Pricing In Physical Trading of Crude Oil

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DECLARTION

I, **Sanjeev Ghoshal - Roll** No. R590212025, Batch 2012-14, MBA (ENERGY TRADING) of the UNIVERSITY OF PETROLEUM AND ENERGY STUDIES (UPES), Dehradun hereby declare that the dissertation report entitled

"PRICING IN PHYSICAL TRADING OF CRUDE OIL"

Is an original work and the same has not been submitted to any other institute for the award of any other degree.

Sanjeev

(Sanjeev Ghoshal)

BONAFIDE CERTIFICATE

This is to certify that **Sanjeev Ghoshal**, a student of **UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**, Dehradun, pursuing **MBA (ENERGY TRADING)**, has successfully completed her dissertation report as a part of her course curriculum. The project report entitled **'Pricing in Physical Trading of Crude Oil'**, submitted by the student to the undersigned is an authentic record of her original work, which she carried out under our supervision and guidance. This study has not been submitted anywhere else for degree purpose.

I wish him all the best.

Date: 21/04/14

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ABSTRACT

The oil market is unique in its complexity and diversity. The scale is international and the trading instruments range from the physical to the financial. Thus because of this widespread, the oil market has attracted the broadest possible set of participants which includes not only oil companies but also banks, government agencies, commodity traders, financial engineers, ship owners, fund managers, airlines, chemical producers, electricity utilities and industrial conglomerates are all involved in the business of trading oil.

The stream of data about oil market basics is not instant and is often subject to major revisions which make the most recent available information highly unpredictable. It is important to analyze the procedure of convergence and understand what the spot price really means in the framework of the oil market, even though the futures price often converges to a spot price.

The process of price discovery and price structure in oil markets remains under-researched and unfortunately little attention has been dedicated to such issues. This topic can be linked to the present debate on the role of speculation versus fundamentals in the determination of oil prices; it goes beyond the existing debates which have recently conquered policy agenda. This document offers a new and deeper viewpoint on the current debate by analyzing how oil prices are discovered in the existing international pricing scheme, by identifying the various layers applicable for the price structure process and by exploration and analyzing the links between the financial and physical layers in the oil market which lie at the heart of the current international oil pricing system. If we analyze the commodity markets, they are different from financial markets and energy markets in particular are among the most complex commodity markets. The reason for this is mainly due to physical constraints such as the local nature of the markets, volume constraints on transfer and storage and mild to severe inelasticity in supply and demand. These strict physical constraints give rise to very specific features and impact the entire dynamics of energy markets. This study would mainly focus on determining the important of aspects of physical trading, pricing methodology in this market and the relation among spot prices and futures prices.

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1.1 INTRODUCTION

Total world production of crude oil is approximately 89 million barrels per day. Crude oil supplies a network of refineries in places located close to key centers of consumption or next to pipelines or transport facilities. Crude oil is processed in refineries and turned into finished petroleum products. Some companies are fully integrated; fine-tune their own production of crude oil and petroleum products distribution networks feed. But for production more part and refining are not fully integrated and refiners to engage in trade to ensure the supply of their facilities or the surpluses. This oil is mainly provided by contracts in the long term that refiners are generally reluctant to over-reliance on shipments as they may not be reliable and have strong price volatility.

Oil & Gas are the products most traded globally. The reasons are many, but include their commercial liquidity (all players of the market are able to negotiate all products), the delta between sources of supply and markets of the application (for example in the Middle East to Europe and the States) and the supply of long and often complex chains that support the physical delivery of oil / gas, where each cargo can be exchanged several times before reaching its destination.

As regards the structure of the oil market is concerned, it includes physical and paper market. Among participants of the physical market actually provides the physical goods namely crude oil. Contracts are tailored made. Example, it is a refiner to buy crude oil from the producer or a trader is the sale of crude oil refiner or the purchase of crude oil from the producer. Physical price assessments are carried out by agencies Platts and Argus petroleum prices. The physical markets trade both place (current month) and before (forward months) contracts. Physical transactions in the crude oil market in wet or actual oil drums.

The physical oil market exists for the sole purpose to provide and receive physical oil. Contracts are normally non – standard, and the title and risk in the oil is transferred from one party to the other at a time and location specified. For crude oil, the physical market is global and competitive worldwide. Refiners source of crude oil worldwide and producers are competing for their business, the creation of a truly competitive market.

The point of view that crude oil has acquired the characteristics of financial assets such as shares or bonds has gained wide acceptance among many observers. However, the nature of the 'financialisation' and its implications are not yet clear. Discussions and analyses of the 'financialisation' of the oil markets were partly reflected in analyses of the relationship between finance and commodity indices, which include crude oil. Items that attracted the most attention were the results: correlations between levels, yields and volatility of raw materials and financial indices. However, a full understanding of the degree of interaction between oil and finance

requires, in addition, an analysis of the interactions, causalities and processes such as the investment and trading of different types of financial participants strategies; financing mechanisms and debt support these strategies; the structure of the markets for products derived from petroleum; and especially more the mechanisms linking the physical and financial market of oil layers.

The crude oil market also has a 'physical' dimension, unlike a pure financial asset, which should anchor the fundamentals of the oil market prices: crude oil is consumed, stored and widely traded with millions of barrels bought and sold each day at prices agreed by parties transactions. Thus, in principle, prices in futures by the arbitration process should eventually converge on the so-called 'spot' in the physical markets prices. The argument is that since physical transactions are negotiated at spot prices, these prices should reflect the conditions of the offer to existing demand.

1.2 WHY OIL IS TRADED

Over the preceding twenty years oil has become the major product market in the world. Oil trade has evolved from principally physical movement into a complicated financial market during this period. With the course of time, it has involved the interest of a wide variety of participants who now include banks and fund managers as well as the traditional oil majors, physical oil traders and independents. Apart from being the largest commodity market in the world it is also the most complicated commodity traded. Many different types of crude oil and refined products are trade in the physical oil market and the relative values of each grade are continually shifting in response to changes in supply and demand on both a global and a local scale. A complex set of interlocking markets has therefore been developed by the industry, not only to establish prices across the entire spectrum of crude spectrums, but also to enable the buyers and sellers to accommodate for any changes in relative prices wherever they might occur. Initially the momentum for the expansion of the oil market came from the changing structure of the oil industry. Oil trading was a marginal activity for most companies, prior to 1973. They only used the market to resolve any imbalances in supply and demand that might emerge. Trading volumes were typically small and usually spot prices were much less transparent than they are today. The industry at that time was dominated by large integrated oil companies that had little use for external markets either as a means of obtaining supplies or as a basis for setting prices.

However, the structure of the oil industry changed irreversibly in the 1970s with the nationalization of the upstream interests of the major oil companies in the Middle East and the other oil producing nations, and trading became an essential component of any oil company's supply and marketing operations. The major oil companies were forced to buy at arm's length from their former host governments because they lost access to large volumes of equity oil and the physical base of the international oil market expanded rapidly. With more oil being traded external markets began to set the price for internal transfers as well as third party sales and

companies started to buy and sell oil if better opportunities existed outside their own supply network, which ultimately lead to the growth of the market.

But the driving force that leads to the rapid growth in oil trading is the huge fluctuation in the price of oil. Prices frequently change by up to 50 cents/barrel and an almost daily price movements of $1/barrel is not uncommon. Leading to the fact that there is no obvious upper or lower bound to oil prices, the price of a barrel of oil can double or half within the space of a few months. This has attracted liquidity from other financial and commodity markets and generated a very large volume of activity in its own right.

1.2.1 Trading characteristics of oil

Many of the characteristic features of the oil market are derived from the nature of oil itself. Inspite of the introduction of highly standardized paper trading instruments, oil remains a physical commodity. Thus similar to other primary commodities, the oil market is ultimately concerned with the processing, transportation and storage of an essential raw material as it travels from producer to consumer. But, this is a slow process, since crude oil may take several months to move from the well-head through the refinery to the sales pump. This is very different from the financial markets where assets can be moved instantaneously from one location to another whenever required. As a result of this, prices often change because the right oil is not in the right place at the right time.

Transportation, processing and storage

One of the most important characteristics of oil is that it is a liquid. Thus oil being a liquid it requires specialized handling facilities for processing, transportation and storage. It is these elements that provide the basic building blocks for the physical oil market.

Transportation

Oil is transported either in ships or pipelines. In the case of crude oil, the quantities are typically large size and usually depend on the capacity of the loading and discharge terminals, the relative cost of shipping and the length of the voyage. In the international market oil moves almost exclusively in ships and it is therefore the size of the ship that forms the basic trading unit. In the North Sea area (BFOE) which is the most active waterborne crude market in the world, 500,000 barrel cargoes are a normal quantity. But incase for longer-haul crudes from the Middle East or West Africa, oil often moves in very large crude carriers (VLCCs) which can take up to 2 million barrels at a time. Thus as a result of which the scale of financial exposure associated with crude oil trading can be very large indeed.

However, refined products are usually traded in much smaller quantities. And many of the most active product markets deal in much smaller barge-sized quantities, of between 1,000 and 5,000 tonnes. Long distance movements may involve shipments as large as 60,000 tones (about

500,000 barrels, depending on the type of product) but most of the international trade is conducted in smaller vessels holding almost 20-30,000 tones. Since products are usually traded ex-refinery and often sold to wholesale distributors who may not have the capacity to receive or store very large quantities so the basic trading unit needs to be much smaller than in the international crude market. On the other hand crude oil is usually sold close to the point of production and title is transferred as the oil flows from the loading terminal into the ship. However, once loaded the oil can either be traded on the water or at the point of discharge. Thus depending on the point of discharge the same cargo of oil may be priced differently. 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 at the same location with prices that reflect different delivery arrangements or parcel sizes.

Oil can also be transported and traded via pipelines. The most important pipeline markets are in the US where access is guaranteed in law to those who want to use them. In many cases oil is traded on a rate-able basis i.e. a specified number of barrels per day over an agreed period such as a fortnight or a month and the oil is sold Free-in-pipeline (FIP) at designated locations. In the case of West Texas Intermediate, oil is also sold in multiples of 1,000 barrels available from or delivered into storage facilities at Cushing, Oklahoma.

Processing

Normally oil is not used in its raw state. In order to turn it into a marketable product such as gasoline, fuel oil or heating oil, crude oil must be processed through a refinery. The only exception is low sulphur crude oil which is sometimes burnt directly in power stations. Although crude and product markets have rather different characteristics, they are inextricably linked by the technology and economics of refinery processes. Oil is therefore traded twice, first as a refinery feedstock, and secondly as a finished product.

Crude oil markets operate between the producer and the refiner. Because there are many different types of crude oil, their relative value depends on the mix of products that can be obtained from them. The characteristics and behavior of the crude oil market therefore depend on the preferences and needs of the refiner as well as the composition and nature of the supply. Generally crudes that yield a higher proportion of the more valuable light products such as gasoline, naphtha, kerosene and heating oil can command a higher price than those which have a high yield of residual fuel oil. But there is no objective method of assessing the price of given crude since every refinery has a different configuration and its market value will depend on who is bidding at the time. Moreover refiners in different regions may have very different views about the price they are prepared to pay.

Product markets operate between the refiner and the blender or wholesaler. They are usually much more localized than crude oil markets, since most refineries are positioned close to the end-user, and their process facilities are tailored to the needs of the local consumer. As a result, refined product prices can differ significantly from one market to another, reflecting the local structure of demand for the various petroleum products, the configuration of the refineries, and the regional product quality specifications.

Storage

Oil must also be stored on its journey from the well-head to the pump. As oil is a liquid, this requires the construction of specialized storage tanks at every stage in the supply chain. Stocks are necessary in any business that produces, manufactures and markets a physical commodity such as oil, and fluctuations in the level of stocks held at different points along the supply chain play an important role in determining the behavior of prices in the oil market. But holding stocks is also costly since it ties up cash and storage facilities are expensive to rent or build. Oil companies therefore try to keep their stocks as near to the minimum operating level as circumstances allow.

A surprisingly large amount of oil is required simply to fill the supply chain from well-head to customer. In addition, stocks are needed to keep the system flowing since deliveries are usually made in discrete quantities and stocks are run down in the intervening period. Also, companies need to hold extra stocks as an insurance policy against unexpected interruptions in supply or increases in demand from their customers. And finally, companies often build up stocks for purely speculative reasons either to profit from an upward price trend or to minimize the losses from a downward price trend.

1.2.2 Demand, Supply and Stocks

The behavior of prices in any primary commodity market is strongly influenced by the fundamental forces of demand and supply. Although prices frequently change for other more ephemeral reasons, especially now that trading screens and on-line news services play such an important role in the day-to-day operation of the oil market, the role of fundament.als in shaping the course of prices should not be forgotten.

Demand

The demand for oil, like other primary commodities, depends mainly on the state of the global economy. Despite improvements in energy efficiency as a result of the price increases of the 1970s and early 1980s, oil demand remains closely linked to the growth in economic activity. Over the past five years, world oil consumption has grown at an average annual rate of just under 2 per cent, adding about 1.3 million b/d to global demand each year.

Oil demand is growing fastest in the newly industrializing countries of the Asia-Pacific rim where the economies have been expanding very rapidly indeed, but the pace of growth slowed dramatically in 1998 *as* a result of the financial crisis before bouncing back in 1999. From 1993 to 1997, the average annual rate of oil demand growth in Asia (excluding China) was just over 7 percent. By contrast, oil demand in the industrialized countries of the OECD has grown more slowly, averaging only 1.5 per cent over the same period, as some countries emerged from recession. And oil demand in the former Soviet Union has continued to fall as the economy contracts and the old, energy-intensive industries are no longer viable. However, the OECD countries still consume more than half the world's oil and it is in these countries that the oil markets are most developed and least constrained by government controls.

Oil demand is also highly seasonal. Peak demand for heating fuels such as kerosene, gas oil and residual fuel oil obviously comes in the winter, while peak demand for transport fuels such as gasoline and diesel comes in the summer. In addition, other products such as bitumen, which is used for road building, also display a clear seasonal pattern that can also affect oil price behavior at certain times of the year. Although the steady shift towards a greater share of transport fuels in the global demand barrel has reduced the annual variation in world oil consumption, there is still a difference of 3 to 4 million b/d between the winter peak and the summer trough in demand.

Prices play an ambivalent role in determining oil demand. In the short-term, they appear t o have very little impact on the level of oil consumption, except in those markets such as electricity generation where there is direct competition with other fuels. In most markets, oil consumers cannot easily react to price increases because this requires investment, either in a new car or new boiler. As a result, the impact of higher prices may take years to filter through. But in the 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 consumer government taxes on the amount of oil consumed per head of the population in countries with similar levels of economic development. For example, the US, which still imposes very low taxes on oil products, consumes nearly twice as much oil per capita as the UK and France, which impose much higher taxes. And the fact oil products are either not taxed, or even subsidized, in many developing countries helps to explain the very high rates of growth of oil demand achieved in recent years, although this is gradually changing.

Supply

Matching oil supply to demand has become much more difficult since the oil industry ceased to be properly integrated. Most oil producers simply maximize their output, subject to the technical constraints of the field, in order to get a quick return on the very large amounts of money they have invested in developing the oil field in the first place. And because their operating costs are typically much lower than the sunk capital costs, they will continue to produce until oil prices

reach very low levels. In the North Sea, for example, most of the fields have operating costs of less than $5/barrel and are unlikely to be shut in unless prices fall below this level. As a result, the responsibility for restraining production below capacity lies with the eleven remaining members of the Organization of Petroleum Exporting Countries (OPEC), who are committed to maintaining prices above their marginal cost of production in order to extract what they regard as a fair economic rent for oil. So far, they have succeeded, although competition for market share between OPEC members has frequently forced prices down until falling revenues have eventually restored a sense of discipline to the Organization. OPEC was particularly successful during the first half of the 1980s when Saudi Arabia was prepared to play the role of swing producer alone, but it became more difficult to balance the market after the Saudis refused to continue cutting production at the end of 1985. However, OPEC re-discovered the benefits of collective action in 1999 when low prices persuaded Saudi Arabia, Venezuela and non-OPEC Mexico to co-operate over output cuts in order t o bring the market back into balance and reduce high stocks.

Two factors have made OPEC's self-appointed task more difficult. First, there is the continued expansion of oil production outside OPEC. Although lower oil prices were initially expected to slow down the development of non-OPEC oil fields, this has not proved to be the case. By encouraging technological developments and forcing companies to cut costs, lower oil prices actually made it easier t o develop new oil fields outside the OPEC countries. As a result: the call on OPEC crude continues to grow more slowly than OPEC would like to see despite rising oil consumption. Secondly, there is the inherent seasonality of oil demand. As the residual supplier t o the world oil market, OPEC potentially faces large fluctuations in the level of production required by refiners at different times of the year. This not only makes it difficult to keep track of the underlying level of demand, but is also difficult to administer since OPEC members find it very hard to agree on how to allocate production between themselves. The problem was temporarily "solved" in November 1993 by setting a fixed production quota over a much longer period of time, thus leaving the market to handle the seasonal variation in the demand for crude. But growing demand made the fixed quota seem increasingly irrelevant and OPEC found it difficult to restrain production after investment by foreign companies in some OPEC countries boosted output and Iraq was allowed to export limited volumes of oil for humanitarian purposes. As a result, global stocks reached record levels following the Asian economic crisis and crude prices fell close to $10/bbl. Faced with the prospect of even lower prices if production was not cut, OPEC negotiated new output targets which have succeeded in eliminating the stock surplus, pushing prices back over $30/bbl. Now OPEC faces a new challenge: how to raise output by enough to rebuild stocks and reduce prices without precipitating another price collapse. So far, attempts to create an automatic adjustment mechanism in response to price changes have failed to garner wider support within the Organization.

