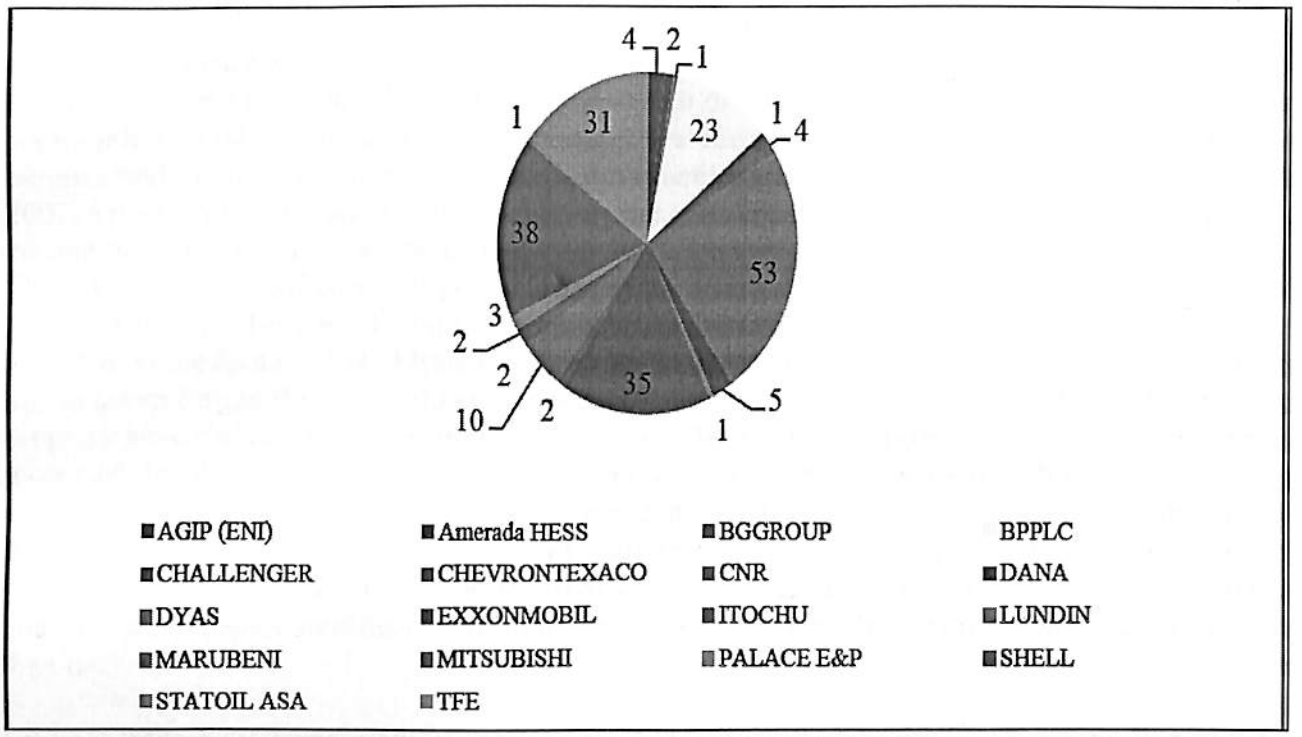


Diagram 5.1: Brent Production by Company (cargoes per year)

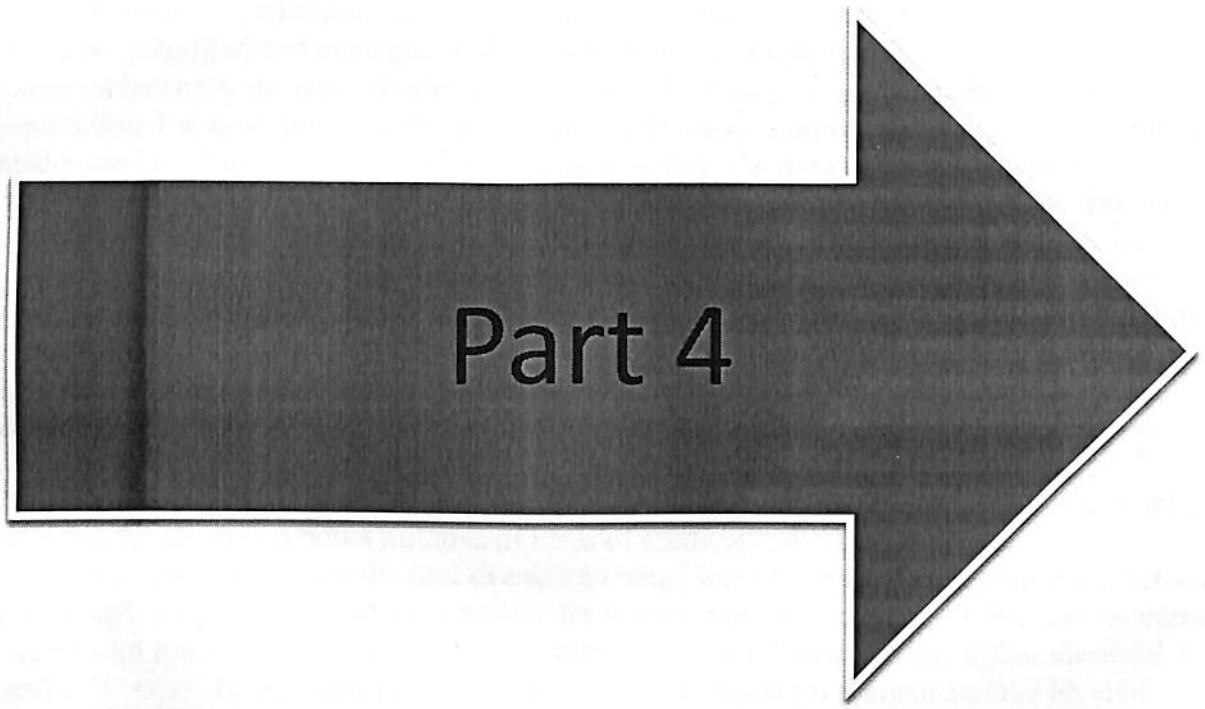
5.2 The Physical Basis of the North Sea

Crude oil in the North Sea consists of a variety of shades that include Brent, Ninian, Forties, Oseberg, Ekofisk, Flotta, and Statfjord to name but a few. In the early stages of the current price of oil system Brent acted as representative for crude oil from the North Sea and communication of prices organizations relied on trading activity in that grade to identify the price of the reference index. Brent is a mixture of oil produced from fields separated and collected by a system of main pipeline to the Sullom Voe Terminal in the Shetland Islands, in the United Kingdom. Since the middle of the 1980s, Brent production began to decline, from 885, 000 barrels in 1986 at 366,000 barrels in 1990. Low physical production has led to distortions, manipulations, and cuts the price leaders of Brent disconnect from the rest of qualities with far-reaching effects. To avoid distortion and possible cutbacks, the separate system Brent was mixed with Ninian in 1990 leading to the creation of a new grade known as Brent Blend while Ninian ceased trade as a raw stream. Co - mix of Brent and systems Ninian attenuated the problem of the decline in the level of production, with production reaching 856,000 barrels in 1992.

Subsequently, however, the production of Brent began to decline, falling to about 400 thousand barrels in 2001. In terms of cargo, representing approximately 20 per month, or less than one.

