

# **PUTTING A PRICE ON ENERGY**

## **Oil Pricing Update**



**2011** ENERGY CHARTER SECRETARIAT

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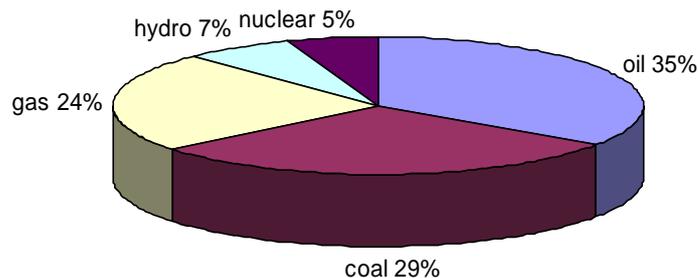
# 1. INTRODUCTION

## 1.1 Oil – a Commodity like No Other

This section looks into pricing mechanisms in the oil sector, particularly into the commodity-type pricing mechanism. The oil sector developed market mechanisms in the mid-1980s, replacing the system of official selling oil prices determined by OPEC. Trading in the oil sector has evolved technically from the spot trading to the futures and derivatives market, which are typically found in all commodity markets. This section looks into the history and mechanisms of the oil market.

Oil is the most important energy source, accounting for more than a third of the world primary energy mix (see Figure 1). According to the IEA forecasts, it is expected to continue to hold the largest share in the coming decades, although the share will decline gradually. In volume terms, the world oil production / consumption have fallen on two occasions in the last thirty years – first, after the second oil crisis in 1979, bottoming in 1983, and, then, after the financial crisis / economic downturns of 2008 (they are still falling at the time of writing). Moreover, oil demand in OECD countries has already peaked in 2005, prior to the financial crisis of 2008, and has been falling since then.

**Figure 1: The World Primary Energy Mix in 2009**



Source: BP

Crude oil is a global commodity. It has been traded internationally since soon after the modern oil industry started in Pennsylvania, the US, in the 1860s. Oil trading has come a long way from the stable, controlled system of the Majors, which ended in the late 1960s, through OPEC's quota system in the 1970s and the first half of the 1980s, to the market mechanism starting in the mid-1980s. However, speculation in the market has become an issue at the time of the financial crisis / economic downturns in 2008, accompanying the bubble and burst of commodity prices including oil prices.

The size, scope and complexity of global crude trade are unique among physical commodities. As of 2009, around 85 million barrels of oil are produced and consumed everyday (see Table 1). Beyond the scale, oil has played a significant role in world history in the 20th century. The strategic importance of oil and the crucial role it plays in war and economy make oil a commodity like no other. Oil prices also have critical impacts on the development of non-fossil fuels, such as nuclear, fuel cells and biofuels.

The global crude oil market has been in a constant process of transformation. The impact of burning fossil fuels (including oil) on the environment became a serious issue in the late 1980s. The rise in terrorism and political uncertainties in the Middle East have revived supply

security concerns. The reform in the financial markets is currently discussed in Europe and the US. These and other factors affect prices and pricing mechanisms.

**Table 1: Largest Consumers, Producers, Importers, Exporters**

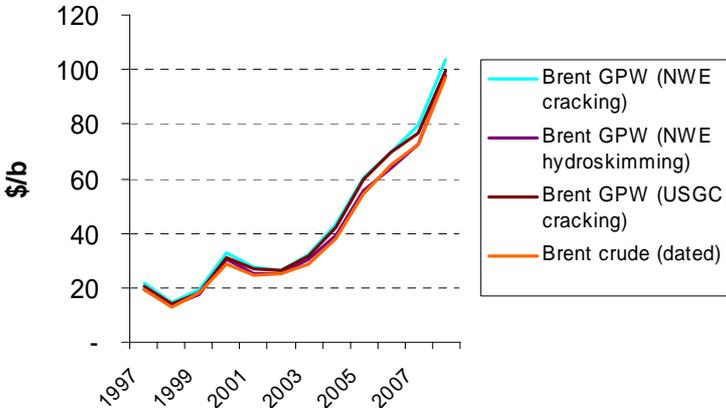
Consumer	mb/d	Producer	mb/d	Importer	mb/d	Exporter	mb/d
1 US	18.7	Russia	10.0	US	9.5	Russia	7.3
2 China	8.6	Saudi Arabia	9.7	China	4.4	Saudi Arabia	7.1
3 Japan	4.4	US	7.2	Japan	3.9	Iran	2.5
4 India	3.2	Iran	4.2	India	2.4	Kuwait	2.2
5 Russia	2.7	China	3.8	Germany	2.4	UAE	2.1
6 Saudi Arabia	2.6	Canada	3.2	Korea	2.3	Norway	2.1
7 Germany	2.4	Mexico	3.0	France	1.8	Nigeria	2.0
8 Brazil	2.4	UAE	2.6	Italy	1.5	Venezuela	1.8
9 Korea	2.4	Iraq	2.5	Spain	1.4	Angola	1.7
10 Canada	2.2	Kuwait	2.5	Singapore	1.0	Algeria	1.5
<b>World</b>	<b>84.1</b>	<b>World</b>	<b>80.0</b>	<b>World</b>	<b>52.9</b>	<b>World</b>	<b>52.9</b>