Stocks

The level of stocks held by the world oil industry has fallen since the early 1980s and was probably close to a minimum acceptable level in both 1996 and late 1999 and early 2000. The reduction is partly due to the transfer of responsibility for strategic stocks from the oil companies to their governments, partly due to changes in the structure of oil demand, and partly due to improvements in the efficiency of company operations.

From the end of 1994, the seasonally-adjusted level of OECD industry stocks fell sharply as companies reduced their operating stocks after introducing "just-in-time'' stock management policies. But demand continued to grow and the forward cover provided by total OECD industry stocks fell to only 54 days at the end of December 1995 –just below the historical minimum operating stock level of 55 days. As a result, prices rose sharply in 1996 as cold weather boosted demand and supply lagged behind expectations due to problems with new non-OPEC fields and delays t o the Iraqi "oil-for-aid "deal. However, oil prices fell in 1997 with the resumption of Iraqi exports, growing competition between OPEC members for market share and the aftermath of the Asian economic crisis, and industry stocks rose again, reaching 58 days of forward cover in the first half of 1999. Since then industry stocks have fallen sharply after OPEC reined in production, falling to a new low of only 53 days of forward cover at the end of the second quarter of 2000.

A detailed study of the US oil industry published by Exxon showed that the US held a total of 89 days of oil stocks at the start of 1981 measured in terms of forward consumption. Out of this total, 7 days worth were held by the government in the Strategic Petroleum Reserve (SPR), and 82 days worth was held by companies. According to Exxon 58 of the 82 days worth of company stocks were minimum operating stocks. More than a third of the minimum operating stocks (20 days' worth) occupied the pipelines and tankers that transport the oil, filled the refineries that process it, and provided the "tank bottoms" for the storage facilities. The remaining 38 days worth of stocks represented the oil in transit through the system, of which a quarter (10 days worth) was in the form of crude oil and three quarters (28 days worth) was in the form of refined products. Companies need to hold more stocks in the form of products than crude for two reasons. First, the different types of refined product need to be kept separate from each other and move along their own distribution channels, which simply increases the amount of oil tied up in the supply chain once it has passed through the refinery. And, secondly, refineries are not sufficiently flexible to vary their product yields in line with the seasonal variation in demand. For this reason, refiners are obliged to accumulate unwanted stocks of heating oil and residual fuel oil when they increase runs to meet peak gasoline demand during the summer, while the reverse occurs during the winter It is this involuntary stock build by refiners that creates the characteristic seasonal pattern in the level of stocks held by the oil industry and influences the behavior of prices in the forward and futures markets).

1.3 TYPES OF PRICING MECHANISM

A necessary condition for successful oil trade is that purchaser and supplier can reach an agreement on price or at least an agreed instrument for determining price. However, this is not as simple as agreeing to sell at a fixed price. Many variables, not least of all the currency and the unit of measurement (volume or weight), must be agreed before a contract can be signed.

The basis on which oil is priced has changed markedly over the past 20 years with the development of new technique for oil trade. In the past, the majority of internationally traded oil was sold on a term basis at a set price. Term contract is typically agreed for a period of a year or more and prices and volumes were reviewed periodically. This worked fine while prices remained reasonably static. But as political developments and supply disruptions made prices more volatile, sellers and buyers both recognized that a fixed price could be way out of line with the market price at the time the oil was moved. As a result, the market developed more flexible or 'floating' pricing mechanisms. Floating prices were usually linked to a published quotation, or the average of a set of published quotations, around the time the vessel loaded or discharged. Term supplies could still be agreed for an extended period of time, but the price of each cargo lifted under the term commitment would vary depending on the marketplace prices at the moment of load or discharge.

Thus a seller would no longer find that his fixed price, perhaps agreed 10 months ago, was considerably lower than he could get for the oil at the time of delivery. Under a fixed price regime, he might have been tempted to renege on his original, but now loss making, deal. Conversely, a buyer would not find that he could buy oil on the spot market considerably cheaper at the time of delivery than the fixed price he had agreed several months previously. As the market moved away from term supplies, more oil became available on a spot basis. Although negotiations centered on a single cargo rather than several loading over a period of time, the loading date might still be some time in the future. Meanwhile, market prices could still move dramatically. As a result, buyers and sellers turned increasingly to floating price formulae.

In the last fifteen years, the introduction of forward (paper) markets, futures, options and swaps has meant that floating prices have become the primary mechanism by which oil is priced. However, the floating price mechanisms have become increasingly sophisticated and complex, especially in the forward or paper markets, and pricing mechanisms have become increasingly separated from the actual physical cargo of oil. Indeed, one popular way of pricing oil is to use EFPs, the 'exchange of futures for physicals', or its swaps market equivalent, EFS. Using these pricing mechanisms, the price to the buyer and seller can be different since each party can place or lift its associated futures position at a different time.

As 'paper' trading has developed and the liquidity of the markets grown, oil has increasingly been treated as a standardized commodity, which means that discussions between parties need

only focus on price –or the pricing mechanism –and timing. At the same time, the development of pricing services has greatly increased the transparency of the markets. In some respects, this has made it easier to gauge the market price for standard oil 'commodity'. However, much of the oil traded is not of standardized lots, but varies in quality, quantity, location, timing, etc. Such cargoes must be accurately valued relative t o the standardized grades quoted by the pricing services, before floating formulae based on published price quotes can be used effectively.

Despite this trend towards floating prices, there is still a market for fixed prices amongst those end users, be they refiners or consumers, who need to know what their feedstock costs will be over a period. For example, a refiner may have sold petroleum products forward at a given price and wants to lock in a refining margin by buying his crude at a fixed price. Or a heating oil distributor might want to know at what level t o set his heating oil prices to his customers over the next year. Because he obviously does not want to run the risk of buying at a higher price than he can sell at, he may ask his supplier t o sell the heating oil to him at a fixed price, either on a term basis or as a spot cargo. In this way he can fix his costs, and guarantee his customers that their bills will not increase over, say, the next 12 months. The requirement to fix future fuel costs has led to the emergence of a 'swaps' market. This adds further pricing flexibility because it offers a buyer of physical oil the possibility of continuing to take the oil from his supplier at a floating price, and yet insure himself against later adverse price movements. He may, for instance, have a long-standing relationship with a reliable supplier like a major oil company. Asking this kind of supplier for a fixed pricing mechanism might jeopardize the relationship by confusing the supplier, accustomed to the more established floating price basis. (There are notable exceptions amongst some of the major oil companies.) The oil buyer may choose t o offload his price risk onto a third party, who will provide, or swap, a fixed price against the floating price agreement. Typically, the third party does not make the price. The third party will, in turn, often hedge his risk in the futures or options markets. It should be noted that the buyer is not only protected against adverse price movements but is also unable to take advantage of profitable price movements. If the buyer wants to fix a maximum purchase price, but still be able to take advantage of lower prices, an alternative strategy would be to purchase a call option.

Thus the pricing of oil would appear to have gone full circle. The difference now is that fixed pricing, although undergoing a small specialized resurgence in interest, is only one of many pricing mechanisms available to a sophisticated oil trader. Whilst some oil is sold at a fixed price per unit volume or weight, increasingly the price is calculated from a formula based on published or futures prices. Although a pricing arrangement may not always be based on published prices, the organizations involved in producing daily, or even hourly, price reports continue to wield what some people see as too much power, or at least a level of power out of proportion to their expertise and knowledge.

The growth of activity on the regulated and highly visible futures exchanges has gone some way towards diluting the power wielded by the pricing services. However, exchange-traded futures and options contracts are only available for a very limited range of crudes and refined products and these can never replace the much wider set of information provided by the pricing services.

1.3.1 FIXED PRICES

Outright Prices

A contract for the sale of a shipment of oil must be specified, as well as the basic price; the guarantee of quality and the price adjustment agreed to the deviation of quality, range of availability dates, where available, if you include shipping and insurance and, where appropriate, the query of duty. While there are other factors which can affect the actual cost of the oil, such as credit terms, the above factors will adequately describe what generally makes up the price of a cargo of oil. Many of these factors apply whether the price agreed is fixed or based on a formula, and this must be borne in mind when considering the following pricing mechanisms.

Quality

A seller may agree to sell an amount of oil of a particular guaranteed quality at a fixed price t o a buyer, say gasoil at $170 per metric tonne. Though, this may not be the concluding price paid for the oil. Many prices contain an escalator/de-escalator clause, given that for price changes in case the quality of oil laden deviate from that contracted for.

For example, gasoil in Europe is generally sold at x dollars per metric tonne, based on a specific gravity of 0.845. If the final gravity is 0.850 then the price will be reduced in proportion to the increase in gravity, i.e. the heavier the material the less valuable the product. The actual gravity will still need to be within the specification range acceptable for a product of marketable quality, otherwise the cargo will be considered outside the agreed specification, and the contract might be considered invalid. The escalator/de-escalator may not only be based on gravity but could be based on actual sulphur level, cold properties (pour point, cloud point), octane, viscosity, etc. In fact, anything can be used as an escalator/de-escalator, even the date of loading or discharge. A buyer and seller may agree that for each day's delay after an agreed date range, the price may be reduced by a given amount.

The important qualities for crude oil are generally gravity, measured in API degrees, metals content and sulphur. Any or all of these factors may be used to alter the final price paid for the crude oil should the quality vary from the contractual grade. An example of this might be Russian crude oil, Urals, which due to political and technical problems can vary on sulphur and metals. A prudent buyer might insist on an escalator/de-escalator clause in his contract. Even so, the oil should not vary so much as to make it unsuitable for the purpose for which it is intended. Clear limitations for critical specifications should still be set to ensure it is of marketable quality.

Currency

Crude is generally traded internationally in US dollars per barrel- 42 US gallons – although there is no reason why another currency should not be used if both parties agree. Indeed, in barter arrangements the oil may be paid for in tractors, livestock or any other commodity. In Europe, oil products that are being traded internationally are generally sold in US dollars per metric tonne. In the US, cents per gallon are used for clean products (gasoline, jet, naphtha, gasoil) and dollars per barrel are used for dirty products (fuel oils). In the Far East, US dollars per barrel are used, except for fuel oils and naphtha which are quoted in US dollars per metric tonne.

Timing

The timing of the oil's availability is often critical. Crude may be required at a refinery by a particular date otherwise stocks which are always kept close t o an operational minimum in order to reduce costs – may drop too low, causing throughputs to be cutback or the refinery to be shut down. Conversely, products may have to be lifted from the refinery by a specified date otherwise storage tanks will be full, forcing the refinery to cut runs.

At certain times of the year, timing can also have a significant impact on pricing because the market is either in backwardation or contango. Backwardation is when the price of a commodity available on a prompt basis is higher than that for deferred delivery. This situation often occurs with gasoline on the US futures market, the Nymex (New York Mercantile Exchange), during the summer months. Since the driving season in the northern hemisphere is considered to end in September, demand for gasoline, and thus the price, tails off towards the end of the year. Contango is when the commodity is cheapest in the prompt position and gets progressively more expensive in the future. This typically occurs for gasoil with the approach of summer, since demand for gasoil is heaviest in the heating season. Thus when gasoline is in backwardation, gasoil may be in contango, and vice versa. Therefore, when setting the price of oil, specifications should include not only its quality but also its delivery date range –e.g. whether it is prompt or deferred. Market pressures have prompted some producers to offer late or early pricing in order to attract buyers. Nigeria, for example, offers flexible date ranges during which buyers can price their purchases. Instead of pricing a cargo five days after the date of the bill of lading, the buyer can either price it over a five day period starting 14 days after bill of lading or the five days preceding B/L. Other producers allow buyers to use the average of the month preceding or following B/L. These flexible date ranges allow purchasers to take advantage of a contango or backwardation in the crude oil market and to manage their price exposure more efficiently.

Location

Another factor affecting price is the location of the oil. With crude this is generally FOB (free on board) at the export terminal connected to the oil field. However, some crude oils are moved to the end of a pipeline to make them more easily accessible and if so, this must be specified when the price is agreed because it will affect the buyer's freight costs and therefore the value of this crude to him. For example, Iranian crude oil is either available FOB Kharg Island in the Mideast Gulf, FOB Sidi Kerir at the Mediterranean end of the Sumed pipeline in Egypt.

Taxes and duties

Some markets requires right that must be paid in the oil when they are imported into the country. In the United States, refined products prices are generally quoted "in duty", i.e., the duty is include in the quoted price. The amount can be quite large, amounting to as much as *5* per cent of the total price. Hence, prices pertaining to these markets must specify whether or not the price includes duty.

Credit terms

Other, less transparent, factors may govern whether one deal on offer is more attractive than another. In a highly competitive buyer's market, such as at the beginning of 1998, these non-price factors become particularly important. For example, varying the credit terms to give the buyer extended credit provides a useful incentive to prospective purchasers as well as disguising the true cost of the oil when it is reported t o senior management or government agencies.

Official Selling Prices

Until the mid-1980s most internationally traded crude oil, except that of United States origin that sold in long-term contracts and a price to an official selling price. This price was established, initially every year, by the Government, the Agency of Government or National Company of oil from each producer country. Official sale (OSP) prices generally reflect the market value of these raw at the time settled the OSP, but only have changed infrequently.

After the Iranian revolution, when spot prices rose to $40/barrel and above, producers were reluctant to fulfill their supply obligations at the lower OSP, and many reneged on their contracts to take advantage of higher spot prices. Once the oil market weakened in the early 1980s and prices started falling, the spot prices were frequently below term prices. As prices declined, it became the buyers' turn to try wriggling out of long term fixed price contracts.

Recognizing that a yearly review was inadequate, and responding to buyer's requests, some countries, such as Mexico, Egypt and the former USSR, started setting their OSPs monthly thus moving towards spot pricing. In addition, North Sea producers who had to pay Petroleum

Revenue Tax on the actual revenue received, started selling at OSP when the spot price was above, and at spot prices when these were below OSP. In this way, an increasing amount of oil reached the spot market to be sold at market prices; fluctuating around OSP. Now few producers sell their crude at a fixed OSP. Whilst many will still quote an official price for their crude, the price a refiner actually pays for this crude is generally set at a premium or a discount to the OSP, the difference being achieved through negotiations and dependent on destination, either on a term basis or for each cargo lifted.

Official selling prices exist now in a variety of forms and although mainly used by the OPEC producers, are also used by some Non- OPEC producers such as Egypt, Oman, and Malaysia. OSPs are now based on a fixed differential to a floating price. Saudi Arabia, for example, announces the next month's price formula at the beginning of the preceding month. The formula varies depending on the destination, and may also vary with market conditions and wider political developments. Prices may, for instance, be lowered in an attempt to buy a larger share of a given geographical market or in order to send a political signal to other OPEC members who may have started cheating on agreed production quotas. Saudi crude which is to be moved into the Far East may be priced against 'the mean of the means' of quotes over a period of time for Oman crude and Dubai crude. On the other hand, Oman and Qatar set their prices retroactively, normally against Dubai quotations and possibly dated Brent. At the beginning of one month, they will announce at what level they will price all crude lifted under contract for the preceding month. Some crudes are restricted on destination in that the pricing formula only applies if the crude is moved into a specific region. In addition, many producers do not allow their crudes to be on-sold to traders, but insist that they be refined by the buyer. OSPs may be used for certain oil products, but their importance fluctuates a great deal with the market. If the market is short of that particular quality of oil then the seller may hold out for higher prices.

Posted Prices

By law, every refinery is required to post at the refinery gate the price at which they will buy crude oil. These prices fluctuate from day to day, depending on the market, and between refiners who will place a different value on each crude depending on their circumstances. These posted prices can be used by two parties to agree a price for a deal of crude oil. For example, a seller may have a cargo of crude which he wants to sell at an average of all the posted prices plus a quality differential. The buyer prefers to exclude the posted price of two refiners who he thinks are not representative of the market, and so the price is agreed based on a more limited number of posted prices.

Wholesale or Rack Prices

The price at which a road tanker, for example, can purchase fuel when loading from a refinery or depot, is known as the wholesale price in Europe. In the US: the road tanker will drive t o a 'rack' and thus the wholesale price is referred to as the rack price. Wholesale or rack prices are quoted, in local currency, by many pricing organizations, although coverage is particularly good in the US. The price is specific not only to the quality of oil concerned, but also to the location, and therefore one country may have many different wholesale prices for a particular quality of oil.

1.3.2 FLOATING PRICES

As oil prices became more volatile, buying or selling oil at fixed prices became more problematic as there was increasing uncertainty about the value of the oil at the time it was t o be loaded or discharged. A producer, selling a cargo of crude at $25/barrel on one day, might find that by the time the cargo of oil was actually lifted, the value of that oil could have gone up by $2/barrel. This dissuaded them from selling oil at a fixed price too soon before loading. However, the buyer and seller did not want to leave their positions open until the last minute for fear of being seen in a distressed position, and therefore forced to accept prices away from the normal market.