In July 2002, Platts has expanded its definition of the benchmark Brent dated to include roaring (the UK North Sea) and Oseberg (Norway) for evaluation and deliverable grades in the front Brent contract. The quarantine is a mixture of oil produced from the fields separated and collected by pipeline to the terminal of Hound point to the United Kingdom. Oseberg is a mixture of oil produced from different fields Norwegian and collected to the Terminal Sture in Norway. The new reference was known as Brent - Forties - Oseberg (BFO). The inclusion of these two categories has increased the benchmark of production volume. It also gave rise to the distribution of cargoes on a wider range of companies with none having a dominant position. However, as seen in the graph below, the production of BFO began its decline, from 63 cargoes per month in 2004 August-about 48 loads in the first months of 2007. In 2007 beginning, BFO output stands at less than 30 million barrels per month, spread over more than 55 companies. 2007, a new grade, Ekofisk, has been added to the complex, which has led to the creation of the current benchmark known as the BFOE, but it is still commonly called Brent or the North Sea. Ekofisk is a mixture of crude oil produced from different fields of the North Sea and is transported to the Teesside Terminal in the United Kingdom. The bulk of the BFOE production is traded on the spot market or transferred within the integrated oil companies where only about one in seven cargos BFOE is sold on a long-term basis. This feature, coupled with the diverse property gave rise to a trading activity active at our BFOE. The inclusion of this new current has increased the physical basis of benchmark to about 45 million barrels per month in 2007 beginning, but since then, it has been in gradual decline. BFOE production began to decline less than 1 million barrel per day of 2012. As indicated by Platts, other changes to the criteria cannot be excluded, in particular, if the production of key categories is considered to be too low or their qualities are to depart significantly from the standard. In fact, such a change could occur sooner than later.

Given that these different qualities are not similar quality, the broadening of the definition of the criteria of the North Sea has repercussions on the pricing process. In particular, the start of the Buzzard field, in 2007 increased viscosity and the sulphur content of the roaring mix do roaring the less valuable between different crudes in the BFOE benchmark. Since one four varieties can be delivered on contract BFOE, sellers tend to offer the best quality and therefore it is roaring who sets the price of the benchmark BFOE. This problem becomes more acute during periods where other areas in the system roaring are closed for maintenance. As a result of including flows Buzzard, Platts had to introduce a quality-escalator in July 2007 which applies for deliveries above the level of 0.60 % of sulphur in base: sulphur, the discount that the seller must give. Currently, a de-indexing cents 60 / barrel applies for each 0.10 percent of sulphur indicated above the basic standard. Before this innovation, the market was unsure of how to handle the issue of sulphur and at certain periods in 2007. There were no transactions in the Platts window. This episode almost made the physical market shutdown with traders complain that Platt's changes to its price assessment process had paralyzed the market.


Part 4

Chapter 6

Risks Related to the Cycles of Crude Oil

The risks are often grouped into five major categories:

- Market risk
- The risk of credit or default
- Operational risk
- Liquidity risk
- Political or regulatory risk

Among these risks, an additional number of other subcategories of risk exists. Many of these risks can be quantified and managed, and many of them can be predictable. Historically, energy business leaders have managed to identify, estimate and manage recurring risks, such as the risks of exploration. For example, according to historical data and complex modeling, an exploration company can be estimated with a high degree of accuracy, the risks and said the chances of success of the discovery of an important reservoir of hydrocarbons in a geographical area. The same applies to the risk of pipeline congestion, inadequate storage and failures of the refinery. Climatic seasonal and daily variations in performance of the energy consumption of important information on the need to increase the capacity of production of energy as well as the likelihood that this additional capacity could always step to meet the demand. These events are all quantifiable with relative certainty, and businesses can implement processes to manage their potential impact.

However, the energy sector also faces other risks, potentially much more serious. For example, a tanker from the Earth that pours millions of litres of crude oil causes an environmental catastrophe. Dramatic and catastrophic events can range from failure of the equipment to terrorist acts. Although the probability of a major disaster is rare, when that happens, it has an immediate and significant impact on the activities of an enterprise. Even though we know that these risks can and will occur, the probability is rare. No amount of capital investment and the level of training can eliminate the risk of failure. They can reduce it. It is a public discussion on the risk-reward balance between investment requirements and reduce the risk.

6.1 Market Risk

Market risk directly affects profitability. Exploration expenses easily run into the billions and the construction of a chain of energy in an undeveloped area previously may take several years to build. If the price of energy is not well managed, there are considerable economic consequences. If the company is unable to obtain a return to cover its investment costs, it may decide either not to make the investment after all, or, for reasons whatsoever relating to its operational activities, to accept significant losses. From the point of view of market risk, it is important to know the size of the market demand is for energy. When the management of market risk, there are a wide variety of issues to consider. A basic problem is that the energy prices may vary significantly to the evolution of demand and supply and may remain volatile for long periods of time. For

example, the price of heating oil is higher in the winter than in the summer months, but due to unforeseen extreme weather conditions, it can peak higher than expected. Similarly, disturbances in the pipes from the failed system of distribution or improper storage of facilities - can have a significant impact on the price.

In some integrated companies, price risk will generally not covered, because they have an impact on the chain of value in different ways and thus would tend to cancel. Market risk management is an ongoing challenge for businesses. There are seasonal and predictable energy prices changes; while these changes are frequent and regular, they are not easy to predict, quantify and manage. Properly assess the price of the different products manufactured and marketed by the companies of energy is also part of market risk. The market price also reflects the differences and ifferences in quality regional awards. There are also unpredictable price changes which may not be as easy to quantify or manage.

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6.2 Credit Risk

When companies sell their products or services, often, they do not require a deposit or a payment in advance. By delivery of the goods or services before receiving payment, the company submits to the non-payment risk. This risk is called credit risk, counterparty credit risk or default risk. When the energy with the other businesses, they often provide energy and wait for the payment, and are constantly concerned about their portfolios of credit risk management. In the case of the integrated energy companies, the credit risk is valid only when transactions are with independent third parties. The energy companies are exposed to the risk of credit in several ways. When a generator of energy sells electricity to a public service, it will deliver the power of utility, while the payment cannot take place until later. Meanwhile, the generator of energy assumes that the risk that the utility can pay. This makes very vulnerable energy production companies to significant changes in electricity prices because most public services are heavily regulated and may not be able to pass higher prices on to their customers. In some cases, a utility may simply not be able to pay, or will have to delay his payment to the generator, causing a series cascade of defaults in all of the energy cycle.

Another risk is related to the non-performance of contracts when the market prices are changing dramatically in the price of the original contract. To reduce the effects of this risk, companies that trade between them require as their counterparts of collateral which is equal to the value of the transaction.

6.3 Operational Risks

Apart from market and credit, energy companies need to measure, monitor and manage operational risk throughout the value chain. There are several types and combinations of different operational risks, and they are inherent at each stage of the merchandise. The following are some examples for different types of operational risks of the energy companies are facing. Conducted transport of crude oil, gas natural and refined products subject to many operational risks. For example, there is a risk of quality: failure to comply with certain contractual quality criteria. Deficiencies in the quality, need compensation, usually in the form of additional payments by the seller to the buyer to offset the shortfall in the quality of the product.

Pipeline operators need to monitor the volume of crude oil passed through the pipeline as well as maintain optimal pipeline performance. When the volumes are excessively high or below the required minimum, pipelines, either pump or remove crude oil to create a balance. To do this, the operators need storage facilities. Crude oil stored can also be used to correct the deficiencies resulting from operational problems. If the pipeline operator is not able to ensure the storage of crude or cannot remove crude oil from storage, operator is exposed to risks of storage.

When pipelines set their hours of operation, they rely on different models to help in their decision making. How these models are created and how they work, can have an impact on the overall success of the company. Yet, due to human error, the contents of the template may be incorrect or the models could be applied incorrectly. Both lead to poorly made decisions. This model may have significant effects. The risk of model is also applicable for enterprises downstream. In the downstream business, models are used to predict the prices, and the risk of model will affect the accuracy of these predictions.

Operational risk is particularly important in the handling of LNG, very dangerous. Handling LNG companies have strict procedures to ensure that the cargo is loaded and delivered safely and effectively. Appropriate risk assessments ensure adequate security and reduce the likelihood of potential hazards, such as spills and other potentially dangerous events.
In the handling of operational risk the LNG-related issues, it is very important to consider the following points:

- Prohibition of ship early with a tight control of the tank during carriage.
- Areas of port traffic control measures, security and safety and monitoring or operational changes.
- The location of the LNG terminals where the risks to public safety, other infrastructure and energy security are reduced to minimum.
- Systems of safety and security in the transport of LNG.
- The risk analysis modeling and validation.
- Strategies for emergency response, evacuation, and event mitigation.