Source: BP, ECS

**1.2 Crude Oil and Petroleum Products**

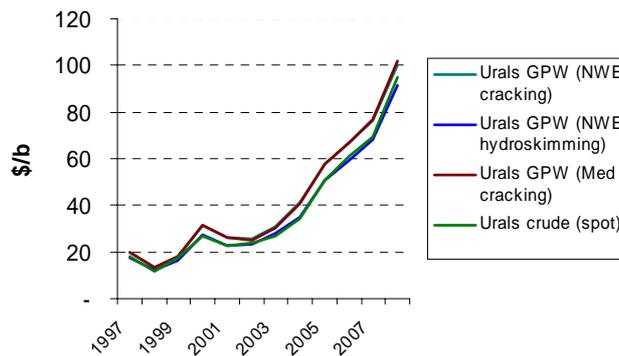
There are over 130 crude grades around the world. However, crude oil itself has almost no direct end use (one exception is direct burning of light, sweet Southeast Asian crude at power plants in Japan and China). Crude oil needs to be refined into petroleum products (gasoline (petrol), heating oil and other) to be consumed. It is the total value of the products processed from crude (called gross product worth or GPW) that determines the crude value. (This does not mean that product prices set crude prices. The two are interactive). From the refiners’ viewpoint, GPW defines the upper limit of crude price (see Figures 2 and 3). Each stream of crude has its own property and each generates different combinations of products.

**Figure 2: Net Product Worth and Crude Prices, Brent (1997-2008)**



Source: IEA

**Figure 3: Net Product Worth and Crude Prices, Urals (1997-2008)**



Source: IEA

Crude oil that has a low sulphur content (less than 0.5%) is called ‘sweet’ and one with a high sulphur content (more than 1.5%) ‘sour.’ To measure crude gravity, the API (American Petroleum Institute) standard is often used. Heavy crude is under API 22°, while light crude is above API 33°. Medium grades are in between. Some crude streams contain metals. All of these factors affect crude prices.

**FOB** (Free on Board) is a price for crude or products at the loading port, while **CIF** (Cost, Insurance and Freight) is one at the destination. Buyers have to pay the additional costs of transport when buying crude or products at a FOB price, while CIF prices include costs of transportation. Furthermore, the timing of the pricing is different. FOB prices are taken on the loading date and CIF prices on the unloading date. Since tanker transportation normally takes between a few days and a few weeks, the difference is often appreciable. It is more common for crude to be traded at a FOB price and for products at a CIF price. This reflects commercial practices that crude buyers normally hire tankers to pick up crude at the terminal of oil exporting countries and product sellers (i.e. refineries) usually deliver products to buyers.

### 1.3 Benchmark Crude

In the late 1970s and 1980s, new benchmark crude grades emerged. A benchmark crude grade serves as the reference for other crude grades of similar qualities and locations. Arabian Light, with its 5 MBD production volume, was the benchmark crude under OPEC’s official selling price system. However, in light of the development of spot and futures markets, the role of Arabian Light was taken over by West Texas Intermediate (WTI) and Brent in the second half of the 1980s.