They therefore looked for a way of concluding a deal well before the cargo moved, but using a pricing basis which would reflect the market at the time the cargo actually moved. As the oil market moved away from fixed prices, and looked towards market related prices so a pricing formula based on published prices developed. This meant that the price actually paid could more closely reflect the market value of the oil at the time of moving the oil, rather than the value on the day it was sold. More recently, the growth of the forward, futures, swaps and options markets has encouraged buyers and sellers to be more innovative with their pricing mechanisms. For example, refiners often prefer to price their crude purchases over the same time period as they are selling their products, thus obtaining a natural hedge to lock in a refining margin. The crude itself may be priced at a differential to dated Brent, so the seller can hedge the additional price exposure by using a combination of futures (IPE Brent) and swaps (Brent CFDs). Pricing formulae are now so numerous as both buyers and sellers try to protect themselves against undue price fluctuations after concluding deals, that it would be impossible to even mention all the variations.

Fixed differential to published prices

The first publication to quote international oil prices regularly was Platt's which started in the 1930s, and thus it was Platt's published prices which were first used for pricing. However, the emergence of the spot market for oil in the 1980s prompted several new organizations to start up

oil price reports. Even so, Platt's continues to dominate the international oil market when it comes to pricing formulae based on published prices. There are some notable exceptions, e.g. London Oil Reports has been used for some feedstock prices, and Petroleum Argus has been used by the former Soviet Union to price their fuel oil. In addition, some crudes are sold by producing nations based on a 50:50 split of Platt's and Argus or LOR quotations, and Reuters and Bridge Telerate prices have also been used. In general, though, the market seems reluctant to break Platt's stranglehold on the oil market with respect to pricing, a role which Platt's claims to accept reluctantly.

Thus Platt's retains the ability to set oil market prices rather than just report them, Platt's dominance of market prices has been weakened by the success of futures markets for oil in New York and London. But other markets which do not yet have formal futures markets, such as jet and fuel oil, can be influenced by the Platt's prices quoted each evening which are also used as a basis for the thriving swaps markets in these products. Many deals are done at a differential to Platt's or other published prices. A transaction may, for instance, be concluded based on the mean of the means of Platt's and Argus high and low quotations for high sulphur fuel oil CIF NEW as quoted on the bill of lading date, plus a premium of $1 per metric tonne.

The above example only uses the published prices on one day that of the bill of lading date. By using the prices published on only one day, the participants in the deal leave themselves open to one-off price rises or falls, or even scope for somebody to manipulate the published price, and therefore the price payable. In an attempt to minimize this, publication related prices may be based on a spread of published prices, such as the mean of the published prices on the bill of lading date plus and minus two working days, a mean of five published prices from each publication. Crude oil is often priced on an average of 11prices, which is the price on bill of lading date plus/minus 5 working days. Some traders use publication-related prices based on a mean of different quotes, such as the mean of the mean of CIF gasoil cargoes NEW and fob gasoil barges ARA.

Over half of the internationally traded crude oils are quoted at a differential to Brent, since this crude is the most widely traded crude in the international oil market and therefore felt to be sufficiently transparent to be a valid benchmark. Another underlying factor, especially important in the early days of price volatility, is that Brent, coming from a politically stable democracy, has been a reliable source of crude oil supply. Brent is thought to be of a consistent quality, and not to vary over time. Therefore, any change in the differential to Brent for a given crude will reflect the relative market interest in that crude compared to Brent.

Fixed differential to futures prices

Rather than using published prices on which to base a formula, some deals may be based on a fixed differential to futures prices. In this case, both the differential and the method by which the absolute futures price is to be determined must be agreed at the time of concluding the deal. For example, it may be the settlement price of a given futures contract at the close of business on the date of the bill of lading (B/L). Or, the parties may agree 'last traded price' on the futures screen. This type of pricing mechanism has been known as 'trigger pricing', and gives either the buyer or the seller the option to choose when to set market price. The popularity of trigger pricing has waned recently, as people have recognized the opportunity for either party to manipulate the marker price ahead of the trigger being pulled, but it is still used.

It is vital that all these details be agreed at the time the deal is struck, and that no loopholes be left open that may cause problems, and possible law suits, at a later stage. An extension to this type of pricing is the exchange for physical deals where a cargo of physical oil is sold to a buyer, who in return gives the seller a position on the futures market. The price of the physical oil will be determined by a previously agreed differential to the futures price.

Floating differential to published or futures prices

Rather than agreeing a fixed differential to a published or futures price, a formula may be agreed to calculate the differential. For example, one may price a cargo of crude at Platt's published differential of the relevant grade to Brent on the bill of lading. This may also be applied to the IPE futures price for Brent.

Pricing against a basket

In order to avoid an over reliance on the price of a particular marker crude or product which could be vulnerable to manipulation, a basket of quotes may be used. For example, dated Brent cargoes with a fixed loading date could be squeezed if one trader buys all the available physical Brent cargoes and then starts artificially to raise the price. So crude which might otherwise be priced against Brent alone might be priced against an average of dated Brent, Forties and Ekofisk. This type of formula is, however, mainly used in transactions between producers rather than on the spot market. Even so, some US importers of West African crudes occasionally use a diversity of pricing baskets to ensure geographical supply dislocations in one area will not impact unduly on prices in another.

Another extension of this type of pricing is to agree the percentage of each published price which is to apply. For example, vacuum gasoil, a feedstock, may be priced as a percentage of the gasoline quotation, plus a percentage of the gasoil quotation on bill of lading, the total

percentages not necessarily adding up to 100. Feedstocks and chemical components are often priced in this way, since many of these more specialized, less traded and therefore less transparent products are not quoted in absolute terms by price reporting organizations.

Exchange of futures for physical (EFP)

EFPs provide an alternative (and more formal) method of pricing a cargo of oil at a differential to the futures market. Instead of using an agreed published futures price, the buyer and seller either create or utilize existing futures positions that match their exposure on the physical oil market. On an agreed date the buyer (of the physical cargo) transfers ownership t o the seller (of the physical cargo) of a number of futures contracts, equivalent or as close as possible to the volume of the cargo of oil. The value of the futures contracts at the agreed time when the transfer is made is used, together with the agreed differential to the futures contracts, to calculate the price of the physical oil, which is then paid for in the normal way, depending on the credit terms in the contract. Taking this deal in isolation, the seller then becomes long futures contracts and the buyer short futures contracts at the agreed level.

There are a number of advantages to pricing oil in this way. It allows two parties in the oil market, one who is long oil and one who is short, and who may both have the same views as to where the market is going, to reach agreement on a deal. They can do this by playing the futures market before and after the transaction of the deal, taking or closing their futures positions when they want to, and therefore effectively pricing the cargo when they want in smaller lots. Most traders rarely want t o take large open positions, but sometimes liquidity in the futures market is insufficient for them to hedge a full cargo in one go without distorting screen prices. In such cases, EFP pricing may discreetly square each party's position without affecting floor prices. There are many more sophisticated pricing techniques involving options, swaps and futures.

Asian Petroleum Price Index (APPI)

In the Far East, crude oil is commonly priced in relation to the Asian Petroleum Price Index (APPI). APPI prices are established by a panel of market participants representing crude producers, refiners and traders who are active in the Far East oil market. APPI prices are also used to calculate the official Indonesian crude prices (ICPs) issued by Pertamina that are used both to price term sales and to assess the upstream tax owed by Indonesia's crude oil producers.

The APPI panel members now supply prices twice a week for a range of local crude oils to an independent agent (Peat Marwick). The submissions are then averaged after removing the highest and lowest prices and published every Tuesday and Thursday. The crudes quoted come from Indonesia, Malaysia, Papua New Guinea, China and Australia together with key imported grades such as Dubai, Oman, Murban, Arab Light and Arab Heavy. The fact that APPI prices are

only published twice a week limits their usefulness compared with the more frequent daily price reports produced by organizations such as Platt's and Petroleum Argus, especially during volatile market conditions. Another more serious limitation is the composition of the panel which contributes the market prices. In general, APPI prices have turned out to be lower than the spot market prices published by the price reporting agencies and spot transactions are often concluded at APPI prices plus a premium. Refiners obviously have an interest in lower prices. But it is often forgotten that crude producers also have an interest in keeping APPI prices low since upstream taxes are often based on APPI prices.

It has been suggested that panel prices constructed in the same way as the APPI could also be used in Europe, but participants have not been enthusiastic and the European market continues to rely heavily on Platt's prices, which –despite some criticisms –remain the basis for many crude oil deals employing price formulae.

FIG 1: Main Benchmarks used in Formula Pricing

	Asia	Europe	US
Saudi Arabia	Oman and Dubai	BWAVE from Jul.'00, Dated Brent Until Jun.'00	ASCI from Jan.2010, WTI until Dec.'09
Iran	Oman and Dubai	BWAVE from Jan.'01, Dated Brent Until Dec.'00	
Kuwait	Oman and Dubai	BWAVE from Jul.'00, Dated Brent Until Jun.'00	ASCI from December 2009 ; Previously WTI
Iraq (Basrah Blend)	Oman and Dubai	Dated Brent	ASCI from April 2010, Previously WTI Second Month
Nigeria		Dated Brent	Brent
Mexico (Maya Blend)		Dated Brent x0.527 + 3.5%HSFO x0.467 - 1%FO x.25 + 3.5%FO x0.25'	WTS x0.4 + 3%HSFO x0.4 + LLS x0.1 + Dtd.Brent x0.1

Source: An Anatomy of the crude oil pricing system-Bassam Fattouh-2011

Figure shows the various benchmarks used by key oil exporting countries. As can be seen from the table, countries use different benchmarks depending on the export destination. For example, Iraq uses Brent for its exports to Europe, a grouping of Oman and Dubai for its exports to Asia, and until very recently WTI for its exports for the United States.

1.4 OIL PRICE REPORTING AGENCIES

The oil price reporting agencies play an important role in the price discovery process of the oil industry. The price assessments by these agencies form the basis of long- term contracts, future market contracts, derivative markets and spot market transactions. The primary aim of these reporting agencies is to act as a mirror to the trade through their methodological structure for reporting physical transactions.

However, deals worth hundreds of millions of dollars per day depend on these published assessments and the nature and structure of oil reporting create trading opportunities and new markets and affect the strategies of oil traders. Thus these Price reporting agencies does more than provide a mirror for 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 reflects accurately the market value of the oil barrel, Price reporting agencies (PRA) enter into the decision-making territory that can influence market structure. Taking for example, Platts decides on the time of pricing of oil, the width of the Platt's window, the size of the parcel to be traded, the process of delivery, and the time of delivery of the contract. PRAs make these decisions on the basis of regular consultations with the industry. In return, PRAs influence the trading strategies of the various participants and their reporting policies. As a matter, new markets and contracts may emerge to hedge the risks arising from some of the decisions that made by PRAs. Although even when the price assessments are based on observed transactions and mathematical formula but still an important element of decision-making is involved as this entails the choice about the assumptions behind the methodology. Analysts in PRAs choose how to build the index (in the case of Argus) and how to allow for non-deals-based methodologies in case of a lack of deals.

To analyze the role the PRAs play in price discovery in the oil market it is important to look at three primary dimensions-- the methodology used in assessing the oil price; the accuracy of price assessments and the internal measures that PRAs implement to protect their integrity and ensure an efficient price assessment process. The various price reporting agencies have a fundamental difference in the methodology and in the philosophy underlying the price assessment process. As a result, different agencies may produce different prices for the same benchmark. It could be possible that the price quotations are based on a mechanical methodology of deals done; still two price reporting services could publish different prices for the same crude because their mechanical price identification process could be different.

PRA's use a wide number of parameters to identify the oil price which may include the volume weighted average system, low and high deals done, and market-on-close (MOC). In January 2001, Platts stopped using the volume-weighted average system and replaced it with the MOC methodology. According to this technique, Platts sets a time window, known as the Platts window, and only deals transacted within this time window are used to assess the oil price. The

prices are anticipated on the basis of offer concluded between two participants, or defaulting, on offers. Assessment will also make use of information of financial on spreads and derived layers. Thus, the MOC 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 MOC 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 7, 2010).

But these two methods:-weighted by volumes as well as MOC made their share of disapproval. Because the technique of the average weighted by volumes allow inclusion of a large number of transactions and is the most representative result, this method is criticized because it can lead to 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, especially in the case the days 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 any means weighted by trade in evaluations is that they lag the market price. They always reflect a price that was a little than the price which is. (Platts, 2010b: 6).

The main criticism of the methodology is that the Platts MOC window often lack sufficient liquidity and can be dominated by a few players that could hinder the process of price discovery. Eg Argus, Platts main competitor believes in the methodology of MOC in the U.S. market could operate only when the industry pays liquidity in this window. Lack of liquidity leaves the assessment value based on the closing bid method, offers and other related factors. It noted that the prices resulting from the MOC method may differ considerably from an average weight of all transactions in the trading day . We expect this divergence because the average price is different from the price stamped and convergence of the two is just a statistical accident, if it ever happens. A study by Argus on the crude oil in the United States market in 2007 compared the cash market traded volume inside the window with the volume traded during the day. The results of the study shown that the volume of trade within the Platts window is only a very small fraction of daily trading volumes. Argus and raises serious questions about the effectiveness of price discovery in the U.S. oil market because the low liquidity and the total absence of participant width cause inefficiency in the process of price discovery.

A cure for such a problem is that if some market players think that prices in the window do not precisely reflect the price of a barrel of oil at the margin, then participants must enter in the window and exert their influence on the price. But this is not the case in all markets because in

some markets, there may be barriers to entry that prevent such an adjustment mechanism from take place. In the context of Dubai, participation (in the window) requires that commercial competent and experienced personnel and a large number of national oil companies that represent end users in Asia are not allowed to participate in speculation, so for this reason the producers of the Middle East will not participate in the market of partials. Fear that trading in this market could threaten relations with the Middle East producers, even the independent commercial buyers without these restrictions in Asia are reluctant to participate in the partial trade. It is important to note that if some 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 obstacles, of the policy and strategic choices which limit commercial activity in the window to a small group of so-called professionals may be other barriers that arise.

Whether players decide to share data depend on their compliance, their internal reporting policies and their attention in doing so. Thus market players are under no lawful or regulatory compulsion to report their deal to PRA or any other body for that matter. In the US, the system is deliberate but one potential explanation of the Sarbanes-Oxley legislation is that companies must report all or nothing and cannot selectively reveal information. In some markets such as the US, privacy concerns dictate that some PRAs do not publish the names of the counterparties to a deal. Many companies have reporting policies that only bind them to report deals that take place at a certain time of day, or in certain regional markets. To ensure enough reporting takes place, PRAs such as Argus sign confidentiality agreements to facilitate deal reporting in the US though companies may have the incentive to report prices without such agreements. Some traders may have the incentive to manipulate prices by feeding false information to reporters since market participants have different interests and different positions, though there have been regulatory efforts to limit such behavior.

If the market is a liquid market and then, false statement may be fewer problems that journalists could observe concluded deals and confirm information obtained by both parties. While at the same time journalists will make use of the regular flow of information from the futures and option market. But in illiquid markets, a small number of recorded transactions or a few bids and can strongly influence the pricing process. PRA's rely on a variety of sources of information sources or talk about market to make intelligent assessments, in an era where journalists cannot observe active transactions or the buyers and sellers or to determine the price or anything just where such agreements do not exist. In such circumstances, the journalist will look at offers and proposals of other march from other markets, draw comparisons with similar crudes but with higher trading activity, analyze forward curves, assess spread across markets to reach a price assessment and survey market participants opinions. In fact, in illiquid markets, the price assessment could be more accurate in the absence of transactions, if these transactions were intended to manipulate the oil price.

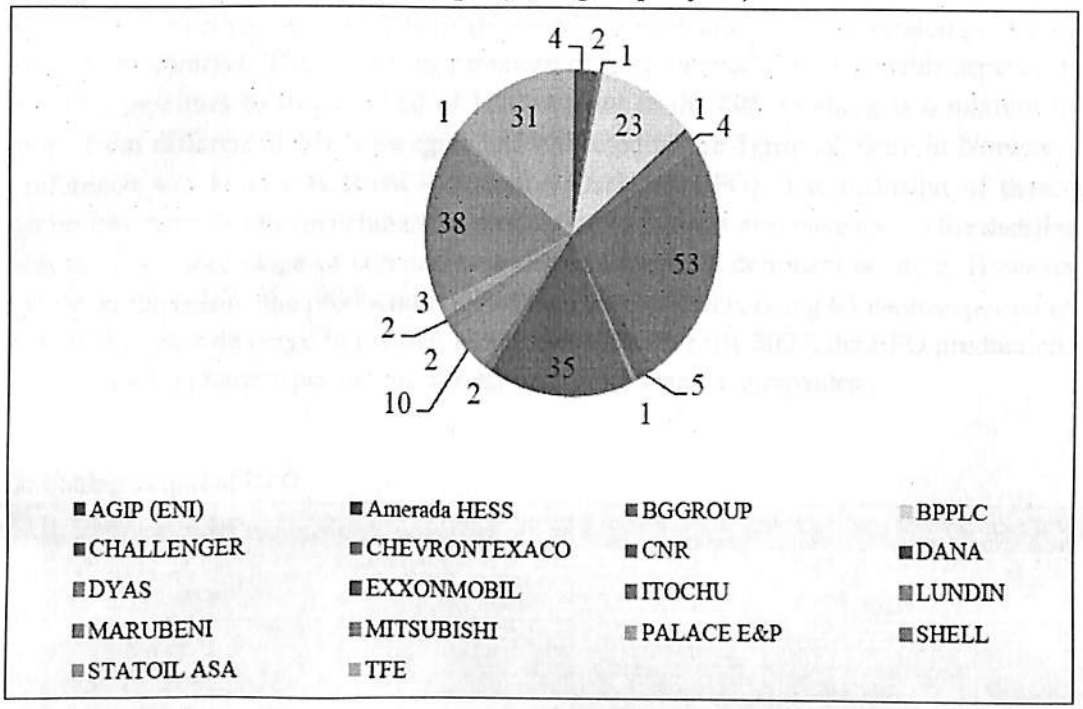
1.5 THE PROCEDURE OF PRICE STRUCTURE IN BENCHMARK CRUDES

1.5.1 THE BRENT MARKET AND PRICE IDENTIFICATION

The market North Sea Brent assumes a central step in the current price of oil system. In this system, the prices generate in the complex Brent constitute the main criteria of price, because on the basis of these 70 per cent of international trade in oil prices is directly or indirectly priced. Market Brent included only the cash market in the early 1980s (known as dated Brent) and the physical market before informal. As the years passed, the market of Brent gained in complexity and is currently poised 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 – planned and grew more compound depending on the needs of the market participants.