6.4 Liquidity Risk

Trading is essential for energy companies. Companies often convert stored energy products with each other. This allows companies to meet the demand of customers in areas where they may not have sufficient stocks, storage capacity or. In order to facilitate the exchange of stocks, apart from the problems of credit, liquidity is important. If the market is not liquid, Exchange, as well as the purchase or sale, need significant concessions on prices by the parties concerned. And the price of concessions will hurt profitability. It is not just the physical markets who may suffer from liquidity risk, financial markets also face a risk.

6.5 Political Risk or Regulatory Risk

The political or regulatory risk of unexpected Government or regulatory intervention and comes from the evolution of the political conditions that affect legislation and regulation of business. Energy companies are particularly sensitive to political or regulatory changes, these companies often have high visibility, and to long term significant investments in exploration, production, transport and distribution.

In these activities, companies shall comply with the regulatory framework that various government agencies require. Changes in political conditions, often by a new Government, can change the established, such as the labour regulations and environmental rules, taxation, which affects the value of the company. In extreme cases, changes of Government can lead to the nationalization, in private property in the property of the Government.

6.6 Price Risk and Credit Risk

The relationship between price risk and credit risk is of particular concern for both integrated and specialized companies. Energy is bought and sold between companies. The company that sells the product - crude or refined oil energy, natural gas, or power' makes delivery. "The company that buys the same energy product - crude or refined petroleum, natural gas or power" takes delivery." When energy prices are high and changing frequently, businesses can realize substantial profits from trading. For example, if a company expects a rise in prices in the future, it could buy energy on the market at low rates today and thus reduce its price risk. However, all businesses will be able to guarantee energy supplies at a low price. Some companies may be forced to buy energy at a very high price and not be able to pass this higher cost to their customers. As a result, they will face a significant business risk.

During periods of high prices, regulatory authorities can intervene to control prices paid by consumers. Such an action could directly penalize companies that have had to buy energy at a very high price, because they would not be able to recover their costs. Some companies that have to take delivery of expensive energy at the rate of the market, and then sell than at an artificially low price, could not have sufficient funds to pay under the terms of their contract and be enforced by default. This defect is likely to cascade in the chain of energy, affecting each of the companies participating in the operation in both upstream and downstream. At the same time, when energy prices are low, the energy companies could barely be able to cover their own

expenses and may be unable to take or make delivery. Here again, the effects of a default will affect both upstream and downstream operators.

6.7 Common Risk Management Tools

There are several tools available to companies different risk management. Mainly, energy companies use following approaches to manage their risks.

6.7.1 Economic diversification

Economic diversification as a risk management technique is based on the principle of not putting all its eggs in one basket a. The integrated two and energy companies specialized use diversification to reduce risk. Integrated companies may invest in a variety of independent businesses or in the same companies in different geographic locations. Companies are also contracts from different sources in order to reduce their dependence on one or a few suppliers or customers. However, this risk reduction approach can be both costly and difficult to manage. Diversification can reduce the risks that are unique to each participant. All risks, for example a major economic downturn can be mitigated by diversification. The effects of a major economic downturn can be mitigated according to types of business of the owner.

6.7.2 Long-term fixed contracts

Many companies reduce market risk by entering into long-term fixed price contracts. For example, the proponent of a project of LNG signed a long term contract with a consumer of gas. These long-term fixed-price contracts can extend up to 20 years and 'block' the price of the gas that makes the development of economically viable project. Even when the price of gas on the market falling below the contract price, gas is still being sold at the market price, which is the promoter of the project. When the market gas prices is higher than the price specified in the contract, the benefit comes back to the consumer. The two parties to the contract share the risk of price changes and are ready to give up potential gains to offset potential losses.

6.7.3 Insurance contracts

All companies use insurance contracts to manage risk. For example, to reduce the financial impact of an explosion in a LNG project, the project owner may obtain insurance to offset the loss of income as well as the cost of having to get other supplies of gas. Insurance also moves the risk to the insurance provider, which in Exchange for the insurance premium is ready to compensate the buyer of the contract of insurance for a loss in the project. Insurance companies have developed expertise in the identification, analysis, quantification and management of risk. Insurance companies have an advantage when they take such risks and benefits of the assumption of such risks.

6.7.4 Financial Markets

Financial energy market, or 'paper' market, has a large volume of transactions. Although the total value of transactions in these markets is not known, it can be generally estimated

that the yearly operations by companies in these markets could amount to billions of dollars. Financial energy markets have historically used by energy companies to cover their assets and reduce their financial risks. At the same time, investment and commercial banks have used these markets to speculate about a specific product or to offset their risks to an energy company that they can be an exhibition of credit.

Most of the tools that the energy companies use are imported from the banking industry and modified to meet the unique needs of the industry of energy. The global energy market has become more efficient over the years as the investment and commercial banks have expanded their role as merchants rather than brokers. This efficiency is derived from greater transparency of information on market prices, financial modeling more sophisticated and extensive search capabilities. These and other factors have contributed to the development and expansion of the world market energy.

The two main exchanges on energy products are NYMEX and ICE. Other exchanges in the world, such as Singapore and Dubai, now offer energy contracts, but NYMEX and ICE are still considered to dominate the markets for these products.

6.8 Organization of Financial Markets

There are two types of markets for trade in energy: market exchange traded and OTC market.

- The exchange traded market, is a centralized market where buyers and sellers, by brokers, interact and exchange financial energy products. The Exchange provides a mechanism of credit support to ensure that each transaction is executed and the contract is settled.

- OTC over-the-counter or OTC market is the place where buyers and sellers of energy products typically run operations with one another, whether by phone or electronically by the individual Contracting customized to meet the specific needs of each party. The vast majority of physical energy products trade takes place on the over-the-counter market at option.

Organized exchanges and over-the-counter market each have their own advantages and disadvantages.

Exchange market places offer:

- **Products standardized** - futures and options on futures contracts are standardized, which eliminates the need to discuss the quality of the products and incurring the costs of negotiating separately each transaction. Brokers will charge fees to execute buy or sell a contract on behalf of their client and Exchange charge compensation (to ensure the transaction) for their services. Brokerage are traded, while compensation fees are set by the Exchange and apply to all users of exchange of this Exchange, according to the rules of the Exchange.

- **Price transparency** - trade relationship with the world, the price at which their contracts are traded in real time, allowing others to observe actual prices.

- **Credit risk** - exchanges act as intermediaries and through their rooms to compensate for financial guarantees which reduce or even eliminate the risk of counterparty will not be able to fulfill its part of the agreement. Indeed, the Exchange became a buyer for every seller and a seller to every buyer.

- **Liquidity** - it is normally scored continuously from the futures and other derivatives, mainly options. Significant volume in major contracts of liquidity provides to buyers and sellers. Unless it is a rare period where he steps of volume of transactions in a certain contract, negotiating these contracts provides flexibility and comfort. Use of market companies can offset the risks.

- **E-commerce** - trade almost offer electronic trading platforms that allow trading 24 hours a day. In fact, the traditional parquet floors, where brokers meet to buy and sell contracts, begin to disappear. Trading floors are replaced by electronic trading alternatives, decreased costs and increased efficiency of negotiation. The major drawback of the exchanges is that they negotiate standardized, as opposed to measuring, products that may not fully meet the specific needs of coverage of an individual company. The major advantage of OTC markets, it is that they offer the possibility of negotiating highly customized products that can be tailored to meet the specific needs of the parties involved in the transaction.

6.9 Derivative Financial Instruments

The most frequently used tools of financial risk management are futures contracts, swaps and options. Futures and options on futures contracts are derivative financial instruments that are standardized and traded on organized market. They are generally very liquid and interchangeable. Exchanges and before are customized agreements that are traded directly between counterparties on the OTC market.

6.9.1 Forward Contracts

A futures contract is the simplest of all financial derivatives. By definition, a futures contract is an agreement between two parties to buy or sell a specific product of energy at a time agreed in advance and specific in the future. The price for the front is specific in advance at the time the contract is launched.

The payment can be made in advance or when the asset is delivered to the seller by the buyer. Anyone who has offered to buy something in the future of someone else, be it a house or a car, for example, is committed in a transaction.

Before are very flexible and can be modified to meet the needs and requests of the parties involved in the contract. For most energy contracts before include the following specifications concerning the delivery:

- The quantity and the specific quality of the product of the energy to be delivered.