North Sea **Brent** possesses all of the vital criteria for a bench marker: security of supply, diversity of sellers and broad acceptance by refineries and consumers. Although Brent was not the largest field in the North Sea and had faced production problems in the past, its satellite fields provided enough production volumes for market trading liquidity. An important factor is that production is shared by several participants and is not concentrated in a single producer. This was the main reason why Forties, whose production was dominated by BP, did not become the North Sea benchmark, despite it being the first major North Sea oil field to come on stream, and that its production was larger than that of Brent.

**WTI** was selected as the reference grade when the New York Mercantile Exchange (NYMEX) launched the crude oil futures trading in 1983. Its landlocked delivery system and the distance from international markets may not best suit the conditions for a benchmark

grade. Nor does it have a large physical production. Nonetheless, trading at the NYMEX saw a huge commercial success. With the single largest trading volume as a commodity, WTI has been the leading crude bench maker since then. There are some differences between WTI and Brent as bench marker. While the financial-market oriented WTI reacts immediately to market expectations, Brent's linkage to the physical markets provides a picture on supply-demand fundamentals.

The financial crisis of 2008 has affected WTI's status negatively. It hit the WTI market hard. WTI was normally \$1 to \$3 per barrel premium to Brent previously but the WTI-Brent relation is no longer stable after the crisis. In addition, oil demand stagnated in the US, WTI's main physical market, while demand is growing in many developing countries where Brent and Brent-linked crude grades are consumed. Benchmark grades are critical in defining prices of other related crude and are key variables in many pricing formulas. At this time, there is an ongoing discussion whether WTI will be able to function as the leading crude bench maker or not.

Saudi Arabia sells its crude only directly to refineries under long-term contracts and its crude is not traded in the spot market normally. At the same time there is the need for a Middle East bench marker for heavier, high-sulphur grades. **Dubai** displaced Arabian Light as the Middle East bench marker in the spot market in the late 1980s. However, it fails to become a global bench marker like WTI or Brent, as there are no major exchanges that trade Dubai futures contracts. Furthermore, Dubai now faces a problem of declining physical production. As a result, **Oman** plays an increasingly important role in the region and Oman in combination with Dubai is linked to other Middle East crude. The monthly average of Dubai / Oman is a basic ingredient in retroactive pricing formula for sales by large OPEC Middle East producers, such as Saudi Arabia, Iran and Kuwait.

Crude from various fields in Russia and the former Soviet republics is mingled when transported by Transneft's pipeline system and becomes the **Urals** grade. Urals exports are currently around 4 MBD, the second largest physical trading grade after Arabian Light. There was also another grade called Siberian Light, which was transported by a separate line of Transneft to the Black sea port of Tuapse. Its export volumes are several hundred thousand barrels per day. The problem Urals is facing is that its markets are limited. Urals is sold mainly to Eastern Europe via the Druzhba pipeline, Northwest Europe by tanker from the Baltic Sea ports and the Mediterranean by tanker from the Black Sea ports through the Turkish straits. It is currently sold at a larger discount to Brent than the quality difference.

To develop new markets for Russian crude, the country started laying a pipeline to connect oil fields in East Siberia with the Pacific coast (called East Siberia-Pacific Ocean [ESPO] Oil Pipeline) in 2004. In December 2009 the pipeline started operating with a 300,000-barrel-per-day export capacity, and the first shipment carrying new ESPO Blend was sent out of a terminal near Nakhodka.

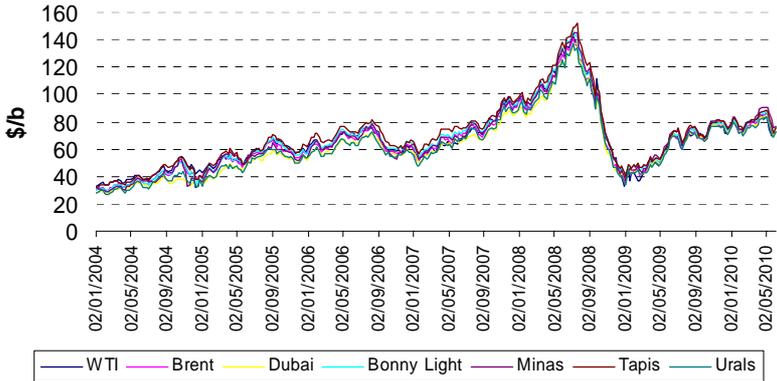
Most crude market places are linked to ports. However, markets can be developed even in inland areas. Various market places for crude oil on the North American continent are good examples. There are also heavy trading activities of Russian Urals along the Druzhba pipeline, between crude oil producers and buyers (mainly refineries in Germany, Poland, Hungary, Slovakia and the Czech Republic). These spot prices are quoted by reporting agencies.