There are a number of factors that favoured the selection of Brent as a benchmark. The main reason is geographic location of the North Sea which is in close proximity to the refining center in Europe and the US, which gives it a benefit over other locations. The implementation of tax policy on the UK North Sea in 1979 provide the oil companies with the incentive to trade and re-trade their output in the spot market which gave rise to an actively-traded spot market in Brent. Brent is waterborne crude and is transferred by tankers to European refiners or, when arbitrage allows, across the Atlantic Ocean to the US. Furthermore, in the mid 1980s, the volume of production of the Brent system was quite which ensured enough physical liquidity for trading. Though, the volume of production, although important, is not the determining factor for a crude oil to emerge as an international benchmark because similar bases of physical liquidity could also be found in other regions of the world, especially in Gulf countries which constitute the largest physical base in the crude oil markets. An important determinant is the legal, regulatory and taxation regime operating around any particularly benchmark. Brent has the UK government overseeing it and a robust legal regime. A supplementary determinant, is ownership diversification one of the most important determinant. The commodity underlying the forward/futures contracts should be available from a wide range of sellers. Any monopoly in production increases the likelihood of squeezes and manipulation, increasing in turn the risk exposure of buyers and traders who would be reluctant to enter the market. Monopoly of production prevented the development of a complex market structure in other markets with a larger physical base such as Mexico. Also most countries in OPEC are single sellers and hence OPEC crudes did not and still do not satisfy this criterion of ownership diversification. This is in contrast to the Brent market which has always been characterized by a large number of companies with entitlements to the production of Brent. The widening of the definition of the benchmark to include other crude streams over the years has reinforced this aspect and resulted in an even higher degree of ownership diversification. Another important aspect is the degree of concentration in the physical delivery infrastructure. Here the degree of concentration is much higher. Like in the case of the Forties Pipeline System (FPS) which collects oil and gas liquids from over 50 fields through a complex set of pipelines is 100% BP-owned.

Fig 2: Brent Production By Company (cargoes per year)



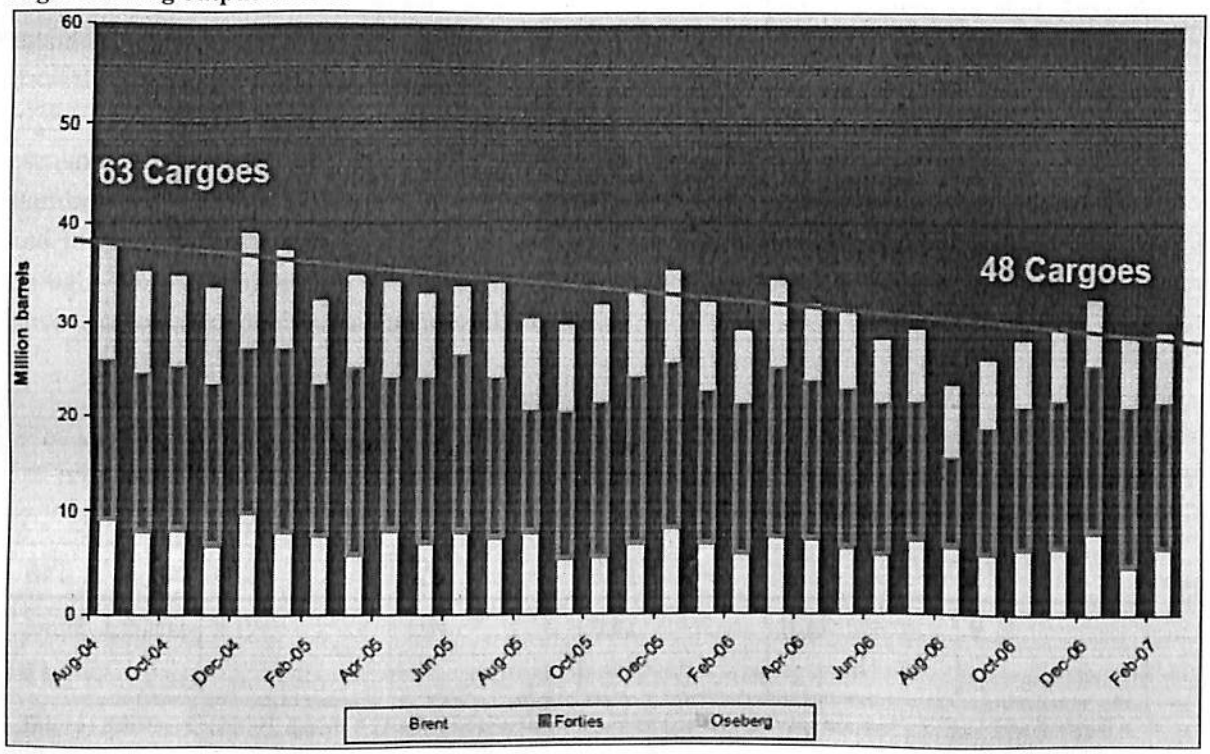
Source: Bossley, L. (2007), Brent: A User's Guide to the Future of the World Price Marker, London: CEAG, p.83.

A) The Physical Base of North Sea

Crude oil in the North Sea consists of a wide variety of grades which include Brent, Ninian, Forties, Oseberg, Ekofisk, Flotta, and Statfjord just to mention few. In the early stages of the current oil pricing system, Brent acted as a representative for North Sea crude oil and price reporting agencies relied on the trading activity in this grade to identify the price of the benchmark. The Brent is a mixture of oil produced from separate fields and collected through a main pipeline system to the terminal at Sullom Voe in the Shetland Islands, UK. From the mid 1980s, the production of Brent started to decline, falling from 885,000 b/d in 1986 to 366,000 b/d in 1990. Low physical production caused distortions, manipulation, and squeezes leading the Brent price to disconnect from the rest of grades with far-reaching effects. To avoid potential distortions and squeezes, the Brent system was comingled with Ninian in 1990 leading to the creation of a new grade known as the Brent Blend while Ninian ceased to trade as a separate crude stream. The co-mingling of the Brent and the Ninian systems alleviated the problem of declining production level with the combined production reaching 856,000 b/d in 1992. Thereafter, however, the production of Brent Blend started to decline, falling to around 400 thousand b/d in 2001.

In July 2002, the Platts has expanded its definition of the benchmark Brent dated to include Forties (the UK North Sea) and Oseberg (Norway) for evaluation and deliverable grades in the Forward Brent contract. The Forties is a mixture of oil produced from the fields separated and collected by pipelines to the terminal of Hound point in the UK. 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, rising 63 cargoes per month in August 2004 to near 48 cargo in the first months of 2007. In early 2007, the BFO production was less than 30 million barrels per month, spread over more than 55 companies.

Fig. 3: Falling output of BFO



Source: Joel Hanley, Assessing the Benchmarks, Platts Presentation, January 31, 2008.

In 2007, a new grade, Ekofisk, was added to the complex which led to the creation of the current benchmark known as BFOE, though it is still commonly referred to as Brent or North Sea. Ekofisk is a mixture of crude oil produced from different North Sea fields and is transported to the Teesside terminal in the UK. The bulk of BFOE output is traded on the spot market or transferred within integrated oil companies where only about one out of seven BFOE cargoes are sold on long-term basis. This feature combined with the highly diversified ownership gave rise to

an active trading activity around BFOE. The inclusion of this new stream increased the physical base of the benchmark to around 45 million barrels a month in early 2007 but since then it has been in gradual decline. Production of BFOE has started to decline to less than 1 million b/d from 2012. As noted by Platts, further changes to the benchmarks can't be ruled out, especially, if production of the key grades is deemed too low or if their qualities were to deviate significantly from the norm. In fact such a change might occur sooner rather than later.

Given that these various grades are not of similar quality, the widening of the definition of the North Sea benchmarks has implications on the price assessment process. In particular, the start-up of the Buzzard field in 2007 increased the viscosity and the sulfur content of Forties Blend making Forties the least valuable among the various crudes in the BFOE benchmark. Since any of the four varieties can be delivered against a BFOE contract, sellers often tend to deliver the cheapest grade and hence it is Forties that sets the price for the BFOE benchmark. This problem becomes more acute during periods when other fields in the Forties system are shut down for maintenance. As a result of including the Buzzard stream, Platts had to introduce a quality de-escalator in July 2007 which applies for deliveries above the base standard of 0.60% sulfur: the higher the sulfur content, the bigger the discount that the seller should give. Currently, a de-escalator of 60 cents/barrel applies for every 0.10 per cent of sulfur specified above the base standard. Prior to this innovation, the market was not sure on how to deal with the sulfur issue and in some periods in 2007 there were no trades in the Platts window. This episode almost brought the physical market to a standstill with traders complaining that Platts changes to its pricing assessment process had paralyzed the market.

Fig. 4- API and Sulphur Contents of BFOE Crudes

	Forties Before Buzzard	Buzzard	Brent	Oseberg	Ekofisk
API	44.1	32.6	38.1	37.7	37.5
Sulfur Content wt.	0.19	1.44	0.42	0.23	0.23

Source: Bossley, L. (2007), Brent: A User's guide to the Future of the World Price Marker, London: CEAG, Table 5.

B) The Layers and Financial Instruments of the Brent Market

Around the Brent/BFOE physical benchmark, a number of layers and instruments have emerged, the most important of which are: Brent Forwards, Contract for Differences (CFDs), Exchange for Physicals (EFPs), and Brent futures, Brent options and swaps. Some of the instruments such as futures are traded on regulated exchanges such as ICE while others such as swaps are traded bilaterally over-the-counter (OTC). Nevertheless, these layers are highly inter-linked and are essential for the risk management and the price discovery functions.

C) The Process of Oil Price Identification in the Brent Market

Trades in oil prices levels rarely occur in the different layers that point the physical dimension of Brent with Brent futures contracts. Instead, the rating agencies of the oil such as Platts and Argus price deduct or identifying the price level for a variety of crude oil using the links and in formation from the different layers of the market Brent. The process begins by identifying the price of Forward Brent / BFOE. The offer represents the value of a cargo for physical delivery in the month indicated by the contract. These quotations are produced daily for three months. The oil price reporting agencies take the price of Brent in front of promotions that they are reported by brokers and traders on the market before (Argus) or on the basis of promotions conducted in the window (in the case of Platts). However, movements on the ICE Brent market may also be taken into account in the assessment. In addition, values and EFP spread could also be envisaged. Thus, oil-reporting agencies often rely on information on the futures market to get Forward Brent price, especially at a time when the futures market suffers from thin liquidity and is dominated by a few transactions.

The contract between Brent and Exchange for physical (EFPs). Oil PRA of oil have more relied on the EFP for the price before Brent. These are often priced as the Brent futures price differential. Futures prices of Brent and the EFPs for a given month allow identification of the price of the Brent forward for this month. The formula can be as simple as adding the value of EFP in a given month (say July) rated by the Intelligence Agency of the oil or generated by trade futures market closing price July according to the futures market.

Forward Brent (July) = Futures Price (July) + EFP (July)

After deriving for the Forward Brent price level, the next step is to determine the price of dated Brent oil. As indicated above, the price of dated Brent is important for the process of discovery of the oil prices because it is considered the market spot Brent and must closely reflect the physical conditions in the oil market. As in the case of the front Brent however, the price of dated Brent oil must be identified using another layer: the market of OTC contracts for differences (CFD). The CFD allows us to derive the Brent before using the following formula

Forward dated Brent = CFD plus Second Month Forward

Given that CFDs are reported for eight weeks ahead, the Forward Dated Brent can be derived for 8 weeks into future which give us the "Forward Date Brent Curve". For each of the weeks, the price of Dated Brent/BFOE swaps is reported.

Based on the derived Forward Dated Brent Curve, it is possible to calculate the average of the Forward Dated Brent from day 10 to day 21. These days are the ones assessed for physical delivery. For instance, if today is 21st May, the 10-21 day cargoes refer to 6th -17th June. Argus reports this as the Anticipated Dated Average for the 10-21 days Forward while Platts uses the

term "North Sea Dated Strip" or the "Forward Dated Brent". These are reported as an outright price.

Since BFOE is comprised of four different crudes, these blends of individually crudes often trade as differentials to the 10-21 average of the Forward Dated Brent or North Sea Dated Strip. Based on an assessment of these differentials through MOC process or observed deals, it is possible to calculate the price of Dated Brent/BFOE or Dated North Sea Light (Platts) or Argus North Sea Dated (Argus) for the day. Specifically, the price of Dated Brent will settle on the most competitive crude among the BFOE combination which is usually Forties.

The above discussion implies that during the last three decades the Brent market has evolved into a complex structure consisting of set of interlinked markets which lie at the heart of the international oil pricing system. The Brent market is multi-layered with the various layers being strongly interconnected by the process of arbitrage. Thus when referring to Brent, it is important to specify what Brent is being referred to: Dated Brent, 21-Day Brent, Brent futures, Brent CFDs or even to Brent altogether as the continuous decline in the physical liquidity meant the Brent Blend has become less important in the North Sea physical complex. These layers and links are central for the price discovery process as identifying the oil price relies heavily on information derived from the financial layers.

1.5.2 THE US BENCHMARKS

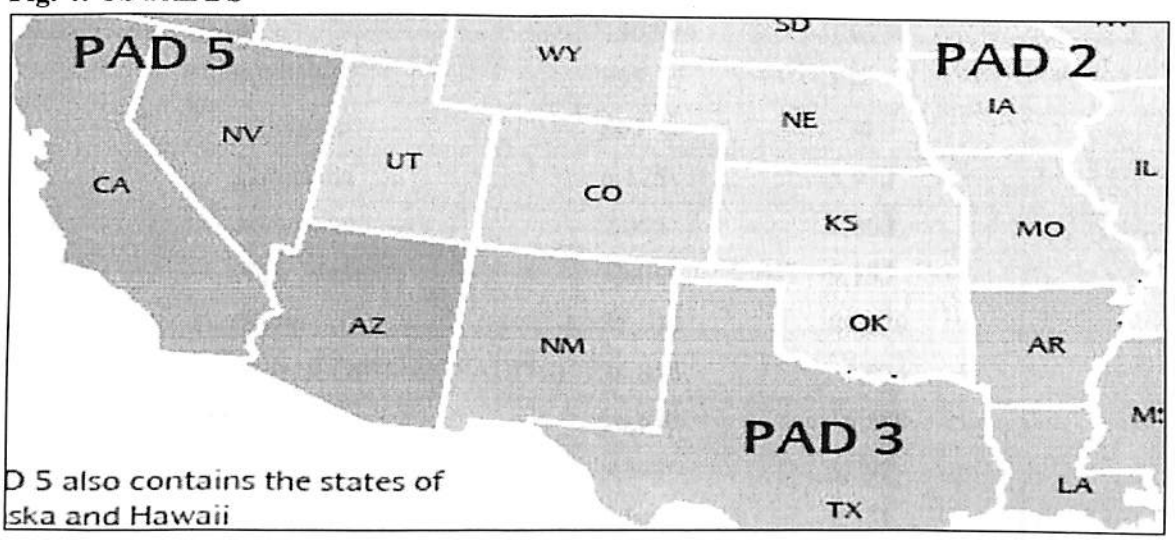
West Texas Intermediate (WTI) is the main benchmark used for pricing of oil imports to the United States, the largest consumer of oil in the world. More crude oil is priced off Brent complex, but the Light Sweet Crude Oil Futures Contract is based on WTI, is a futures commodity most actively traded. While the current WTI crude is best known in the United States, other types of crude oil WTI coexist. One such is the sweet light crude Louisiana (LLS), which became the local reference for sweet crude in the Gulf Coast of the United States. Other major streams include gross Sour and medium Coast – Gulf States such as Mars and Poseidon (Louisiana product offshore) and Southern Green Canyon (produced offshore Texas). Based operations in these three types of crude oil, Argus take ASCI. Platts publishes a similar index called crude marker America that incorporates the value of four sour grades: Mars, Poseidon, CGT and Thunder Horse (Louisiana offshore product).

A) The Physical Base for US Benchmarks

The United States is the largest oil market in the world. Represents the consumption of the United States for nearly a quarter of global consumption. The United States is also a major producer, its production reached 394.9 MT or about 9.6 % of world production in 2012. The United States is also a major refining center with a refining capacity usable than 17 million b / d in 2012.