- The price of the delivery, the formula or the relationship determines the price of the front.

- Delivery period, including the exact time of delivery during the delivery period
- The place of delivery.
- Delivery regulation physically or financially.

Before are very suitable, binding agreements. Traditionally, before have not been negotiated on organized markets, and were bought and sold on over-the-counter markets. Futures transactions were made directly between the buyer and the seller. Negotiation of futures trading on over-the-counter markets has limited the ability of the parties to leave the market. There were only two alternatives to termination of the agreement: both parties agree that the contract is null and void, or one of the parties takes a position of compensation with another company.

Over the past years financial innovation has sought to find a different solution to the output of a contract term. Electronic exchanges, such as the ICE, have emerged to facilitate trade in futures contracts. These exchanges allow the parties to assign forward-looking statements to others, which increases liquidity in the financial markets of energy products.

6.9.2 Futures

By definition, the futures are highly standardized, contracts traded for the purchase or sale of a specific asset at a specific time and for a specified price. Most energy futures contracts are on the underlying commodity like natural gas, petroleum crude, or heating oil. There are also futures contracts for power.

In a futures contract, the volume, the price, the place of delivery, delivery time, and the last day of trading or regulation are all specified at the beginning. This level of standardization allows for flexible futures trade negotiation. Many exchanges list of several futures contracts on the same product. Each futures contract has a predetermined expiration date (i.e. the last day it can be traded on the market).

An important aspect of futures, it is that they are evaluated on the market daily and any changes in the value of the contract are added or subtracted from the account of the owner every day. If the price of futures contract falls below the purchase price, the owner of the contract term must send its broker a payment which ensures that the owner of the future result of the transaction.

For the market to operate efficiently, exchange traded the underlying market for the Exchange contract must meet three criteria:

- Underlying commodity prices should be volatile.
- There must be a large number of buyers and sellers.
- The underlying physical products be fungible, -products are interchangeable for purposes of transport or storage.

A person can negotiate contracts in term of energy 24 hours a day through electronic trading systems offered by trade. The volume of traded energy contracts has increased dramatically over the years, and it should continue to grow that energy companies and other investors are becoming more familiar with the use of these types of financial instruments.

6.9.3 Options

There are two types of options: purchase options and put options. Stock options give the right, but not the obligation, where an "option" to the purchaser to buy a product at a price predetermined by the expiration date. This predetermined price is called exercise price. While the buyer of a call option has the right to purchase the product at the strike price if the buyer of the option so decides, the seller of the same option has the obligation to sell the product at the exercise price. The buyer of the option pays a premium for the right to purchase the product at the exercise price. The premium compensates the seller of the option, which must sell the product at a price known, which could be less than the actual price at the date of the sale. Call options are valuable for the buyer of the option contract so that the exercise price is less than the price of the product can be purchased elsewhere. The buyer of a contract is known to "go long" the contract. A seller is considered to be 'go short' contract.

6.10 Volatility and Energy Risk Management

Volatility is a measure of uncertainty or 'risk', and plays a unique role in the world of risk. Volatility is a key element in various mathematical risk management applications, such as the Value-at - Risk and assessment of options. The volatility of commodity communicates the probability and magnitude of potential movements of prices for this commodity product. Volatility is a measure and is calculated using yields and not price. Thus, rather than looking at prices on Monday, Tuesday and Wednesday, the analysis focuses on yields: variations in relative prices between Monday and Tuesday, then Tuesday and Wednesday.
The use of feedback allows us to compare the evolution of the various markets. For example, using yields lets compare a movement of $1 in a market of energy, where the typical price is $100/Mwh, a movement of a $1 in a market of natural gas, which the average price is about $ 10. A variation of $1 10/mmBtu price $ natural gas is ten times larger than the variation of $1 the price of $100 electricity. Thus, natural gas price changes are more, and the gas is much more volatile than electricity. Of course, and despite what this example might suggest, the electricity is generally a much more volatile than natural gas product. Greater volatility reflects a wide range of prices and incomes and indicates a higher risk.

There are two ways to measure the volatility:

- Historical volatility uses historical prices and find information on the product and is a retrospective measure of volatility. Historical volatility is relatively easy to find if the historical price data are available. The disadvantage of the historical volatility is that they assume that future conditions mimic the last, which is akin to driving a car on a winding mountain road using only the rear-view mirror.

- Implied volatility uses current price and return information for the product and is a forward-looking measure of volatility. The implied volatilities are often calculated from

the prices of options. The implied volatilities are the hardest to find because of the illiquidity of most of the options markets.

The historical volatility, using historical price data, plays an important role in managing risks, mainly because it is relatively easy to calculate. A market, goods, or the price which presents greater price volatility is perceived to be more risky.

Chapter 7

Risks Related to Crude Oil Trading

7.1 Background

Risk is the probability that the actual performance of an investment will be lower than the expected return. The lower return can some time lead to catastrophic to a firm and can even lead to huge loses to the government. After studying various article, papers, magazines, books, etc on crude oil trading various types of risks evolved out which have significant impact on the trading of the crude oil. Some of the prominent risks which have a significant impact on the crude oil trading are as follows:

7.1.1 Currency Risk

Currency risk is the risk of loss of the fluctuation of exchange rates when the investor has exposure to foreign currency or foreign currency - traded investments.

The currency risk is important to understand because Exchange rates can change dramatically the total return of an investor on foreign investment, despite the way in which the investment.

7.1.2 Supply Risk

Supply risk is the risk intended to be caused due to delay or other supply chain problems which can lead to subsequent loses to the trader, buyer and seller of crude oil.

7.1.3 Price Risk

The risk of a decline in the value of a security or a portfolio. Price risk is the greatest risk for all investors. Although a stock-specific price risk can be minimized through diversification, market risk cannot be diversification. The risk of price, while inevitable, may be mitigated by the use of techniques of coverage.

7.1.4 Geopolitical Risk

The risk that the performance of an investment may suffer as a result of political changes or instability in a country. Instability that affects the performance of the investments can come from a change in Government, legislative bodies, other officials of foreign policy or military control.

The political risk is also known as "the geopolitical risk", and becomes more of a factor that lengthens the time horizon of an investment. "

7.1.5 Economic Scenario

The economic risk is the possibility that the macroeconomic conditions such as exchange rates, government regulations, or political stability will affect investment, in general in a foreign country.

7.1.6 Global Demand & Supply Scenario

The risk usually pertains to the risk caused in the portfolio caused by change in demand and supply of the crude oil.

7.1.7 Weather Conditions

Weather has somewhat direct implication in the price of the crude oil, so it plays significant role in the ups and downs of crude price movement.

7.1.8 Freight Charges

Freight risk is the risk which is directly dependent upon the price of crude oil and poses a great threat to the trader and buyer or seller on the type of INCOTERMS used for it.

7.1.9 Credit Risk

The risk of loss of capital or financial reward loss resulting from the failure of a borrower to repay a loan or otherwise a contractual obligation. Credit risk occurs when a borrower expects to use cash flow to repay current debt. Investors are compensated for assuming the credit risk through interest payments from the borrower or the issuer of a debt obligation.

The credit risk is closely linked to the performance potential of an investment, the most notable being that bond yields are strongly correlated with their perceived credit risk.

7.1.10 Liquidity Risk

The risk arising from the absence of marketing of crude that cannot be bought or sold fairly quickly to prevent or minimize a loss. Liquidity risk is generally reflected in unusually wide discrepancies between the offer request or great movements of prices (in particular.

7.1.11 Cash Flow Risk

The risk that the company don't have enough cash to meet its obligation of the crude contract and thus not able to meet its financial obligations.

7.1.12 Basis Risk

The Basis Risk is the risk that the value of a futures contract of crude (or a (OTC) coverage on-the-counter) does not move in line with that of the underlying exposure.

Otherwise, it is the risk that the term of cash spread will widen or narrow between the moments where a position of cover is implemented and liquidated.

7.1.13 Contingencies

The risk carried with the contingencies or emergencies have significant impact on the crude oil trading.

7.1.14 Conflict with Government

Sometimes conflict with government can have very bad effects on the crude oil trading. In the past conflicts with government has resulted to huge loses to the suppliers, traders and the buyers of the crude.