There are other regional benchmark grades, such as Tapis (Malaysia), Minas (Indonesia) and Bonny Light (Nigeria). The **Tapis** field off Malaysia is operated by Exxon, and Malaysia's state-owned Petronas is a regular seller of spot Tapis. Indonesian **Minas** is also traded

regularly in the spot market. Minas is middle grade in its quality, and production volumes are the largest in the region. Minas production is in the hands of Caltex and Indonesian state-owned Pertamina. **OPEC Basket** price is made up of 12 OPEC crude grades.<sup>1</sup>

While the benchmarks play the key role in defining the absolute price levels, most other crude are traded in the form of spread trading. The preference for spread trading reflects a reaction to the volatility that is common in international oil markets. The differences between prices tend to be less volatile than absolute price levels (see Figure 4).

**Figure 4: Benchmark Crude Prices (Jan 2004 - June 2010)**



Source: US DOE/EIA

### 1.4 Crude Transactions

#### *Barter Deal*

Barter deals remain important. The transactions typically involve trading of crude oil or petroleum products in exchange for goods, services or finances. Middle Eastern countries use barter deals to acquire industrial facilities (e.g., desalination plants) in exchange for oil. Other countries pay for petroleum products, e.g., with cargoes of sugar or cashew nuts. Financing agreements can be part of these deals. Typically under these agreements, hard currency loans are provided and the principal and interest are paid by crude cargo deliveries. Countries which have difficulties in accessing international financial markets can benefit from this technique.

#### *Cargo Transaction*

Spot and forward contracts are based on cargo-by-cargo transactions. Forward transactions (i.e. sales at a fixed price for a fixed future delivery) cover purchase and sale of cargoes with delivery scheduled typically for one to three months ahead. Spot transactions mean in commercial practices those with schedules within 15 days to one month (oil trading for delivery on the same day is rare).

#### *Long-Term Contract*

After the integrated system of the Majors, OPEC developed long-term contracts in crude trading. In the early 1970s, producing countries took control of the upstream sector and, as a

<sup>1</sup> Saharan Blend (Algeria), Girassol (Angola), Oriente (Ecuador), Iran Heavy (Islamic Republic of Iran), Basra Light (Iraq), Kuwait Export (Kuwait), Es Sider (Libya), Bonny Light (Nigeria), Qatar Marine (Qatar), Arab Light (Saudi Arabia), Murban (UAE) and Merey (Venezuela).

result, the oil industry was transformed. Upstream concessions were replaced by contractual relations and then expropriated. Based on these upstream assets, national oil companies emerged. Oil prices were set at OPEC meetings as official selling prices and the Majors lost control of oil prices. This official selling price system lasted until the mid-1980s. Long-term contracts were FOB-based, because the tanker fleets were still in the hand of Majors. Long-term contracts also offered supply security under these circumstances.

Long-term contracts are widely used in international crude trading today. OPEC countries in the Middle East sell their crude exclusively to refiners through long-term contracts. The situation is similar for Russian crude oil, which is transported to refineries by pipeline. The duration of these contracts is normally one year with renewals, in terms of the trading volumes. For producing countries, long-term contracts guarantee market access for their crude. Refiners in the consuming country can enjoy stable supply volumes and crude qualities provided by long-term contracts. On this basis, refiners can optimise their operation by buying residual volumes through spot trading.

## **1.5 Price Formula**

Prior to 1979-80, long-term contracts accounted for most international trade. In the 1970s, crude was sold at official selling prices, which were set according to differentials to Arabian Light. The differentials were based on physical properties of the grades and distances to the markets. However, the official price system, which was the basis for most long-term contracts then, was no longer working in the mid-1980s under the decreasing call for OPEC oil due to increased non-OPEC production and diminishing oil demand in the early 1980s. Saudi Arabia, which played the role of swing producer within the OPEC quota system, abandoned the official prices and established a netback pricing system in late 1985 to defend its market share. The netback pricing system tied the value of crude oil to the spot market prices of refined products (see the next section).