Central to understanding the physical basis of U.S. benchmark is the "Petroleum Allocation for the districts of defense" (PADD) regional definitions. The United States is divided into five regions or PADD as seen on the map below. The most important area in terms of production is PADD III in 2012 where he produced more than 3.6 million b / d of total U.S. production. PADD III is also the largest refining center in the United States, with refining capacity used about 8.5 million b / d representing nearly half of the refining capacity in the United States operates.

Fig. 4: US PADDS



Source: EIA

Fig. 5: District wise Production in Monthly- Thousand Barrels

Production	Aug-13	Jan-14
U.S.	231,625	246,112
PADD 1	1,031	957
Florida	197	204
New York	30	30
Pennsylvania	448	405
PADD 2	44,915	46,317
Illinois	843	703
Indiana	205	166
Kansas	3,990	4,150
Kentucky	336	176

Michigan	660	645
Missouri	17	17
Nebraska	250	409
North Dakota	28,247	28,927
Ohio	529	627
Oklahoma	9,668	10,326
PADD 3	136,994	146,505
Alabama	893	812
Arkansas	567	554
Louisiana	6,175	5,972
Mississippi	2,055	1,860
New Mexico	8,808	9,155
Texas	81,639	89,079
Federal Offshore (PADD 3)	36,856	39,074
PADD 4	16,570	16,888
Colorado	5,348	5,797
Montana	2,549	2,351
Utah	3,147	3,337
Wyoming	5,526	5,404
PADD 5	32,114	35,445
Alaska	13,270	16,791
South Alaska	504	556
North Slope	12,767	16,235
Arizona	5	6
California	17,274	17,227
Nevada	28	27
Federal Offshore (PADD 5)	1,536	1,395

Source: EIA

as PADD III is the main centre of production and refining in the United States, the PADD II is of particular importance because it is the main center of crude oil storage and point at the expiration of the contract sweet light crude oil futures for delivery. Cushing, Oklahoma located in the PADD II is an Assembly with large storage facilities centre: storage capacity of crude usable about 45.9 million barrels and rated storage capacity of 55 million barrels. PADD II itself can be

divided into two sub regions: the centre of the continent and the Midwest. Cushing is located in the centre of the continent. It collects crude oil of Texas, Oklahoma and other around any gross. It connects major refineries centers both in the centre of the continent, the Midwest (PADD II) and PADD III by a whole complex of pipelines. Historically, refineries in the centre of the continent relied gross domestic for their journeys. However, with the decline in domestic production, refineries in the centre of the continent have increased their reliance on foreign imports and Canadian crude delivered in Cushing and the wider region. A similar image also appeared for the Midwest where historically it relied heavily on domestic production. However, given the decline in production and its proximity to Canada, the Canadian crude oil began to rise in importance move domestic production and imports from outside of the Canada, a trend that should continue.

Although a wide variety of crudes is produced in the United States, WTI is of particular importance in the global oil markets and financial from WTI underlies Light Sweet Crude Oil, one of the largest futures contract traded commodity futures contract. However, it should be noted, however, that exchanges around Cushing, and a futures around this trade market, existed before the creation of the futures market.

This futures market existed in parallel market futures during the late 1980s and early 1990s. However, unlike the market Brent, as volumes have increased, it has finally eliminated the need for the futures market. This market was before knows that the "WTI Cash Market ". Its last vestige remains that in the three days between the futures of maturity and scheduling of pipeline on the 25th of each month.

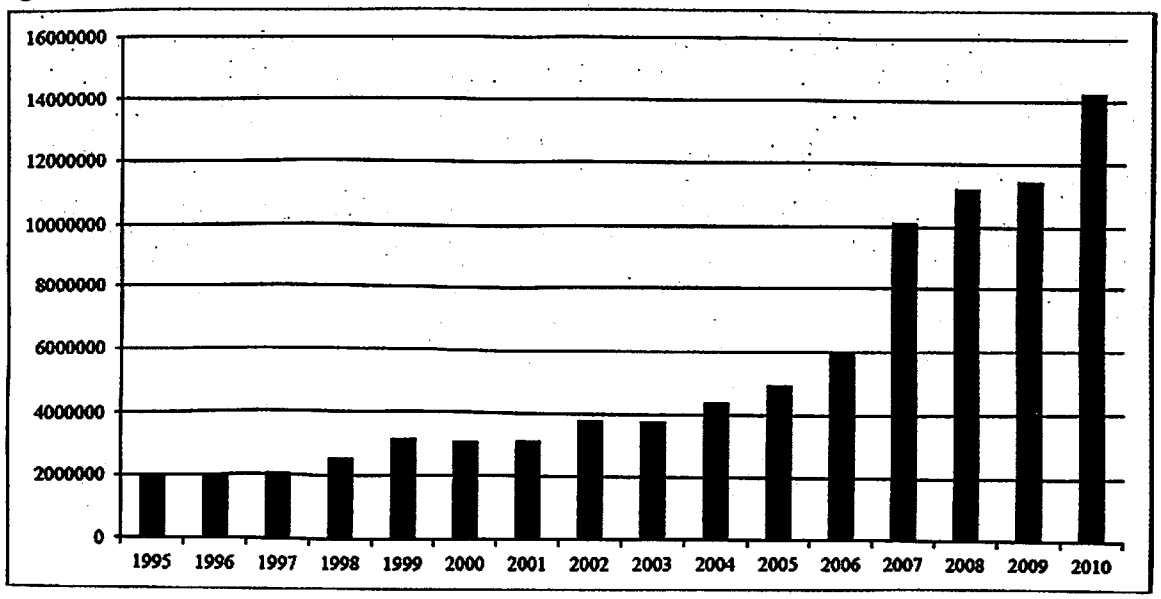
WTI is a mixture of crude oil produced in the fields of Texas, New Mexico, Oklahoma and Kansas. It's a crude pipeline and shipments are made at the end of the system of pipeline to Cushing, Oklahoma. As in the case of Brent, WTI market is also characterized by a large number of independent producers who sell their crude oil to a large number of pickers. However, unlike Brent, which is gross water WTI is crude oil pipeline and is thus subject to logistical bottlenecks and storage problems. Brent is exportable which makes it more flexible and better adapted to the trading conditions in the Western hemisphere. In addition, as discussed later in this section, the WTI can show severe disruptions on other markets in some cases, reduce its attractiveness as a world reference or even as U.S. benchmark.

B) The Layers and Financial Instruments of WTI

Very few layers emerged around the WTI, the most important of which are the futures and option contract and OTC derivatives. The Light Sweet Crude Oil Futures contract has been trading on the New York Mercantile Exchange (now part of the CME Group) since 1983. Between 1995 and 2010 (January-September), the monthly volumes of traded contracts grew at an average annual rate of 15%. In 2010, the monthly average volume exceeded 14 million contracts or 14 billion barrels. On a daily basis this amounts to more than 475 million barrels of

oil, around 6 times the size of the daily global oil production. Most of the trading takes place through the electronic platform (known as GLOBEX) which provides ease of access from virtually anywhere in the world almost 24 hours a day. A wide range of players are attracted to the futures market including commercial enterprises such as producers, marketers, traders as well as speculators and variety of financial investors such as institutional and index investors.

Fig. 6: Monthly averages of volumes traded of the Light Sweet Crude Oil Futures Contract



Source: CME Group

Unlike the Brent futures contract (where the delivery is urgent via the EFP mechanism), the light sweet crude oil futures contract is fully physically delivered for each contract remains open at maturity default. It specifies thousand barrels of WTI to be delivered to Cushing, Oklahoma. The agreement also enables the delivery of national crude types (Low Sweet Mix, New Mexican Sweet , North Texas Sweet , sweet Oklahoma and South Texas Sweet) and foreign types of crude oil (Brent , Nigeria Bonny Light and Qua Iboe Norwegian Oseberg Blend and Colombian Cusiana) against the futures contract . It is important to note, however, that only a small percentage of trading volume is physically installed with most physical settlement occurring through the mechanism EFP. EFP offers a more flexible way to organize physical delivery because it allows traders to agree on the location, type, quality, and business partner. Futures contracts on crude oil traded for up to nine years before. However, liquidity tends to decrease sharply for contracts below.

In addition to futures and options, a group of financial instruments OTC Link to WTI complex, allowing participants to use more customization than those available in the futures market instruments. As indicated in the case of Brent, much offers OTC related to WTI using the clearing of the CME Group and ICE. The CME Group lists over 90 financial OTC contracts for crude oil are erased exchange. Contracts such as WTI - Brent (ICE) Calendar Swap Futures and

WTI Calendar Swap Futures are more personalized and are traded OTC, but offset by the exchange.

C) The Price Discovery Process in the US Market

Unlike Brent market, trading on the U.S. market pipeline is smaller volumes usually around 30,000 barrels of 600,000 barrels on the market. Trade in small volumes increased diversity and the number of players who find it easier to obtain credit and storage facilities to participate in the U.S. market. In addition, the U.S. market has maintained its liquidity despite the decline in physical production and consolidation of the industry. The volume of trade market combined with twelve national ranks of the United States (for the month of April) is usually more than the other criteria, including BFOE, Oman and Dubai. Following twelve grades : **WTI P - Plus ; WTI Midland ; WTI diff CMA ; LLS ; Eugene Island ; HLS ; Thunder Horse ; MARS Month ; Bonito ; Poseidon ; WTS ; CGT.**

Most of these crudes are imported into the United States and sold on the spot market are related to WTI with a few exceptions such as Iraq, Kuwait and the sale of Saudi Arabia to the United States that are related to the ASCI; some imports from the West Africa and the North Sea that are linked to Dated Brent; and some raw East Coast also point Dated Brent. While producers still use the evaluated price of WTI in their pricing formula, these assessments are often carried out as a differential settlement price in the futures market. In other words, the futures market that sets the price level while prices assessed by oil price assessment bodies set differences.

Mechanisms of physical distribution complicate the process, pricing. On the futures market, trading in the current delivery month expires on the third business day preceding the twenty-fifth calendar day of the month preceding the delivery month. For example, the March WTI futures contract expires on February 22. Under the terms of the futures contract, delivery shall be made at any pipeline or storage facility at Cushing, Oklahoma and must take place no earlier than the first calendar day of the delivery month (March) and at most later than the last calendar day of the delivery month (March). At maturity, three working days are required for the planning pipeline to arrange physical delivery in March. The three-day window between the end of the NYMEX WTI monthly contract and the deadline for completion of the shipping arrangements (i.e. between 22 and 25 February in our example) is known as the period deployment. During this period, the March WTI futures contract has already expired while instead of months (physical) is still Mars. To calculate the cash price of WTI Mars, ARP evaluates the roll of cash that is the cost of deployment of a futures contract within one month without delivering on it. This can also just be a buy / sell provision of the current month, with a value of PEF term next month. On 26 February, the month before becoming physical in April which can then be linked to WTI futures contract in April.

Historically, a large number of independent producers used to sell their crude to be taken on the basis of the screen WTI more (P - Plus), which is the sum of the wellhead showed plus delivery price at Cushing. P market today - is more widely used with its sister market, the average monthly calendar Nymex (CMA) of the gap in the market. Market P - Koch view more used only as a base until about 3 years ago when Koch stopped publishing it. Now, companies tend to treat compared to the ConocoPhillips display. The value offered by a gap (P - Plus) represents the value of the supply at Cushing in the current month, assuming a cost for moving the barrels at Cushing. ConocoPhillips is known to use Nymex settlement price, as amended by the cost of moving the barrel at Cushing, the price of the ad. In this way, markets and CMA P - Plus are mathematically related and never too far from the synchronization. The market for CMA won liquidity and is increasingly used to assess gross invites the United States. It is important to note that the CMA is an extension for the futures market. The market AMC has not negotiated price levels, but trades often differential regulation of the price of WTI futures contract. CMA and P - have replaced more cash WTI window.

Platts uses its window to evaluate differential WTI CMA and other domestic crudes. While the CMA market is highly liquid with a large and diverse number of players, the percentage of transactions in the Platts window is only a small fraction of total transactions during the day. In June 2007, for example, the total trade window was only 4 % of all trading days observed by Argus. For all gross of U.S. trade window the total amounts to 2.4% of all trade in cash. Some gross flows such as Mars show 19 days of no trade in June 2007 and the awards were evaluated on the basis of requests and offers. In addition, despite the diversity of market participants, the degree of concentration in the window is quite high with a few players dominating the trading activity. Given these concerns and the fact that the CMA is billed as a differential price on the futures market, it is surprising that producers do not use more widely futures prices directly in their pricing formula. The WTI futures contract is physical and the price of the futures contract converges to the spot price at contract expiration. Thus, in the case of WTI, the use of futures prices instead of prices measured in pricing formulas would be little difference. Depth and high market liquidity futures WTI surrounding and the diversity of its market participants should encourage buyers and sellers to use the futures prices in their price formula. In practice, there is evidence that the front month WTI futures prices may have a high volatility around the expiration date, in some cases, which may partly explain the preference of some traders to stick to an assessment of the price of WTI. In addition, both the P -Plus and CMA are ways of valuing WTI is a slower that month futures contract do quicker.

1.5.3 THE DUBAI- OMAN MARKET

At present most cargoes from the Gulf to Asia are priced against Dubai or Oman or mixture of these crudes where around 94% of Gulf exports destined to Asia are priced of Platts assessment of Dubai/Oman. With oil initially started to flow from East Siberia to Asia in 2009 through the East Siberia-Pacific Ocean Pipeline (ESPO), one could argue that Dubai's role has now

expanded into Russia, as ESPO currently trades as a differential to Dubai. Dubai became the main price indicator for the Gulf region by default in the mid 1980s when it was one of the few Gulf crudes offered for sale on the spot market. Also unlike other countries in the Gulf such as Iran, Kuwait, and Saudi Arabia, until very recently Dubai allowed oil companies to own equity in Dubai production. Up until April 2007, the major producing offshore oil fields of Fateh, Southwest Fateh, Rashid, and Falah were operated by the Dubai Petroleum Company (DPC), a wholly owned subsidiary of Conoco-Phillips. DPC acted on the behalf of the DPC/Dubai Marine Areas Limited, a consortium comprised of Conoco-Phillips (32.65%), Total (27.5%), Repsol YPF (25%), RWE Dea (10%), and Wintershall (5%). In April 2007, the concession was passed on to a new company, the Dubai Petroleum Establishment (DPE), a 100% government owned company while the operations of the offshore fields were passed to Petrofac which acts on the behalf of DPE. The Dubai market emerged around 1984 when the spot trade in Arabian Light declined and then ceased to exist. When the Dubai market first emerged, few trading companies participated in this market with little volume of trading taking place. This however changed during the period 1985-1987 when many Japanese trading houses and Wall Street refiners started entering the market. The major impetus came in 1988 when key OPEC countries abandoned the administered pricing system and started pricing their crude export to Asia on the basis of the Dubai crude. Over a short period of time, Dubai became responsible for pricing millions of barrels on a daily basis and the Dubai market became known as the "Brent of the East".

Dubai is not the only benchmark used for pricing cargoes in or destined to Asia-Pacific. Malaysia and Indonesia set their own official selling prices. Malaysia's sales are set on a monthly-average of price assessments by panel Asia Petroleum Price Index (APPI) plus P-Factor premium which is determined by the national oil company PETRONAS. Indonesia sells its cargoes on the basis of the Indonesian Crude Price (ICP) which is based on a monthly average of daily spot price assessments. While some cargoes are priced as a differential to Indonesian Minas and Malaysian Tapis, these benchmarks have fallen in favour with Asian traders. Since APPI and ICP are often used to price sweet crudes, trading against Dated Brent for sweet crudes has been on the increase in Asia, a trend which is likely to consolidate as the physical liquidity of the key Asian benchmarks Tapis and Minas continues to decline. This should be of concern to producers and consumers as the Dated Brent benchmark may not necessarily be fully reflective of supply/demand fundamentals in East of Suez markets. Abu Dhabi, Qatar and Oman also set their own official selling prices. The former two countries set their OSP retroactively. For instance, the OSP announced in October refers to cargoes that have already been loaded in September. To reflect more accurately market conditions, spot cargoes traded in October or November are often traded as differentials to OSP. Dubai and Oman shifted from a retroactive pricing system to a forward pricing system based on the DME Oman Futures contract. The pricing off the DME contract however still comprise only a small percentage of Gulf crude exports to Asia.

A) The Price Discovery Process in the Dubai Market

Two major oil Platts and Argus price reporting agencies follow very different methodologies in their assessment of the price of Dubai that repeatedly lead to Dubai prices. Over the years, the decrease in the production of Dubai has pushed Platts to find alternatives to maintain the viability of Dubai as a world reference. In 2001, it allowed the delivery of Oman against the Dubai contract. In 2004, Platts has introduced a mechanism known as the partial mechanism, to counter the problem of the low liquidity of Dubai. The mechanism of the partial effect is to decide a cargo of Dubai (and Oman) in small parcels that can be traded. The smaller bargaining unit was set at 25,000 barrels. Since operators do not allow the sale of the cargo of this volume, it meant that the seller of a partial contract is not able to meet its contractual obligation. So the delivery will happen only if the buyer was able to negotiate 19 partial totaling 475,000 barrels with a single counterparty. Any amount negotiated less than 475,000 barrels is not available and must be settled in cash (Platts, 2004). Platts enables the delivery of Omani crude oil or Upper Zakum against Dubai in case of physical convergence of the contract. In other words, the buyer must accept delivery of higher value generally of a cargo Oman or an Upper Zakum against the Dubai contract. The addition of Oman has created its own problems. In the benchmark of Dubai and Oman, Oman crude has a content less sulphur and severity higher than Dubai crude oil. In certain periods according to relative demand and supply for different stocks, the price differential between the two types of crude oil tends to widen. Due to this discrepancy, many observers have called for the inclusion of another type of crude in Dubai screening process that is closest to Dubai and Oman.