7.1.15 Tax Risk

Tax risk refers to the change in tax patterns frequently, of a country which are related to crude oil trading and can impact the margin or can even cause a loss to a counterparty.

7.1.16 Operational Risk

Operational risk is defined as a risk by the internal activities of the organization.

Operational risk is the broad discipline with an emphasis on the risks of people, systems and processes by which a company operates.

7.1.17 Legal Risk

The possibility that legal action will be taken because an individual or actions, inactions, the products, the services of the crude oil trading company or other events.

7.1.18 Time Basis Risk

The risk which is carried by the time factor over the period of time in crude oil trading is Time Basis Risk.

7.1.19 Location Basis Risk

The extra effort or cost incurred than estimated to bring out the crude for shipment or trading due to the remote location of its availability sometimes effects the trading as well as the price of crude.

7.2 Factors Affecting Crude Oil Trading

Survey was conducted among 161 personnel in the energy trading industry and basis on that factor analysis has been conducted among the prominent risk in trading i.e. Currency Risk, Supply Risk, Price Risk, Geopolitical Risk, Economic Scenario, Global Demand & Supply, Scenario, Weather Conditions, Freight Charges, Credit Risk, Liquidity Risk, Cash Flow, Basis

Risk, Contingencies, Conflict with Government, Tax Risk, Operational Risk, Legal Risk, Time Basis and Location Basis Risk.

7.3 Results of Factor Analysis

Factor analysis is a data reduction which tells the various variables correlated with each other for project cost performance. Hence here are the results of the factor analysis.

7.3.1 KMO and Bartlett's Test Result

Kaiser-Meyer-Olkin measure of sampling adequacy is an index used to examine the appropriateness of factor analysis. High values (between 0.5 to 1.0) indicate factor analysis is appropriate. Values below 0.5 imply that factor analysis may not be appropriate.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.637
Bartlett's Test of Sphericity	Approx. Chi-Square	411.25
	Df	171
	Sig.	0

Table 7.1: KMO & Barlett's Test Result

As from above table we can identify that the KMO result of conducted factor analysis is 0.637 which is more than 0.5 hence the conducted analysis is appropriate.

Communalities		
	Initial	Extraction
Currency	1	0.619
Supply	1	0.647
Price	1	0.564
Geopolitical	1	0.522
Economic	1	0.629
Demand and Supply	1	0.7
Weather	1	0.617
Freight	1	0.64
Credit	1	0.432
Liquidity	1	0.565
Cash Flow	1	0.662
Basis	1	0.613
Contingencies	1	0.578
Conflict with Government	1	0.592
Taxation	1	0.531
Operation	1	0.635
Legal	1	0.564
Time	1	0.611
Location	1	0.517

Table 7.2: Communalities Results of Factor Analysis
Extraction Method: Principal Component Analysis.

Total Variance Explained									
Comp-onent	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.583	13.596	13.596	2.583	13.596	13.596	2.007	10.561	10.561
2			2.224	2.224	11.708	25.304	1.955	10.29	20.85
3	1.586	8.347	33.651	1.586	8.347	33.651	1.722	9.063	29.913
4	1.432	7.539	41.19	1.432	7.539	41.19	1.69	8.894	38.807
5			1.275	1.275	6.709	47.899	1.314	6.917	45.724
6	1.104	5.81	53.709	1.104	5.81	53.709	1.298	6.831	52.554
7	1.036	5.45	59.159	1.036	5.45	59.159	1.255	6.605	59.159
8	0.925	4.867	64.026						
9	0.858	4.515	68.54						
10	0.788	4.15	72.69						
11	0.754	3.971	76.661						
12	0.734	3.861	80.522						
13	0.68	3.578	84.101						
14	0.6	3.158	87.259						
15	0.577	3.039	90.298						
16	0.542	2.851	93.149						
17	0.483	2.543	95.692						
18	0.43	2.264	97.955						
19	0.389	2.045	100						

Table 7.3: Total Variance
Extraction Method: Principal Component Analysis.

7.3.2 Interpretation of Factors

Interpretation is facilitated by identifying the variables that have large loadings on the same factor. That factor can then be interpreted in terms of the variables that load high on it. The given table will explain the interpretation through factor loadings.

Variables	1	2	3	4	5	6	7
Currency		X		X	X	X	X
Supply		X	X	X	X	X	
Price		X	X	X			X
Geopolitical		X		X	X		X
Economic	X			X	X		X
Demand and Supply	X	X		X	X		X
Weather	X	X	X	X			
Freight	X	X	X			X	X
Credit	X			X	X	X	X
Liquidity		X		X		X	X
Cash Flow	X	X	X		X	X	X
Basis	X		X	X	X	X	
Contingencies	X	X	X	X		X	X
Conflict with Government		X	X	X		X	
Taxation	X	X				X	
Operation			X			X	X
Legal	X		X		X		X
Time	X	X	X				X
Location	X			X		X	X

Table 7.4: Component Matrix Results

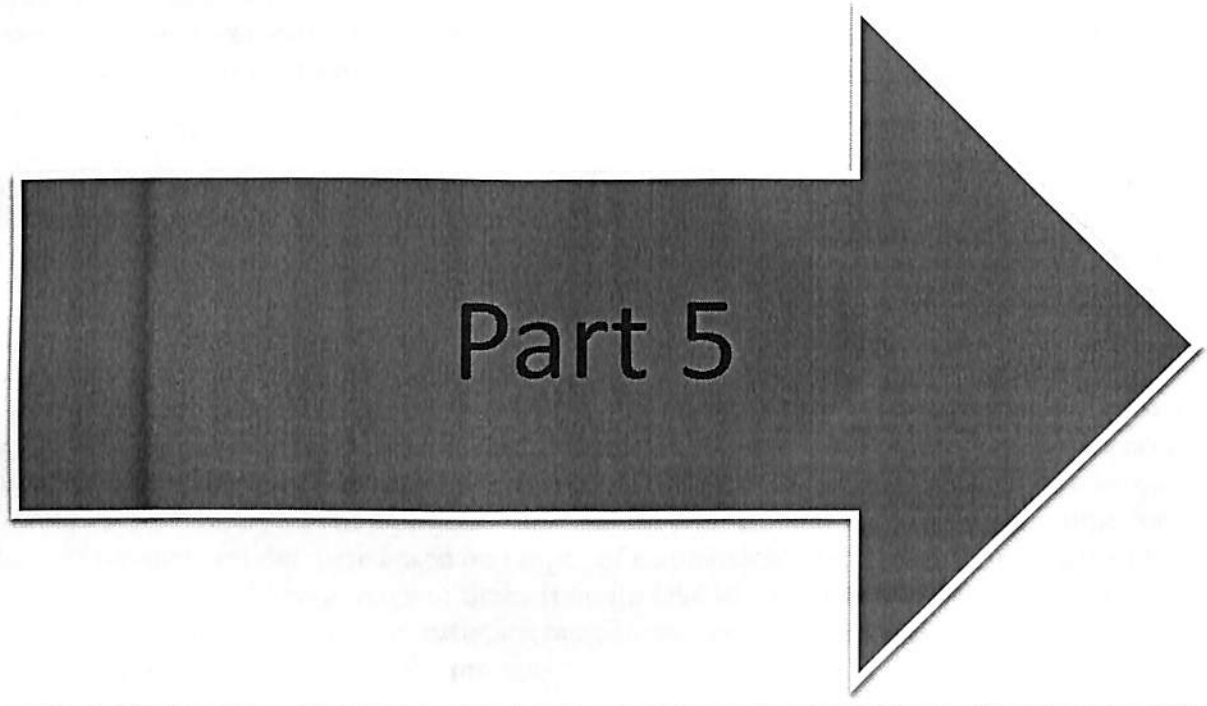
The table clearly shows that various risk variable are highly correlated with each other. The factor wise variables which are correlated are:

- **Factor 1:** Economic condition, demand and supply risk, weather risk, freight risk, credit risk, liquidity risk, cash flows risk, basis risk, contingencies risk, taxation risk, legal risk, time risk and location risk are highly correlated to each other.
- **Factor 2:** Currency risk, supply risk, geopolitical risk, demand & supply risk, weather risk, freight risk, liquidity risk, cash flow risk, contingencies risk, conflict with government, taxation risk and time risk are highly related to each other.
- **Factor 3:** Supply risk, price risk, weather risk, freight risk, cash flow risk, basis risk, contingencies risk, conflict with government, operation risk, legal risk are highly correlated to each other.
- **Factor 4:** Currency risk, supply risk, price risk, geopolitical risk, economic condition risk, demand and supply risk, weather, credit risk, liquidity risk, basis risk, contingencies risk, conflict with government and location risk are highly correlated to each other.