The netback pricing system was followed by a brief, unsuccessful return to the fixed official price system. In late 1987, however, geographically specified pricing formulas were introduced. This system is still in place today. It has a direct reference to the global crude markets. It also permits sellers to target specific areas and customers by modifying formulas and other aspects of the contracts to meet individual needs. These adjustments have resulted in highly individualised contracts and price formulas. Although the use of tailor-made formula reduces transparency of prices, pricing formula has proved to be an effective, durable and flexible tool.

If a price formula is only linked to one benchmark crude, the particular characteristic and special market circumstances of the referred crude can have large effects. To avoid this, the use of crude baskets involving more than one benchmark is common. For instance, common formulas for crude sales of Arabian Light to the Asia-Pacific market (eastbound sales) are linked to the Dubai and Oman grades. Meanwhile, those for Europe and North America (westbound sales) refer to ICE Brent futures price (ICE BWAVE). Normally the eastbound sales prices are higher than the westbound sales prices (the difference is called the 'Asian premium').

## **1.6 Netback Pricing**

Although netback pricing was a brief episode in the history of crude oil pricing mechanisms, the concept is often used in pricing other fuels than oil, e.g., natural gas. The netback pricing in the oil sector was developed by Saudi Arabia in 1985. By 1984-85 the official selling price system,

which was the basis for most long-term contracts, had broken down. Buyers were finding the strict conditions and official prices unacceptable, in the face of a global supply glut.

At the time, Saudi Arabia was acting as swing producer within the OPEC quota system, lowering its production volumes so that total OPEC production could be kept within the volume to support the prices set by OPEC. However, under this policy, the country's production had to be cut back from 10 MBD to 3.5 MBD, coming to the lower limit Saudi Arabia had to produce in view of associated gas needs. In addition, Saudi Arabia's efforts were not necessarily shared by the other OPEC countries. Finally, in 1985 King Fahd decided to increase production and recover his country's market share. Netback pricing was introduced as the instrument to implement this production increase. It proved to be a very effective tool for Saudi Arabia to quickly regain market share.

The netback pricing formula was:

$$\begin{aligned} \text{Crude oil price (FOB)} &= \\ &\text{GPW in the spot market} \\ &\quad - \text{fixed refining margin} \\ &\quad - \text{transportation costs*} \end{aligned}$$

*\* from the terminal in the oil-exporting country to the refinery in the oil-importing country)*

This netback pricing system introduced the concept of market prices for crude oil, although it was based on petroleum products. Netback pricing was also attractive to the buyers (refiners), which otherwise were suffering from unstable, low margins.

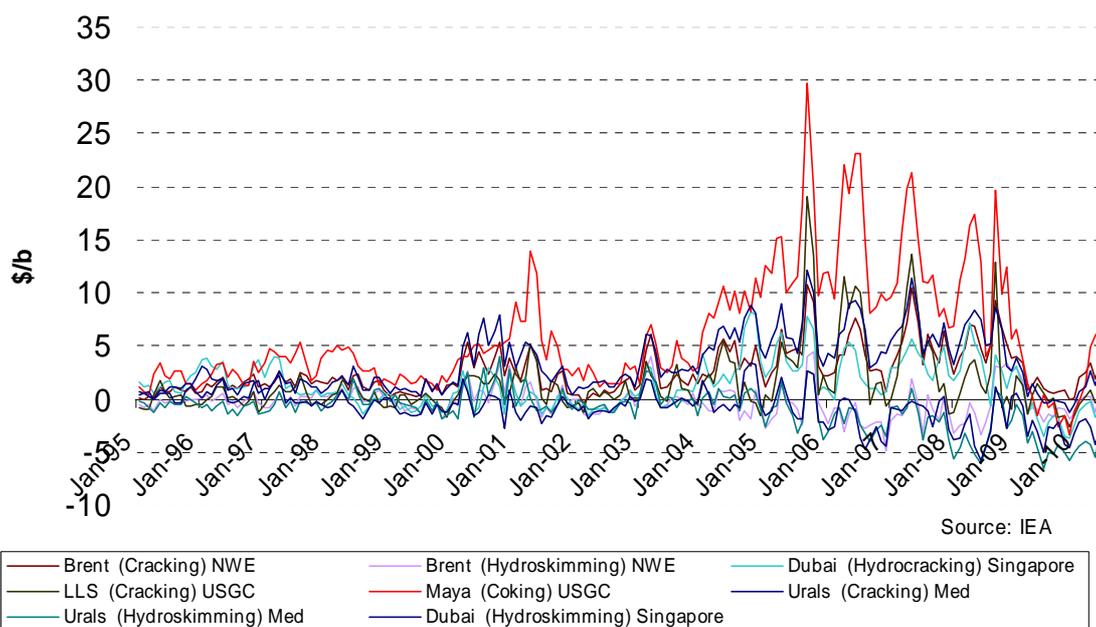
However, the success of netback pricing and the increase in Saudi Arabia's production led to a huge drop in oil prices in 1986, plunging below 10 \$/bbl. Netback pricing was blamed for the price crash. After a brief period of netback pricing dominance, the fixed official selling prices returned briefly in late 1987. But producing countries stopped posting the prices in 1988.