The Dubai price is assessed in partial concluded deals in the Platts window, failing on the application and offers and failing information exchanges around Dubai. Thus, despite the fact that the NOCs in the Gulf have a great physical liquidity which in principle allows them to set the price of oil, oil-exporting countries have avoided this role, moving the power to set the price of a few merchants who participate in the Platts window. Petroleum exporting countries do not participate in the window; they simply take assessment Platts of Dubai and use it in their formula of price fixing. This transfer of the role of the Platts window price discovery reaches an objective as a petroleum exporting countries do not want to be perceived as influencing the price of oil: it is the market that sets the price of oil and non-oil exporters. On the other hand, this transfer of power creates a kind of distrust in trading activity in the Platts window.
Initially, the transitions to partial trading in 2004 has produced encouraging results, the increase in the volume of trading activity and thus improve the effectiveness of the discovery of the prices, the reduction of the bid / offer spreads, and attract new players on the market. However, over the past years, the liquidity in the Platts Dubai window has decreased to a point where only a few transactions are concluded for a month. In many days, there is no partial transaction execution. In fact, since October 2008, not there was partial operations execution in 50% of the trading days. This does however not Platts to produce a value of Dubai, which can be based on

the offers and the information and / or the value of the derivative instruments. Only a few players like Sietco, Vitol, Glencore, and Mercuria dominate the Platts Dubai window at any one day. On the sell side, large Asian refineries such as Unipec and SK have been dominant. The concentration of trading activity in the hands of few players in the Platts partials market has raised serious concerns that some traders by investing as little as in a 25,000-barrel partial contract can influence the pricing of millions of barrels traded every day. However, market participants who think that prices are being manipulated by a few players have the incentive to enter Platts window and exert their influence on the price. Critics argue that barriers to entry can prevent such an adjustment mechanism from taking place.

Once the price of Dubai is identified, the derivation of the Oman price follows in a rather mechanical way, mainly by exploiting information about Dubai-Oman spreads. If Oman partials are traded in the window, Platts uses the price of concluded deals or bids/offers to derive the Oman price. When this is not feasible, the Oman value will be assessed using the Oman-Dubai swaps spread, a derivative contract which trades the differential between Oman's OSP and Dubai for the month concerned. The contract is traded over the counter and does not involve any physical delivery. The Dubai-Oman swap price differential will then be used in a formula which links it to the value of Dubai. Similarly, Argus assesses the value of Oman by comparing the value of Oman with that of Dubai. Argus first calculates the differential to Dubai swaps and then adds it or subtracts it from Dubai outright swap to get the Oman forward price. So currently, the assessment of Oman price by PRAs is a simple extension of the Dubai market, where the Dubai/Oman spread provides the necessary link.

The above price derivation shows clearly that the Brent futures market sets the price level while the EFS and the inter-month Dubai spread market set the price differentials. These differentials are in turn used to calculate a fixed price for Dubai. In a sense, the price of Dubai need not have a physical dimension. It can be derived from the financial layers that have emerged around Dubai. This has raised some concerns as calls to use swaps as pricing benchmarks for physicals are at best uninformed as swaps are derivatives of the core physical instruments. But this neglects the fact that liquidity in Platts Dubai's window is thin. In addition, the argument against using swaps is inconsistent with Platts use of swaps (CFDs) in identifying the price of Dated Brent. It is also inconsistent with the fact that at times when no partials are trading, Platts has no alternative but to use the EFS to identify the Dubai price.

Another concern is that unlike the WTI-Brent differential which reflects the relative market conditions in Europe and the USA, the Brent-Dubai differential does not usually reflect the trading conditions of Asian markets except on some rare occasions such as the Iraqi invasion of Kuwait. In normal times, Dubai crude is more responsive to trading conditions in Europe and the US than the Far East. Specifically, the authors argue that the Brent-Dubai differential reflects better the relationship between prices of sweet and sour crudes. In support of this hypothesis, they argue that when OPEC decides to cut production, these cuts affect the production of heavy

sour crudes. As a result, the price of these crudes will strengthen relative to sweet crudes leading to the strengthening of Dubai prices relative to Brent.

1.6 DEVELOPMENT OF SPOT MARKET

1.6.1 An Overview of Present Trading Markets

Crude Oil and Petroleum products are traded in either of two categories: By contract (referred to as term sales) or by spot transactions. In the past, this period could have been as far ahead as three years. More recently, both the contract period and the price have been much more flexible. Spot sales on the other hand, refer to short term trading usually involving one cargo of oil per deal, with each deal struck at an agreed price for prompt lifting or delivery. Spot trading can thus be defined as a process by which cargoes of petroleum are exchanged on a day to day basis rather than under long term contracts.

During the last decade, spot trading in petroleum has grown dramatically, from 10-15 percent to about 30-35 percent of total volume traded in the international market. In addition, a new wave of spot related transactions that link the contract price to spot market price has emerged. These deals were virtually nonexistent before the 1980's, now comprise an estimated 50-55 percent of total trade.

1.6.2 The Underlying Forces behind development of Spot Markets

The main problem with spot trading is that neither the producer nor the consumer can predict the price and quantity and thus are unable to plan the business. Of course the extent of this problem is different for different commodities depending on the volatility of market and the lead time needed for investment decisions. A difficult trading situation in the oil industry is that in which: the supply of the commodity and thereby its price is subject to manipulation and the other one is there is long investment lead time for both producers and consumers, who may use this commodity to produce other goods. Faced with the unpredictability of spot trading and the problems it poses for planning, both the producers and consumers search for contractual arrangements that provide predictability in price and quantity over a specified period of time.

While term contracts facilitate the planning and management of business, they take away flexibility. For Term contracts are normally made for long periods of time and at predetermined prices. When business conditions are relatively stable, the rigidity of these contracts is acceptable. But when markets become unstable, rigid contracts can hinder efficient business operations. The attempt to balance the benefits and drawbacks of both systems has resulted in two approaches to trading. In the short and medium terms, the producers and consumers need flexible arrangements- Combine both spot and contract trading in their portfolios in order to keep some flexibility while preserving predictability. The composition of such a portfolio will vary

among business entities and over time. As a result the industry's trade will undergo periodic shifts between spot and contract trading.

The search for flexible contracts eventually leads to entering into futures market. These markets will indirectly provide contract trading with price flexibility and transferability options while allowing contracts to be based on long- term delivery and fixed price conditions. After future market are incorporated into overall trading practices, both buyers and sellers are better off if they return to long – term contract, because this type of trading can be combined with futures market activity to keep the flexibility needed to cope with the changing business environment. The extent of the return to the long term contract trading would depend on the extent to which the futures markets have developed.

1.6.3 Various Stages of Development of Petroleum Spot Markets

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

Stage 1: The Spot market Functioning as the Residual Market

Almost all oil companies face the problem of matching their refinery yield with the market's present demand for a range of products. They have deficit of some yields and surplus of others. The company may stabilize the deficit and the surplus by storage and/or shipment facilities. But moderately it is more economical to stabilize them by swapping or selling and buying some products on the spot market. This was primarily the function that the spot market served in its early stages of development in the 1950s and 1960s.

The role of the spot market at this stage can be described as a residual channel of oil trade. The main channel for oil supply was the integrated system of the major oil companies: each company had its own supply of crude oil and had the capacity to refine it. Petroleum products outside this closed system, either released from it due to due to imbalances between refinery output and market demand, or refined independently of it, constituted the basis for spot trading.

Stage 2: Shift from a Residual to a Marginal Market

After the 1973-74 oil crises, the spot market began to play a marginal role in petroleum trading, small but significant trading posed to the small and insignificant trading of the residual market. The significance is, of course, in terms of the impact on the main (contract) market. When the spot prices serve as the residual role it basically follows contract prices (usually with a discount or a premium) without significantly affecting these prices. But when the spot market serves as a marginal role, it becomes an indicator of overall market conditions. The costs and revenue of

producing or processing the marginal barrel constitute the basis of decision making in many planning areas – especially in refinery operations.

Stage 3: Turning into a Major Market

Despite the significance of spot transactions to the industry's planning and pricing policies, their volume remained small during the second stage of market development. It was only after 1983 that spot and spot – related trade began to grow appreciably. Between 1983 and 1985, spot and spot – related transactions grew to account 80 – 90 percent of international traded oil. Several factors contributed to this rapid development. First excess refining capacity forced refiners to fight for their survival. Refiners were forced to use the most economical way of procuring crude oil. They increased their refinery throughput to the point where price of a marginal barrel of product covered the marginal operating cost. This brought about a shift from term contract arrangements to spot purchasing of crude to take advantage of flexible (declining) spot prices over rigid contracts. Refining for the spot market also became a common practice.

Second, as the members of OPEC began to lose their market share, they began to engage in so called spot related sales to recapture lost sales. These spot related sales included variable price contracts, barter trade, and netback pricing deals.

Stage 4: Parallel Function with Futures Markets

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

None of the first generation contracts attracted the petroleum industry, and all faded into obscurity. The most important reason for this failure was that petroleum prices did not fluctuate as expected. The international spot price of crude oil stayed between $10.30 and $10.40 per barrel during the period from October 1974 to December 1975. Price stability was further reinforced in the United States by the Energy Policy and Conservation Act, by limiting the annual increase in crude oil price, led to reasonable predictability in petroleum prices.

Crude oil contract introduced on NYMEX in March 1983 was one of the most significant contracts. It expanded the potential for trading petroleum futures and substantially intensified the interaction between the futures and spot markets. Indeed, it was after the introduction of this contract that the petroleum industry began to take futures seriously. The significance of this contract was in:

- Its cash market ,that is, the crude oil spot market, being one of the largest commodity markets in the world;

- The complementary role of this contract in providing the industry's requirement of crude contracts before effectively utilizing petroleum futures for hedging purposes;
- The fact that it soon developed into a price signaling channel for crude oil traders, especially in United States.

Interactions with Contract Markets

Although it may no longer be the case, for almost two decades the pricing policy of the major oil companies was associated with contract markets, whereas the independent companies followed spot market directives. Beginning in the early 1970s contracts was signed between the major oil companies and the governments of oil producing countries, which had taken over the production of crude oil. The companies would then refine the crude in their own refineries or resell it to third party customers, including some independents and government companies in consuming countries. Thus the major oil companies were the main channel of contract trading in the petroleum market. The independent companies on the other hand bought some of their requirements from the large companies but relied mainly on the spot market.

The interface between the majors and the independents in the retail market provides a useful exposition of 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 under soft versus tight market conditions; and (b) the difference between the weighted average cost of supplies to the majors and the independents. These two are the main vehicles through which spot and contract prices interact to bring about an equilibrium price at the retail level.

One of the basic tenets in economic theory is that in order for a producer to maximize profits, he should expand or limit production to the point at which the revenue from the sale of the last unit (marginal revenue) is equal to the cost of producing it (marginal cost). Although the oil industry's long term decisions are guided by these principle, its short term decision are much more constrained. An oil companies has customers to serve and a market share to protect. Therefore, it cannot change its supply level freely. Yet the marginal cost of supply may change every day, and the company has to do its best to cope with its market obligations while trying to maximize its profit. Under soft market conditions, the average cost to each company remains constant upto the level of contracted supplies. This is basically the traditional take –or- pay contracts which obliges the company to buy a specified quantity of crude at a contracted price. Beyond the level of contracted supply, the company can go to the spot market and buy the additional crude at a cheaper price. Therefore its marginal cost is below the average cost. As it buys more on the spot market, the average cost of its crude supplies will be reduced but still remain above the cost of spot crude. Thus an independent company which has few contractual obligations than a major can acquire its crude oil supply at a lower average cost by depending more on spot market supplies. Under tight conditions, the opposite conditions would prevail: the

marginal supply of crude oil will be procured on the spot market at a price higher than the contract price.

Based on its mix of spot and contract supplies, and under certain regulatory constraints, in most countries and oil company has to set its retail price high enough to cover its price and low enough to compete with the retail outlets of other companies. The price would, on the cost side, depend upon the weighted average cost of spot and contract supplies. This is true for both major and independent companies. However the weight is different for each group. The contract price has a higher weight in case of majors, while the spot prices have a higher weight in case of independents. This is the principle vehicle that brings about equilibrium in the retail market.

In the future the interaction process will remain essentially the same, but the number of players will increase. Spot trading is no longer limited to independent oil companies, many majors, state owned oil companies and OPEC producers are becoming involved in spot or spot related trading. As a result, the market is becoming more fluid. The market disequilibrium show themselves rapidly and need to be taken care of equally quickly. That is the contract/spot interactions are becoming more efficient as a larger number of entities are learning how to use the spot market.

1.7 Crude Oil Spot Markets

The main spot markets for crude oil are Rotterdam for Europe and New York for the US. These markets have their own benchmarks: Brent and WTI. In particular, Brent was the centre of spot and forward trading in the 1980s. There are other grades which have strong spot trading activities. They are: Ekofisk, Forties, Oseberg from the North Sea; Russian Urals; Dubai (UAE); Oman; Minas (Indonesia); Tapis (Malaysia); Alaska North Slope (ANS) and West Texas Sour (WTS) in the US; and Forcados and Bonny light from Nigeria. Although most OPEC grades are contracted on a long-term basis, some OPEC countries are known to use spot transactions to sell part of their production.

The main markets for petroleum products are located in Northwest Europe (ARA - Amsterdam, Rotterdam, Antwerp), the Mediterranean (Genoa, Lavera), the Gulf, Southeast Asia (Singapore), US Gulf of Mexico (including the Caribbean) and US East Coast (New York). Spot market participants are refiners and producers where crude oil is concerned. For petroleum products, buyers are traders or large consumers, and sellers are refiners. Traders play an essential middleman role. They buy cargoes from sellers and re-sell them to end users or other traders. Alongside traders are trading divisions of oil companies. There are also intermediaries and brokers, who help conclude transactions. Although they do not buy or sell cargoes themselves, they earn a commission.

1.7.1 The Rotterdam Market

Spot trading in general is often referred to as Rotterdam market. This association arose because Rotterdam is the birthplace of petroleum spot trading, which was, due to its extensive oil production, storage and distribution facilities. Rotterdam has always been the most active spot market as well as the only market that both imports and exports large quantities of spot crude and products. It also plays a central role in the world spot market. However any reference to the Rotterdam spot market embraces all spot trading concluded in the north-western Europe- including Sweden, Denmark, Norway, east coast of England, the Federal Republic of Germany, Netherlands, Belgium and France. Furthermore all spot transactions taking place elsewhere in the world, but relating to crude oil and products stored in Rotterdam, or destined for or leaving one of the above countries are normally regarded as transactions on the Rotterdam market.

Logistically Rotterdam trade consists of two distinct but related segments:

- An international cargo trade via large oil tankers that takes place between Rotterdam and ports throughout the world, but specially in the North Sea area;
- A barge trade from Rotterdam and the Rhine delta to the customers in Netherlands, West Germany, Switzerland, Belgium and France.

Rotterdam links these two oil segments together by providing facilities for breaking cargo shipments into barge lots. Development of the Rotterdam market has been closely related to the developments in the petroleum industry itself. Rotterdam first became significant to the oil trade in the early 1960s with the discovery of Libyan crude oil supplies by U.S independents. These discoveries represented a substantial source of low-priced crude oil outside the majors closed system. Barred from the U.S markets by import quotas, this oil was diverted to the large and rapidly growing industrial market of Europe; independent refining and trading of petroleum products was then developing in Europe, particularly at the port of Rotterdam.

Rotterdam's geographic position made it a particularly attractive centre for oil trading. Located at the mouth of Rhine, Rotterdam offered the independents easy access to the hinterland markets in Western Europe as well as to overseas markets. As a deep water port, Rotterdam could accommodate large oil tankers. Recognizing these attractive features, major oil companies joined the independents by gradually developing their swing refining capacity there. These developments saw the Rotterdam markets through its birth and infancy. The second stage of Rotterdam's development began with the 1973-74 oil embargo and continued till 1978. High petroleum prices and the recession of 1974-75 depressed petroleum demand and left Rotterdam market with excess capacity in all its operations. At the same time demand shifted to lighter products and less sophisticated refineries became less profitable to operate. The market forced

these refineries to run at lower rates of utilization and their operators to meet product shortages (and to dispose of surpluses) in the Rotterdam market. During this period the market was also recognized by the governments of many European countries as a "free" market for petroleum, on which domestic price controls can be based.

The third stage of Rotterdam's development began in the late 1978, when the market based there became recognizable as the barometer of global oil supply and demand. At that time the price of crude moved to its peak of $40 per barrel. OPEC and non- OPEC producers began to use information from Rotterdam market to set increases in prices and justify the increase by the growth in demand exhibited by Rotterdam prices. Actual trading on the Rotterdam market was very thin, but it was viewed as the only valid reference point for demand and supply balance. This view was not shared by consumer states, which were irritated by the proposition that such small portion of total supplies, not even representative of Europe as a whole, could be given such importance. Concern about the effects of high Rotterdam prices on the world economy prompted the governments of industrialized countries to seek ways to control the market.