- **Factor 5:** Currency risk, supply risk, geopolitical risk, demand and supply risk, credit risk, cash flow risk, basis risk and legal risk are highly correlated to each other.

- **Factor 6:** Currency risk, supply risk, freight increase risk, credit risk, liquidity risk, cash flow risk, basis risk, contingencies risk, conflict with government, taxation risk, operation risk and location risk are highly correlated to each other.

- **Factor 7:** currency risk, price risk, geopolitical risk, economic risk, demand & supply risk, freight risk, credit risk, liquidity risk, cash flow risk, contingencies risk, operation risk, legal risk, time risk and location risk are highly correlated to each other.


Part 5

Chapter 8

Monte Carlo Simulation Model

8.1 Introduction

Monte Carlo simulation, or probability simulation, is a technique used to understand the impact of risk and uncertainty in financial, project management, cost, and other forecasting models.

When we develop a forecasting model – any model that plans ahead for the future – we make certain assumptions. These might be assumptions about the investment return on a portfolio, the cost of a construction project, or how long it will take to complete a certain task. Because these are projections into the future, the best we can do is estimate the expected value. We don't know with certainty what the actual value will be, but based on historical data, or expertise in the field, or past experience, you can draw an estimate. While this estimate is useful for developing a model, it contains some inherent uncertainty and risk, because it's an estimate of an unknown value.

In some cases, it's possible to estimate a range of values. In a construction project, we might estimate the time it will take to complete a particular job; based on some expert knowledge, we can also estimate the absolute maximum time it might take, in the worst possible case, and the absolute minimum time, in the best possible case. The same could be done for project costs. In a financial market, we might know the distribution of possible values through the mean and standard deviation of returns. By using a range of possible values, instead of a single guess, we can create a more realistic picture of what might happen in the future. When a model is based on ranges of estimates, the output of the model will also be a range. This is different from a normal forecasting model, in which we start with some fixed estimates – say the time it will take to complete each of three parts of a project – and end up with another value – the total time for the project. If the same model were based on ranges of estimates for each of the three parts of the project, the result would be a range of times it might take to complete the project. When each part has a minimum and maximum estimate, we can use those values to estimate the total minimum and maximum time for the project.

8.2 General Interpretation from Monte Carlo Simulation Model

When you have a range of values as a result, you are beginning to understand the risk and uncertainty in the model. The key feature of a Monte Carlo simulation is that it can tell you – based on how you create the ranges of estimates – how likely the resulting outcomes are.

In a Monte Carlo simulation, a random value is selected for each of the tasks, based on the range of estimates. The model is calculated based on this random value. The result of the model is recorded, and the process is repeated. A typical Monte Carlo simulation calculates the model hundreds or thousands of times, each time using different randomly-selected values. When the simulation is complete, we have a large number of results from the model, each based on random input values. These results are used to describe the likelihood, or probability, of reaching various results in the model.

8.3 Application of Monte Carlo Simulation on Crude Oil Trading Risks

Various risks which were sorted out in the paper, energy and trading books, magazines, etc were taken as the inputs and then Monte Carlo Simulation was applied in the excel.

- **Assumptions taken:**

1. Risk/Loss bearing capacity = 10% of portfolio
2. Number of attempts = 1000
3. Range of Risk/Loss in percentage= 50 attempts of Sums of 1000attempts

Monte Carlo Simulation Table (Table 8.1)

ATTEMPT	C-R	S-R	P-R	GP-R	D&S-R	ES-R	WC-R	FC-R	C-R	L-R	CF-R	B-R	Co-R	Cw G	T-R	O-R	L-R	TB-R	LB-R	Others
1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
2	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
3	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
4	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	0	0	1	1
5	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
7	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
10	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
11	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
14	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1
15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

16	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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952	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1
953	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	1
954	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
955	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
956	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
957	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
958	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
959	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
960	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

0																				
961	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
962	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
963	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
964	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
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967	1	1	1	0	1	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1
968	1	1	1	0	1	1	1	1	1	0	1	1	0	1	1	1	1	0	1	1
969	1	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1
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971	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0
972	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
973	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
974	1	1	1	1	1	0	1	0	1	1	1	1	1	0	0	1	1	1	1	1
975	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1
976	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	1	1

977																				
978	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
979	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
980	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
981	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
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983	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1
984	1	1	1	1	1	0	0	0	1	1	1	0	1	1	0	0	1	1	1	1
985	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1
986	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
987	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1
988	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
989	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
990	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	1	0	0	1
991	1	1	1	1	1	1	1	1	0	1	0	1	0	1	1	1	1	0	1	1
992	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
993	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1

994	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
995	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
996	1	0	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	0
997	1	1	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
998	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1
999	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	0	0	1	1
1000	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
SUM	885	899	898	883	901	902	899	899	908	902	900	878	901	912	906	923	895	911	899	914

C-R-> Currency Risk
P-R-> Price Risk
D&S-R-> Demand & Supply Risk
WC-R-> Weather conditions Risk
C-R-> Credit Risk
CF-R-> Cash Flow Risk
Co-R-> Contingencies Risk
T-R-> Tax Risk
L-R-> Legal Risk
LB-R-> Location Basis Risk
S-R-> Supply Risk
G-R-> Geopolitical Risk
ES-R-> Economic Scenario Risk
FC-R-> Freight Charges Risk
L-R-> Liquidity Risk
B-R-> Basis Risk
CwG-> Conflict with Government
O-R-> Operational Risk
TB-R-> Time Basis Risk

8.3.1 Interpretation:

From the above table of Monte Carlo simulation we can very easily make out that Currency Risk, supply risk, price risk, geopolitical risk, weather condition risk, freight charges risk, basis risk, operational risk and location basis risk are the various risk whose risk tolerance of 10% is increasing, therefore in future these risk are to be looked or kept in mind while trading in crude oil.
We can see that the above mentioned risks are same as those of FACTOR ANALYSIS and are efficient to use.

Table 8.2: 50 Attempts of Sum of result of Monte Carlo Table

ATTEMPT	C-R	S-R	P-R	G-R	D& S-R	ES-R	WC-R	FC-R	C-R	L-R	CF-R	B-R	Co-R	Cw G	T-R	O-R	L-R	TB-R	LB-R	OTHERS
1	902	908	889	890	914	901	907	919	907	900	913	889	903	908	906	888	904	901	907	889
2	884	912	892	921	896	876	902	904	891	901	910	897	905	906	904	895	871	909	903	888
3	912	910	898	877	899	882	926	907	906	883	881	883	893	903	905	883	905	906	893	884
4	901	895	910	906	888	879	894	896	908	890	900	895	885	903	912	889	897	904	887	901
5	901	898	907	893	897	891	897	903	899	919	889	901	902	893	888	910	885	891	905	894
6	917	905	902	887	895	918	904	913	906	903	899	899	889	905	919	904	901	901	907	905
7	896	894	909	898	892	909	891	920	900	863	904	894	915	911	906	905	896	893	922	910
8	884	892	898	901	910	882	893	909	898	903	906	902	907	886	894	890	893	889	890	877
9	895	908	910	879	893	899	899	897	887	906	898	913	899	898	903	900	897	909	908	910
10	903	903	913	912	895	902	904	903	886	903	904	898	885	881	892	906	898	894	904	895
11	886	897	894	901	901	909	915	895	893	905	899	889	895	904	903	917	902	887	891	913
12	894	898	889	895	894	891	897	897	916	895	903	889	905	909	895	901	911	891	886	916
13	896	913	896	900	886	894	920	884	906	908	896	910	922	897	913	904	903	901	884	898
14	895	910	904	905	898	907	901	907	894	893	884	889	898	898	904	897	894	899	899	893
15	880	904	895	889	899	889	905	901	896	890	907	884	888	895	891	907	897	897	891	887
16	886	894	887	896	896	888	892	897	882	895	890	902	890	895	893	900	886	903	907	893
17	893	882	907	886	921	903	921	904	892	891	911	902	906	898	895	902	924	896	880	907
18	889	899	899	894	909	899	901	910	896	907	908	904	908	903	912	911	894	911	905	896
19	899	904	892	908	895	900	910	895	902	895	890	919	895	893	921	892	905	910	895	915
20	896	903	915	892	894	890	912	892	888	884	896	896	890	876	889	892	897	912	887	902
21	914	902	905	891	911	883	903	894	908	896	882	900	891	889	897	898	886	900	908	903
22	898	903	911	889	894	890	900	910	914	906	901	899	902	899	895	908	898	889	894	913
23	900	887	907	911	892	885	891	899	895	900	898	890	900	911	907	914	902	883	901	896
24	899	893	890	907	897	913	906	900	909	903	889	906	919	899	903	904	877	906	890	896
25	896	905	901	895	892	897	904	898	885	905	906	898	906	896	915	913	897	913	910	894
26	906	895	929	895	890	909	895	902	906	895	886	891	901	909	912	889	911	905	907	894
27	903	899	908	916	910	915	909	902	904	906	912	911	894	877	883	912	882	890	899	912
28	891	891	885	904	902	893	902	887	892	901	902	912	897	897	888	904	908	901	898	896
29	911	894	886	914	907	915	889	902	903	902	885	895	904	901	880	892	906	890	898	893

30	890	909	896	903	888	917	899	902	913	877	904	892	896	898	901	875	891	881	904	895
31	896	897	909	896	889	901	889	899	917	892	892	910	902	891	890	889	892	907	918	912
32	911	892	899	897	905	891	913	891	907	908	903	908	905	908	913	900	896	897	887	891
33	900	894	887	915	902	883	914	908	908	908	915	890	907	907	893	906	889	902	893	888
34	913	883	888	893	906	901	903	901	923	901	907	920	889	900	904	901	894	891	924	893
35	897	903	901	907	898	901	887	903	893	898	904	903	907	911	885	891	899	908	924	906
36	898	904	899	900	874	897	901	888	891	909	905	893	905	893	896	900	902	910	902	890
37	908	901	925	883	905	896	908	905	893	892	896	900	883	904	898	893	910	903	895	897
38	899	909	897	896	902	909	898	903	901	894	895	894	911	893	915	902	905	886	900	912
39	909	891	890	897	906	884	899	900	892	901	893	897	905	896	902	904	896	896	899	889
40	893	909	903	891	898	900	921	904	908	885	888	899	912	904	877	896	899	896	923	899
41	913	898	894	902	897	895	912	927	901	918	902	901	894	893	891	903	910	898	894	903
42	899	901	905	917	895	888	912	893	898	909	902	893	903	908	907	913	898	892	895	894
43	900	894	906	901	919	892	907	899	905	908	905	894	913	909	888	899	907	902	885	891
44	911	904	895	892	907	881	893	903	898	886	898	889	904	898	890	891	890	917	905	905
45	902	898	914	898	902	902	889	896	897	903	900	904	887	893	898	886	890	899	900	882
46	912	893	886	904	903	911	897	915	913	890	891	895	891	901	908	901	881	904	890	899
47	883	897	872	904	899	895	903	890	893	900	892	899	897	904	908	912	908	896	898	896
48	908	898	908	893	897	911	906	878	901	879	908	908	893	898	902	898	903	903	914	908
49	905	904	900	896	915	886	883	906	903	911	906	903	908	896	900	891	909	899	902	895
50	884	896	886	905	884	884	893	893	890	908	914	902	901	878	899	902	899	898	917	892
MINIMUM	**880**	**882**	**872**	**877**	**874**	**876**	**883**	**878**	**882**	**863**	**881**	**883**	**883**	**876**	**877**	**875**	**871**	**881**	**880**	**877**
MAXIMUM	**917**	**913**	**929**	**921**	**921**	**918**	**926**	**927**	**923**	**919**	**915**	**920**	**922**	**911**	**921**	**917**	**924**	**917**	**924**	**916**
AVG	**899.2**	**899.5**	**899.8**	**898.8**	**899.1**	**896.7**	**902.3**	**901**	**900.3**	**898.5**	**899.4**	**899**	**899.9**	**898.5**	**899.8**	**899.4**	**897.9**	**899.3**	**900.5**	**898**
LOSS	**-0.8**	**-0.5**	**-0.2**	**-1.2**	**-0.9**	**-3.3**	**2.3**	**1**	**0.3**	**-1.5**	**-0.6**	**-1**	**0.1**	**-1.5**	**-0.2**	**-0.4**	**-2.1**	**-0.7**	**0.5**	**-2**

C-R-> Currency Risk

S-R-> Supply Risk

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D&S-R-> Demand & Supply Risk
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CF-R-> Cash Flow Risk
Co-R-> Contingencies Risk
T-R-> Tax Risk
L-R-> Legal Risk
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G-R-> Geopolitical Risk
ES-R-> Economic Scenario Risk
FC-R-> Freight Charges Risk
L-R-> Liquidity Risk
B-R-> Basis Risk
CwG-> Conflict with Government
O-R-> Operational Risk
TB-R-> Time Basis Risk

8.3.2 Interpretation:

We can see the fluctuation range of various risk in the above table and hence can make out the range in which these risks are supposed to vary.

Chapter 9

ANALYSIS & FINDINGS

9.1 Factor Analysis:

- **Factor 1:** Economic condition, demand and supply risk, weather risk, freight risk, credit risk, liquidity risk, cash flows risk, basis risk, contingencies risk, taxation risk, legal risk, time risk and location risk are highly correlated to each other.
- **Factor 2:** Currency risk, supply risk, geopolitical risk, demand & supply risk, weather risk, freight risk, liquidity risk, cash flow risk, contingencies risk, conflict with government, taxation risk and time risk are highly related to each other.
- **Factor 3:** Supply risk, price risk, weather risk, freight risk, cash flow risk, basis risk, contingencies risk, conflict with government, operation risk, legal risk are highly correlated to each other.
- **Factor 4:** Currency risk, supply risk, price risk, geopolitical risk, economic condition risk, demand and supply risk, weather, credit risk, liquidity risk, basis risk, contingencies risk, conflict with government and location risk are highly correlated to each other.
- **Factor 5:** Currency risk, supply risk, geopolitical risk, demand and supply risk, credit risk, cash flow risk, basis risk and legal risk are highly correlated to each other.
- **Factor 6:** Currency risk, supply risk, freight increase risk, credit risk, liquidity risk, cash flow risk, basis risk, contingencies risk, conflict with government, taxation risk, operation risk and location risk are highly correlated to each other.
- **Factor 7:** currency risk, price risk, geopolitical risk, economic risk, demand & supply risk, freight risk, credit risk, liquidity risk, cash flow risk, contingencies risk, operation risk, legal risk, time risk and location risk are highly correlated to each other.

9.2MONTE CARLO SIMULATION:

From the table of Monte Carlo simulation we can very easily make out that Currency Risk, supply risk, price risk, geopolitical risk, weather condition risk, freight charges risk, basis risk, operational risk and location basis risk are the various risk whose risk tolerance of 10% is increasing, therefore in future these risk are to be looked or kept in mind while trading in crude oil.

9.3 Overall:

From the above table of Monte Carlo simulation we can very easily make out that Currency Risk, supply risk, price risk, geopolitical risk, weather condition risk, freight charges risk, basis risk, operational risk and location basis risk are the various risk whose risk tolerance of 10% is increasing, therefore in future these risk are to be looked or kept in mind while trading in crude oil.
We can see that the above mentioned risks are same as those of FACTOR ANALYSIS and are efficient to use.