Today Rotterdam is still considered a very important oil trading centre of the world and its prices still represent the reference point for market analysis and many trade agreements. However Rotterdam is no longer the only important spot market; there are growing spot markets in the U.S, the Far East and the Persian Gulf. In addition the rapid growth of futures market in the United States has shifted some attention away from the Rotterdam prices to the price of WTI crude on NYMEX.

1.7.2 The Singapore Market

Singapore's central location at the crossroads of Asia has made Singapore the second largest petroleum port of call in the world next to Rotterdam. With about one million barrels per day of nominal refining capacity, Singapore is one of the largest refining centers. It has traditionally served as the "balancing" refining centre for the Asia- Pacific region, in that it supplies consuming centers when shortages of certain products arise. Singapore's refining activities include (a) conventional operations such as refining and processing of crude and selling products on a term and spot basis; (b) term processing- receiving crude from national oil companies (Indonesia's Mindo; Malaysia's Petronas; China's Sinochem), processing it and returning to them all or part of the product yields; and (c) spot processing- receiving crude from traders and returning the end products to them.

The outlook of Singapore is somewhat mixed. The future of Singapore's refining is not very bright, since demand for crude processing which has long been the refineries main activity is less now than in the late 1980s. In the face of increasing competition from export refineries in the Middle East, Singapore's refineries now must consider whether to upgrade their facilities by

building new sophisticated units thus positioning themselves to tap the growing demand for gasoline. At the same time the outlook for trading in Singapore looks exceptionally good. Because of its history as a major refining centre, Singapore has infrastructure to support large scale trading in oil. At present it has more than fourty oil trading companies, including subsidiaries of major oil companies, the national oil companies of OPEC countries' the independent U.S trading companies and the Japanese trading houses.

Singapore is in an ideal position to take advantage of trading opportunities. With crude oil trading from all sources taken into account, about 90% of its imports were for re-exporting. Its trading potential is particularly good in terms of following factors:

- The flow of Middle East products into the Asia Pacific market is rising. Continuing crude oil disposal problems are also pushing Asian producers such as China, Indonesia and Malaysia into product marketing. As a result product trading in Asia Pacific region is rising, together with opportunities for Singaporean trading companies to expand their region wide role in product balancing deals.

- Presence of almost all major world oil companies and oil trading organizations allows major decisions on product trading to be coordinated from Singapore.

- The large storage facilities of Van Ommeren and Paktank as well as refiner owned facilities mean that large scale product trading can occur.

- A free market economy, as well as excellent telecommunications and other infrastructure, makes Singapore ideally suited to respond to changes in the Asia Pacific oil market region.

- Implementation of new petroleum price reporting system and introduction of petroleum futures market in Singapore provides much of the transparency and market information needed to conduct the trade.

1.8 THE ROLE OF PETROLEUM SPOT PRICES

Use of spot prices reported by organizations such as Platt's is much wider than might be expected. The primary areas of use are

- Product terms contracts with variable pricing clause;
- Crude oil sales based on spot crude or product prices;
- Management of refining/marketing activity;

- Adjustments in refineries posted prices; and
- Government retail price controls linked to spot product prices.

There are two ways by which product term contracts between refiners and marketers are normally related to the spot. Either there is an explicit linkage through the inclusion of a formula that automatically changes the contract price as spot prices vary, or there is a de facto linkage through the inclusion of a periodic price review clause which would normally provide for monthly or quarterly negotiation of the price based on spot market trends. Both of these arrangements may result in contract prices that somewhat lag behind the spot price, but the influence of the spot price would in any event remain substantial.

Crude oil sales based on spot prices are of more recent origin. They take the form of:

- Term contract with an automatic price adjustment;
- Term contracts with monthly or quarterly renegotiation clause;
- Netback value contracts;
- Realization deals.

The use of product spot prices in the management of refining/marketing activity is a product of market conditions in the 1980s. For several years refiners in the United States, Japan and Western Europe were plagued by overcapacity. Poor operational economies stemming from low capacity utilization, coupled with marginally refined and therefore cheap surplus products available on the spot market, meant that some refining/marketing companies had to consider the possibility of cutting back on running crude themselves, opting instead to buy products manufactured by others. Spot prices were studied closely to determine how much of these companies needs should be produced through the companies own refineries and how much should be purchased from the spot market. This practice has now become the routine function of most of the refining marketing companies.

The use of product spot prices in setting "posted prices" has also become a normal practice. The posted price is an official selling price set by refiners. Posted prices have traditionally lagged behind product spot prices, which could imply that there is no strong link between posted and spot prices. The catch, however is that the posted prices are not necessarily the prices at which trade occurs. They serve as reference point for negotiations and, depending on market conditions, there will always be premiums and discounts to account for. These premiums and discounts on the other hand, take account for prevailing difference between the posted and spot prices, effectively linking the purchase price to the spot price.

The use of spot prices in government retail price controls emerges from: (a) the need to regulate domestic prices; (b) the need to set a reference point for internal price transfers of integrated oil companies; and (c) the lack of any other measure that could be used for these purposes. As a

result, most European countries have worked out complex formulas to relate price maximums and minimums to Platt's prices.

Most Frequent Complaints Against Spot Prices: Political And Technical

Complaints against spot prices are of two types: political and technical. Political objections are normally raised when spot prices are moving against the interest of a group. The use of spot prices to support political objectives is clearly demonstrated by the periodic shifts of the position and attitudes of consuming governments and OPEC member towards the legitimacy of spot markets. During the slack years 1974-78, governments of consuming countries used low spot prices as a lever against OPEC price increases and as a medium to limit the majors domestic prices. OPEC was then playing down spot prices, denouncing their reliability, accuracy and representativeness. In 1979 consuming governments and OPEC switched positions on the validity of spot prices. OPEC used high spot prices, either explicitly or implicitly, to raise its contract prices. Consuming governments on the other hand denounced the spot prices as "no longer an indication of overall commercial oil value" and embarked upon various studies to limit the activity of the spot market. As market conditions later reversed, consuming countries again discovered that spot prices represent true value of oil, while OPEC blamed spot prices for the instability of the petroleum market.

Technical objections to spot prices are more systematic and worth nothing. The most frequent complaints are: (a) the lack of an organized trading floor, (b) the thinness of trading and (c) the inefficient assessing of spot prices.

Lack of an Organized Trading Floor

A point often made about spot prices is that, without formal trading floor, information on spot prices is necessarily incomplete and unreliable. Because spot trading does not take place on an organized exchange or trading floor, there is no location at which all deals are made on registration of membership, no official reporting of transactions (price and volume), and no formal administrative body. Instead deals are individually registered between agents who can be anywhere. Much of the assessments of these deals are made through Platt's editor's telephone calls to selected trading contracts. Therefore market information cannot be collected within a solid and systematic framework. This is a generally accepted problem in the transparency of present spot prices. The source of the problem does not lies in Platts price reporting system but in the structure of the spot market.

Thin Trading

Thin trading and lack of adequate and continuous supply have occasionally been cited as fundamental problems with spot prices in general, and with Platt's assessment in particular. If Platt's cannot discover any deals to report, then it repeats the previous day's prices. For some products in certain markets it is not uncommon to have gaps of upto several weeks between

publicly reported deals. Thus when Platt's can again report a firm prices it may well bear little relation to the one that has been continually restated over the preceding weeks.

Oil companies have during slack periods, extended the thin trading argument to claim that the spot price is, in general, too thin and limited in actual supplies to provide a basis for pricing of petroleum products in retail markets. This is, in nature, a more fundamental criticism than the reporting problems. However this complaint indicates a lack of understanding of the role of the spot market. By definition, spot prices are predicted upon marginal transactions, and significant volumes need not be behind such prices. At any point in time, incremental additions to or disposals of one's oil stocks via spot purchases or sales will have different values to different parties. Spot purchases will always be made by the buyer who places the highest value on incremental supplies. Similarly, spot sales will always be made by the seller who least values his excess supplies. Consequently, spot prices show the equilibrium point of the marginal values of oil to the seller and buyer. These prices will almost always be different from the average market prices. What oil companies are pointing out is that the marginal price should not be replacing the average price, which is presumably related to the cost of refining and marketing the oil.

Subjectivity of Platt's Price Assessments

Objections to Platt's methodology are primarily concerned with the subjectivity of its price assessments. Platt's subjectivity is to be expected. Such private endeavors often lack a comprehensive database, and what is missing in statistical data must be filled in by the assessor's intuition about the market. Platt's makes no pretensions about this point. It emphasizes that its price are assessments of market conditions. Nevertheless, the subjectivity in performing these assessments poses problems. For one, no two individuals are likely to judge the market precisely the same way. How big a problem this subjectivity of assessments is depends on the ways and means in which the prices are used.

1.9 INTERACTIONS BETWEEN FUTURES TRADING AND SPOT MARKET PRICE

1.9.1 Behavior Of Futures Prices

Futures market is believed to destabilize the spot market in order to provide speculative opportunities. This perception is not, in general correct. Futures trading can actually help the spot market work more effectively.

In the absence of a futures market, the spot market provides guidelines for the producers to organize and distribute their supplies. In addition, the spot market serves as a means of sharing risk among some producing and consuming agents. If a trader wants to avoid the risk on the value of his inventory, he will sell part of his inventory in the spot market. Consequently, some other agent in the industry will assume the risk through the spot market mechanism. The spot market will then have a dual function to serve- that is, the provision of supply and demand guidelines and the sharing of risk. However, it cannot serve either function in the most effective

manner, because no organ can satisfy a dual objective as effectively as it can a single one. If a futures market is introduced and can play its role effectively, then the second function of the spot market-risk sharing- is transferred to the futures market.

Therefore, the spot market can play its primary function – facilitating the interaction of supply and demand forces- more efficiently. When futures trading exist in a market, speculators find it more convenient to deal in futures contracts than to buy a quantity of the commodity at the current spot price and hold it with the hope that there will be a rise in the spot price. In the same manner traders who want to avoid the risk of a price decline can do so more conveniently by selling futures contracts than by selling the commodity in the spot market. Thus, the risk-sharing function of the spot market is transferred to the futures market.

Although the futures and the spot market will serve, at least theoretically, two distinct functions, the interaction between the two markets constitutes the most important aspect of futures trading. This interaction is normally studied by exploring the relationship between spot and futures prices. There are two important factors to consider in this relationship:

- The relationship between the futures prices and the forthcoming spot market price (the spot price that will prevail in the delivery month)
- The relationship between futures contract prices and the current spot market price (the cash market price)

With regard to the first factor, most studies have concluded that there is no significant correlation between the two prices. The conclusion denies one of the important functions- providing information about future price trends- that many analysts have attributed to futures trading. The empirical evidence has shown that the correlation between futures prices and spot price in the delivery period is very weak. The lack of strong correlation has been intuitively explained by the idea that any information about future supply and demand conditions that becomes available is incorporated in the current spot market price. Thus, there is no reason for futures contract prices to contain more information about future market conditions than the current spot price.

With regard to the second factor- the relationship between the futures contract prices and current spot prices- most studies have found a very strong correlation between the two. Is, however, the futures price affecting or simply following the spot market price? This is, of course, a critical determinant of the impact of oil futures trading on the structure of the petroleum market.

1.9.2 Futures Prices and the Prediction of Future Spot Prices

There is an argument that futures prices provide information that can be used to guide production, storage and processing decisions. Some have argued that the emergence of futures trading is a response to the economic demand for information. That is, the main role of futures trading is to collect and disseminate information about future spot prices. The efficiency of

futures prices as estimators of forthcoming spot prices depends on the closeness between the two prices and confidence attached to the expected price difference (between futures and forthcoming spot prices). The greater the efficiency with which futures prices serve as estimators of forthcoming spot prices, the better is the quality of information imparted by futures trading. Several attempts have been made to measure this efficiency and thereby the capacity of future trading to provide information on future spot prices.

On the empirical side, various studies have attempted to measure the accuracy with which prices have been forecast in the market with futures trading. The general conclusion which should be intuitively clear is that the longer the forecast period (involving futures of more distinct months), the more subject to error will be the prediction of futures prices. Recent investigations have concluded that the existence of active futures market promotes more efficient operations of the spot market such that spot prices tend to converge to more "information efficient" equilibrium.

On the conceptual side there are three basic questions about the information spreading role of the futures markets. First does the market actually convey all the information from those who have it to those who do not have it? Second do the "owners" of information have enough incentive to transfer their knowledge to other people? If the information these owners possess become public through the transactions they pursue in the futures market, they soon lose their comparative advantage, with no assurance that they have been compensated for their efforts in acquiring information. Third, can the information not be transferred through the spot market and should there be anything left for the futures prices to reflect?

Chapter 2: REVIEW OF LITERATURE

2.1 Review of Literature

All through history, the oil prices were very unstable, changing their trajectory and behavior with regard to the monetary situation. For industrial goods, including oil, the most unpredictable years were 1971 and 1989 (Cashin P, 2002). These years are important because the appearance of price movements increased considerably after 1971 (Cashin P, 2002) and the magnitude of price swings more than ever after 1989. For example, Cashin and McDermott found that even if price developments have been very volatile, "price variability completely dominates the long-term trends."

Moreover, there is a very well-built seasonal constituent, where oil prices are conventionally high during winter than during summer. Oil prices have been gradually increasing, reflecting increasing demand for crude oil predominantly from developing nations. However, there is no leading upward trend, since the end of the 1990s. Instead, oil prices display large upward or downward swings primarily caused by "fluctuations in demand, mining costs, and reserves" (Pindyck, 1999). Any upward shifts in demand for oil or a rise in mining costs will cause the spot and futures prices of oil to increase, and this might pilot to a change in the slope of the price trajectories (Pindyck, 1999). After such swings, prices emerge to revert to their long-run mean value or long-run marginal cost, which also appear to change over time. Moreover, "temporary price spikes account for a large part of the total variation of changes in spot prices".

Spot and futures prices are probable to be associated to each other in the long-run on the basis of a number of hypothetical models. Among the various theories explaining the spot futures relationship, the theory of storage (Kaldor, 1939) has received substantial empirical validation. In this theoretical set-up, futures price should be equal to the spot price plus the cost of carry (the sum of the cost of storage and the interest rate) and the convenience yield (that is, the benefit from holding spot oil which accrues to the owner of the spot commodity). Since the study of (Garbade K.D., 1983), a widely recognized benefit of futures markets has been the process of competitive price discovery that is the use of futures prices for pricing spot market transactions through the timely incorporation into market prices of heterogeneous private information or heterogeneous interpretation of public information by way of trading activity. Even though spot and futures prices are likely to be driven by the same fundamentals in the long run, the stochastic properties of oil prices may differ in quiet compared to turmoil periods.

According to the paper The Price Correlation between Crude Oil Spot and Futures – Evidence from Rank Test (Yu-Shao Liua, 2011) the petroleum futures and spot prices have non-linear equilibrium relationships towards equilibrium using rank tests by Breitung (2001). They then estimate the asymmetric Bivariate TECM GJR-GARCH model to capture the short-run and long-run dynamic adjustments with the asymmetric price and volatility transmissions between the petroleum spot and futures markets. They analyze that the petroleum futures prices are co

integrated and nonlinear with spot prices in the long-run. This effectively confirms the expectations hypothesis. In the mean equations, they find evidence that the spot price adjusts strongly to a positive basis in the short-run, and they will revert to the long-run equilibrium level. In the variance equations, they find that when bad news happens in the petroleum spot and futures markets, volatility will increase in its own market. Besides, asymmetric effects are also found in both the petroleum spot and futures market in our conditional variance models.

Further studies like the paper, the time-varying and asymmetric dependence between crude oil spot and futures markets: Evidence from the Mixture copula-based ARJI–GARCH model (Chang, 2012) designs a Mixture copula-based ARJI–GARCH model to simultaneously investigate the dynamic process of crude oil spot and futures returns and the time-varying and asymmetric dependence between spot and futures returns. The individual behavior of each market is modeled by the ARJI–GARCH process. The time-varying and asymmetric dependence is captured by the Mixture copula which is composed of the Gumbel copula and Clayton copula. Empirical results show three important findings. First, jumping behavior is an important process for each market. Second, spot and futures returns do not have the same jump process. Third, the tail dependence between spot and futures markets is time-varying and asymmetric with the magnitude of upper tail dependence being slightly weaker than that of lower tail dependence.

In the article (Li Liu, 2011) an analysis was done between the asymmetries of exceedance correlations and cross correlations between West Texas Intermediate (WTI) spot and futures markets. First, employing the test statistic proposed by Hong et al. [Asymmetries in stock returns: statistical tests and economic evaluation, Review of Financial Studies 20 (2007) 1547–1581], they found that the exceedance correlations were overall symmetric. However, the results from rolling windows showed that some occasional events could induce the significant asymmetries of the exceedance correlations. Second, employing the test statistic proposed by Podobnik et al. [Quantifying cross-correlations using local and global detrending approaches, European Physics Journal B 71 (2009) 243–250], we find that the cross-correlations were significant even for large lagged orders. Using the detrended cross-correlation analysis proposed by Podobnik and Stanley [Detrended cross-correlation analysis: a new method for analyzing two nonstationary time series, Physics Review Letters 100 (2008) 084102], they found that the cross-correlations were weakly persistent and were stronger between spot and futures contract with larger maturity. The final results from rolling sample test also show the apparent effects of the exogenous events.