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Appendices

Factor Analysis

KMO and Bartlett's Test				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.637		
Bartlett's Test of Sphericity	Approx. Chi-Square	411.25		
	df	171		
	Sig.	0		
Communalities				
	Initial	Extraction		
Currency	1	0.619		
Supply	1	0.647		
Price	1	0.564		
Geopolitical	1	0.522		
Economic	1	0.629		
DemandandSupply	1	0.7		
Weather	1	0.617		
Frieght	1	0.64		
Credit	1	0.432		
Liquidity	1	0.565		
CashFlow	1	0.662		
Basis	1	0.613		
Contingencies	1	0.578		
ConflictwithGovernment	1	0.592		
Taxation	1	0.531		
Operation	1	0.635		
Legal	1	0.564		
Time	1	0.611		
Location	1	0.517		
Extraction Method: Principal Component Analysis.				

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.583	13.596	13.596	2.583	13.596	13.596	2.007	10.561	10.561
2			2.224	2.224	11.708	25.304	1.955	10.29	20.85
3	1.586	8.347	33.651	1.586	8.347	33.651	1.722	9.063	29.913
4	1.432	7.539	41.19	1.432	7.539	41.19	1.69	8.894	38.807
5			1.275	1.275	6.709	47.899	1.314	6.917	45.724
6	1.104	5.81	53.709	1.104	5.81	53.709	1.298	6.831	52.554
7	1.036	5.45	59.159	1.036	5.45	59.159	1.255	6.605	59.159
8	0.925	4.867	64.026						
9	0.858	4.515	68.54						
10	0.788	4.15	72.69						
11	0.754	3.971	76.661						
12	0.734	3.861	80.522						
13	0.68	3.578	84.101						
14	0.6	3.158	87.259						
15	0.577	3.039	90.298						
16	0.542	2.851	93.149						
17	0.483	2.543	95.692						
18	0.43	2.264	97.955						
19	0.389	2.045	100						
Extraction Method: Principal Component Analysis.									

Component Matrixa							
	Component						
	1	2	3	4	5	6	7
Currency	-0.392	0.243	-0.21	0.387	0.185	0.412	0.093
Supply	-0.206	0.394	0.069	0.005	0.442	0.072	-0.494
Price	-0.192	0.137	0.085	0.005	-0.694	-0.141	0.01
Geopolitical	-0.348	0.471	-0.019	0.067	0.25	-0.284	0.176
Economic	0.397	-0.338	-0.146	0.445	0.311	-0.196	0.046

Demand and Supply	0.235	0.268	-0.139	0.297	0.057	-0.587	0.344
Weather	0.207	0.365	0.3	0.161	-0.2	-0.284	-0.452
Freight	0.127	0.657	0.315	-0.242	-0.08	0.155	0.071
Credit	0.41	-0.065	-0.491	0.024	0.011	0.108	0.076
Liquidity	-0.103	0.577	-0.337	0.067	-0.194	0.131	0.219
Cash Flow	0.469	0.375	0.067	-0.237	0.422	0.059	0.243
Basis	0.584	-0.059	0.378	0.268	0.055	0.182	-0.135
Contingencies	0.518	0.103	0.198	0.102	-0.105	0.453	0.181
Conflict with Government	-0.094	0.041	0.383	0.654	-0.016	0.082	0
Taxation	0.438	0.141	-0.437	-0.295	-0.104	0.08	-0.157
Operation	-0.252	-0.215	0.525	-0.118	-0.01	0.068	0.48
Legal	0.196	-0.421	0.305	-0.428	0.21	-0.167	0.014
Time	0.548	0.485	0.197	-0.095	-0.024	-0.154	0.05
Location	0.587	-0.214	-0.112	0.211	-0.263	0.023	0.009
Extraction Method: Principal Component Analysis.							

Rotated Component Matrixa								
	Component							
	1	2	3	4	5	6	7	
Currency	-0.105	-0.087	-0.164	0.71	0.214	-0.128	-0.085	
Supply	-0.322	0.135	-0.05	0.185	0.39	-0.232	0.532	
Price	-0.033	0.001	-0.072	0.079	-0.739	0	0.07	
Geopolitical	-0.515	0.213	-0.194	0.265	0.08	0.299	0.084	
Economic	0.375	-0.323	0.048	-0.086	0.404	0.459	0.018	
DemandandSupply	-0.044	0.129	0.029	0.062	-0.028	0.821	0.042	
Weather	0.113	0.2	-0.058	-0.065	-0.225	0.124	0.701	

Frieght	-0.042	0.753	-0.057	0.118	-0.134	-0.117	0.149	
Credit	0.258	-0.053	0.53	0.105	0.138	0.153	-0.169	
Liquidity	-0.162	0.302	0.212	0.582	-0.213	0.113	-0.074	
CashFlow	0.065	0.645	0.167	-0.08	0.416	0.169	-0.077	
Basis	0.672	0.178	-0.12	-0.141	0.195	0.016	0.24	
Contingencies	0.626	0.387	0.016	0.102	0.048	-0.097	-0.123	
ConflictwithGovernment	0.312	-0.106	-0.576	0.296	0.014	0.118	0.222	
Taxation	0.115	0.169	0.697	-0.027	-0.011	-0.036	0.038	
Operation	-0.031	0.133	-0.597	-0.22	-0.095	-0.088	-0.441	
Legal	0.012	0.029	-0.056	-0.708	0.178	-0.083	-0.14	
Time	0.205	0.632	0.143	-0.106	-0.032	0.278	0.244	
Location	0.612	-0.084	0.272	-0.094	-0.103	0.204	-0.007	
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.								

Component Transformation Matrix							
Component	1	2	3	4	5	6	7
1	0.705	0.34	0.43	-0.295	0.165	0.279	0.097
2	-0.263	0.718	0.076	0.504	-0.092	0.137	0.359
3	0.2	0.352	-0.781	-0.389	-0.07	-0.171	0.201
4	0.424	-0.381	-0.37	0.55	0.091	0.406	0.248
5	-0.251	0.062	-0.106	-0.063	0.954	0.087	0.013
6	0.388	0.136	0.015	0.434	0.193	-0.728	-0.274
7	0.012	0.278	-0.224	0.109	-0.059	0.415	-0.827

Component Score Coefficient Matrix							
	Component						
	1	2	3	4	5	6	7
Currency	0.061	-0.038	-0.084	0.463	0.204	-0.117	-0.11
Supply	-0.16	0.012	0.015	0.052	0.339	-0.219	0.447
Price	0.031	-0.012	-0.017	0.014	-0.566	0.03	0.047
Geopolitical	-0.28	0.108	-0.113	0.071	0.091	0.287	0.005
Economic	0.132	-0.204	-0.027	-0.003	0.27	0.333	0.034
DemandandSupply	-0.111	0.03	-0.047	-0.016	-0.051	0.67	-0.042
Weather	0.033	0.002	-0.031	-0.102	-0.179	0.051	0.562
Frieght	-0.004	0.397	-0.055	0.037	-0.085	-0.128	0.013
Credit	0.101	-0.048	0.286	0.118	0.075	0.06	-0.14
Liquidity	-0.033	0.145	0.122	0.335	-0.146	0.067	-0.151
CashFlow	-0.038	0.354	0.032	-0.048	0.308	0.086	-0.159
Basis	0.345	0.059	-0.133	-0.015	0.121	-0.075	0.17
Contingencies	0.367	0.218	-0.058	0.158	0.017	-0.163	-0.18
ConflictwithGovernment	0.243	-0.079	-0.37	0.211	0.02	0.081	0.144
Taxation	0.007	0.047	0.413	-0.004	-0.032	-0.103	0.037
Operation	0.019	0.183	-0.38	-0.116	-0.061	0.016	-0.399
Legal	-0.084	0.065	-0.044	-0.431	0.116	-0.029	-0.063
Time	0.04	0.291	0.025	-0.092	-0.048	0.161	0.106

Location	0.294	-0.08	0.111	0.016	-0.129	0.093	-0.006
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.							

Component Score Covariance Matrix							
Component	1	2	3	4	5	6	7
1	1	0	0	0	0	0	0
2	0	1	0	0	0	0	0
3	0	0	1	0	0	0	0
4	0	0	0	1	0	0	0
5	0	0	0	0	1	0	0
6	0	0	0	0	0	1	0
7	0	0	0	0	0	0	1
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.							