2.2 RESEARCH GAP

- Hypothetically, the futures prices are equal to the spot prices in the future. Though, it is always not consistent with the actuality because of the operation cost and market noise. Thus, it is worth having an inspection of correlations between spot and futures markets.

- Although the price of futures contracts often converge to a spot price, it is important to analyze the convergence process and understand what the cash price really means in the context of the oil market.

- Little attention was devoted to the issues and the process of price discovery and the formation of prices on oil markets remain under - studied. While this topic may be linked to the current debate on the role of speculation against the fundamentals in the determination of the price of oil.

2.3 RESEARCH QUESTIONS

- How the different layers of the oil market form a complex network of links and how they all play a role in the price discovery process?

- How the futures prices are related to the spot prices and till what extent speculations influence the spot prices?

2.4 OBJECTIVES

- To analyze the pricing methodology adopted in present crude oil pricing structure and to explain the structure of the main benchmarks at present used namely Brent, West Texas Intermediate (WTI) and Dubai-Oman.

- To develop relationships between the crude oil spot market and the futures market and how the derivative markets influence the physical market.

Chapter 3: RESEARCH METHODOLOGY

•Objective 1: Descriptive Research

For achieving this objective various reports like –An Anatomy of Crude Oil Pricing System and reports published by Platts and other agencies were studied. In this part the relation between the physical base and the financial layers of benchmark crudes would be studied and thus the process of price discovery would be analyzed.

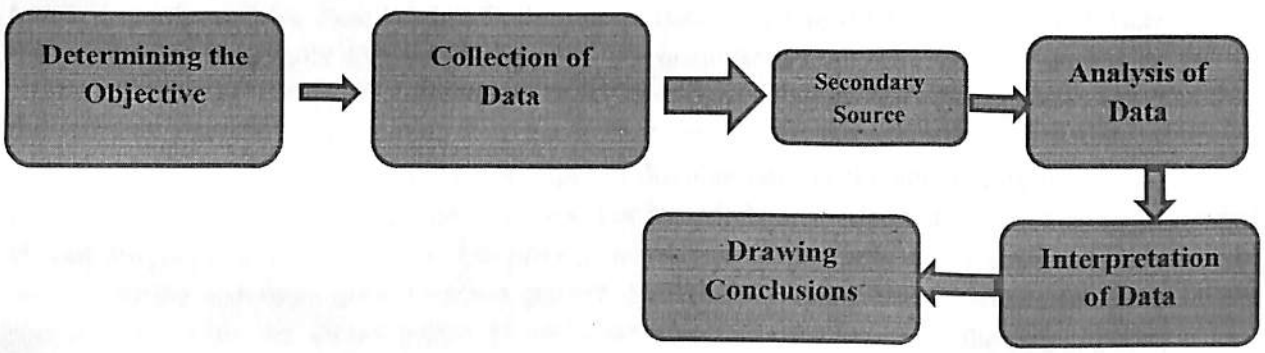
• Objective 2: Analytical Research

For achieving this object secondary data was collected from EIA and Thomas Reuters and data used is from Jan-2005 to March-2014. In this part the relation between WTI spot and WTI futures prices for one, two and four month maturity would be analyzed to find the relation between them.

Secondary Data

These are the data which have already been collected by someone else and which have already been passed through the statistical process so the secondary data is also collected in order to get the information. The data collected was from the manuals, from the site of EIA, Platts, Argus and research papers from Oxford University's Energy Institute and from other books.

The following research design would be adopted for the research:



Chapter 4: ANALYSIS AND FINDINGS

PROCESS OF IDENTIFYING PRICES IN BENCHMARK CRUDES

In the early stages of the current pricing system linking price criteria to physical benchmarks planned pricing producers and consumers of the formula pricing with a sense of comfort that the price is rooted in the physical dimension of the market. Suspicion still exists if the price of oil from paper markets such as the futures market reflects the physical realities of the oil at the time of the pricing market.

This project demonstrates that the different layers in the oil market are strongly interconnected and form a network complex of links, which all play a role in the price discovery process. Information from financial layers plays an important role in determining the level of the price index. The market Brent, Brent dated oil price is evaluated using the information of several layers, including CFDS, futures markets, EFP and markets futures. Similarly, in complex WTI, prices of the various physical criteria are closely interwoven with futures markets. The price of Dubai is often calculated using information from the very active OTC Dubai / Brent swaps market and inter- Dubai swap market. Thus, the idea that one can isolate the physical and financial layers in the current oil price regime is a myth. The price of crude is jointly or co - determined in two layers, based on differences in the calendar, location and quality.

Relation between Futures Prices and Spot Prices

In this analysis we have considered daily time series data from Jan, 2005 to March, 2014. Here the linkages between daily spot and future prices for maturities of one, two and four months of WTI crude oil are investigated. A Regression analysis is done between the two data sets to check the relation between Futures prices and future Spot prices. The futures price will equal the expected future spot price only if the risk-adjusted discount rate for the commodity is equal to the risk-free rate, i.e., there is no risk premium. For most industrial commodities such as crude oil and oil products, we expect the spot price to co-vary positively with the overall economy, because strong economic growth creates greater demand, and hence higher prices, for these commodities. Thus we should expect to see a positive risk premium, and the risk-adjusted discount rate should exceed the risk-free interest rate. This means that the futures price should be less than the expected future spot price.

Relation between One Month Futures Prices and Future One Month Spot Prices:

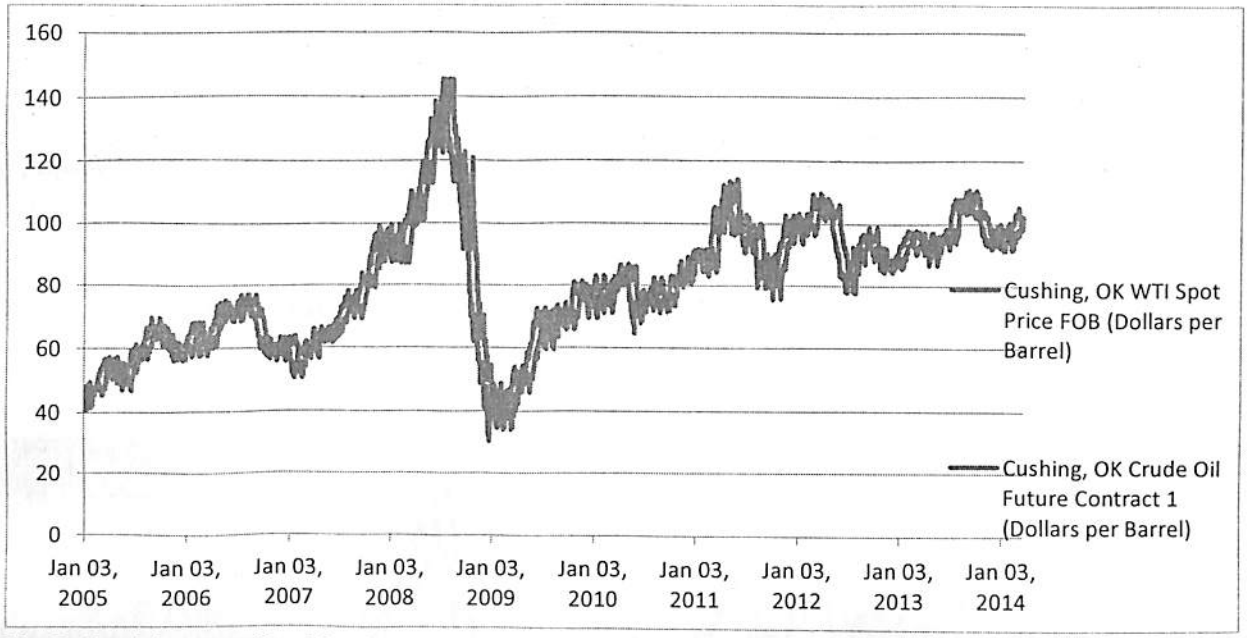


Fig. 7: Graph between One Month Futures Prices and Future One Month Spot Prices

Regression Statistics	
Multiple R	0.930470312
R Square	0.865775002
Adjusted R Square	0.865716996
Standard Error	7.384773462
Observations	2316

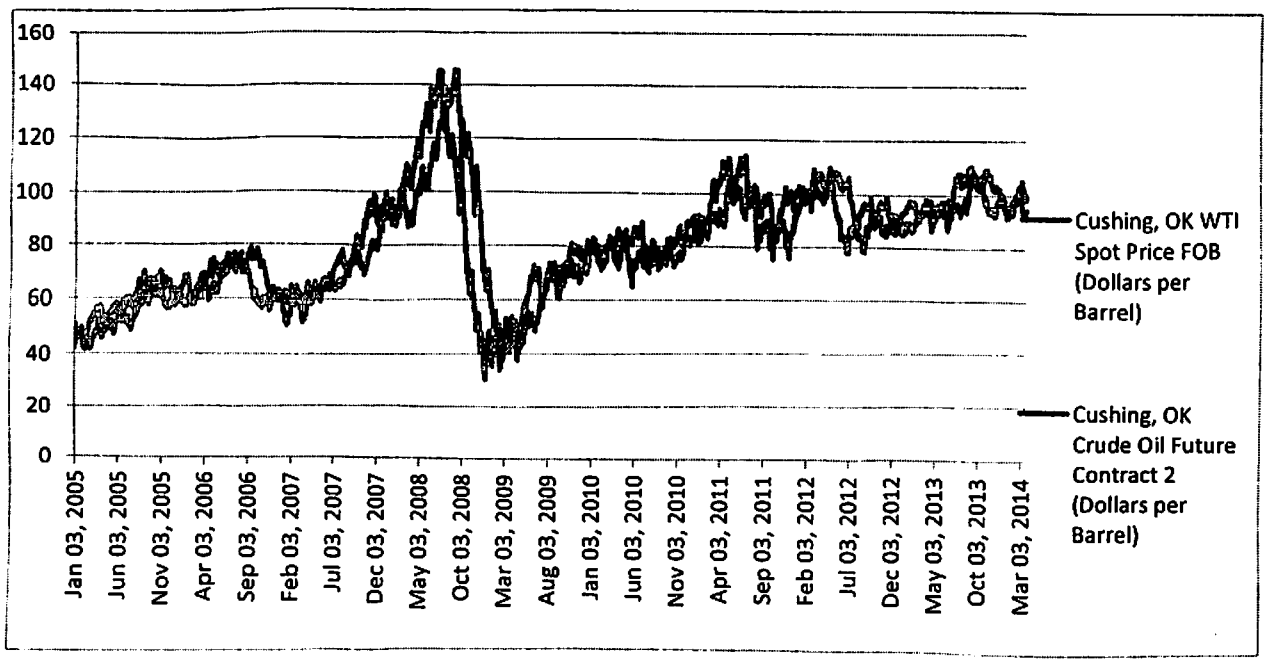
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	813971.7725	813971.7725	14925.70968	0
Residual	2314	126193.7102	54.53487909		
Total	2315	940165.4827			

Analysis:

Sig.-F – 99% Ability in the model to explain the relation.
RSS, ESS & TSS-- The main function of these values lies in calculating test statistics like the F-test, etc.
R-Square – 86% proportion of variation in the dependent variable that can be explained by the independent variable.
Adjusted R-square – 86% proportion of variance in the dependent variable that can be explained by the independent variable.

Relation between Two Month Futures Prices and Future Two Month Spot Prices:



Regression Statistics	
Multiple R	0.841506133
R Square	0.708132571
Adjusted R Square	0.70800644
Standard Error	10.88963417
Observations	2316

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	665761.8006	665761.8	5614.257	0
Residual	2314	274403.682	118.5841		
Total	2315	940165.4827			

Analysis:

Sig.-F – 99% Ability in the model to explain the relation.
RSS, ESS & TSS-- The main function of these values lies in calculating test statistics like the F-test, etc.
R-Square – 70% proportion of variation in the dependent variable that can be explained by the independent variable.
Adjusted R-square – 70% proportion of variance in the dependent variable that can be explained by the independent variable.

Relation between Four Month Futures Prices and Future Four Month Spot Prices:

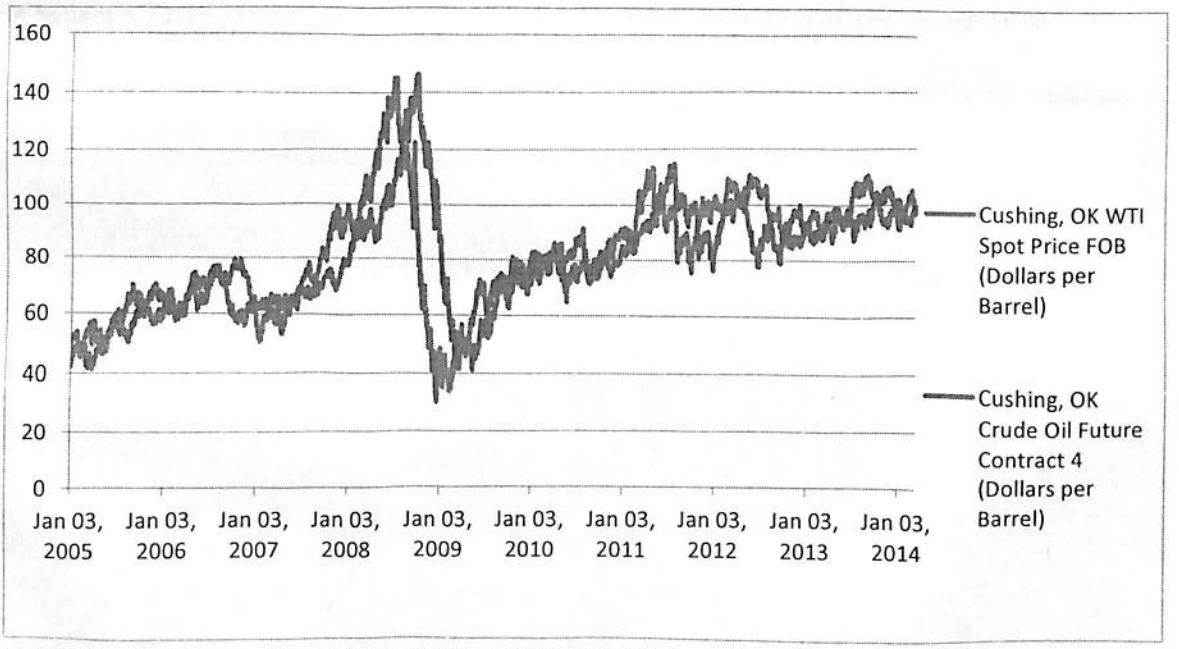


Fig. 9: Graph between Four Month Futures Prices and Future Four Month Spot Prices

Regression Statistics	
Multiple R	0.71828887
R Square	0.515938901
Adjusted R Square	0.515729713
Standard Error	14.02395679
Observations	2316

ANOVA

	df	*SS*	*MS*		
Regression	1	485067.9463	485067.95	*F*	*Significance F*
Residual	2314	455097.5364	196.67136	2466.388	0
Total	2315	940165.4827			

Analysis:

Sig.-F – 99% Ability in the model to explain the relation.
RSS, ESS & TSS-- The main function of these values lies in calculating test statistics like the F-test, etc.
R-Square – 51.5% proportion of variation in the dependent variable that can be explained by the independent variable.
Adjusted R-square – 51.5 % proportion of variance in the dependent variable that can be explained by the independent variable.

5. CONCLUSION

The hypothesis that the procedure of identifying the price of benchmarks in the current oil pricing system can be isolated from financial layers is rather simplistic. The analysis in this project shows that the different layers of the oil market are highly interconnected and form a complex web of links, all of which play a responsibility in the price discovery process. The information derived from financial layers is essential for identifying the price level of the benchmark. One could argue that without these financial layers it would not be possible to discover oil prices in the current oil pricing system. In effect, crude oil prices are jointly co-determined and identified in both layers, depending on differences in timing, location and quality.

The contemporary belief, however, is that futures trading encourages specialization in the activities of assembling and interpreting market information. Thus, it can be expected to improve the performance of the spot market. This belief is specially reinforced by several scholarly works that have, theoretically or/and empirically, shown that futures trading improves the allocation of resources over time even if producers do not participate in the futures market but only use the price information provided by futures trading. Both theoretical and empirical studies on the impact of futures trading on the stabilization of cash market price are based on two distinct issues:

- The role that futures trading plays in risk sharing; and
- The information that futures trading provides to producers, processors and stockpilers.

The results of empirical research on the impact of information role of futures trading on the stability of the spot market price have been controversial. They have had a slight tendency to support a stabilizing role of futures market "that have reached a mature stage". On the other hand, the results of research on the impact of the informational role of futures trading on the stability of cash market price have been conclusive. They indicate that futures trading transmit the informed traders information to all economic agents, especially producers and processors. This transfer provides a link between the variations in supply and demand, thereby stabilizing spot market prices.

Impact of Futures Market operations on the Stability of Spot prices

Through the risk sharing role

The effect is not clear.
Empirical Research has a slight tendency towards supporting a stabilizing effect.

Through the information provision role

The futures market stabilizes the spot price.
Its stabilizing effect is more important in markets with a scattered and decentralized structure.
The stabilizing effect materializes where the futures market has reached a mature stage.

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