### 1.7 Refining Margins

Refining margins represent monetary gains or losses associated with crude oil processing operation. To make comparisons possible by crude grade, refinery operation or region (see Figure 5), calculations normally assume standardised refinery configurations. The margin calculation takes into account fixed costs (including wages, depreciations of equipments and facilities, and other associated costs) together with variable costs of buying crude and processing operation. Although margin calculations are more reflective of economics of processing a marginal barrel rather than returns from base-load operation, refining margins can suggest indications of financial returns to a refinery.

$$\begin{aligned} \text{Refining margin} &= \\ &\text{GPW} \\ &\quad - \text{crude costs} \\ &\quad - \text{transport costs and applicable fees and duties} \\ &\quad - \text{financial costs} \\ &\quad - \text{variable costs} \\ &\quad - \text{fixed costs} \end{aligned}$$

**Figure 5: Refining Margins Jan 1995 - May 2010)**



Source: IEA

There are four main types of refining operation; hydroskimming, catalytic cracking, hydrocracking and coking. The hydroskimming refineries are the basic, standard ones in which crude components are separated at atmospheric pressure by heating, condensing and cooling. The hydroskimming refineries are equipped with atmospheric distillation, naphtha reforming and hydrodesulphurisation facilities. The catalytic cracking refineries have, in addition to the above, vacuum distillation, catalytic cracking and alkylation processes. The catalytic cracking process breaks down the larger, heavier and more complex hydrocarbon molecules into simpler and lighter molecules by heat and the presence of a catalyst, but without adding hydrogen. Hydrocracking is similar to catalytic cracking, but, with hydrogen and higher pressure. The hydrocracking process can convert heavy oil (a fuel oil component) to lighter and more valuable products (notably naphtha and middle distillate components). A coking unit thermally de-composes residues under high temperature and pressure, and produces lighter products (gasoline (petrol), naphtha, gas oil).

There are several refining centres in the world, including Northwest Europe, Mediterranean, US Gulf Coast, US West Coast and Singapore. To calculate regional refining margins, it is common to accommodate regional characteristics in the calculations. For example, Brent and Urals are normally assumed to be crude inputs in Northwest Europe, and Urals and Es Sider from Libya in the Mediterranean. Refineries in the US Gulf Coast are typically equipped with cracking and coking process facilities. Refineries in the US West Coast are designed to process heavier crude. Singapore refining margin calculation is often based on the Dubai crude and hydroskimming and hydrocracking refining operations.

## 2 DEVELOPMENT OF OIL PRICING MECHANISMS

### 2.1 Early Days

The modern oil industry started with the first oil drilling in Titusville, Pennsylvania, in the US in 1859. In the early days oil prices went up and came down violently every time a field stopped production and a new field was discovered. Oil production in the US was concentrated in the Appalachian area until 1901, when a drilling on Spindletop in East Texas found a huge quantity of oil.

John D. Rockefeller established the Standard Oil Company in Cleveland, Ohio, in 1870 and proceeded to swallow up competitors, or drive them out of business. In 1911, however, Standard Oil was broken up into smaller companies in a famous US anti-trust case under the Sherman Anti-trust Act of 1890, which made monopoly illegal. Three (Exxon, Mobil, Chevron) of the Seven Sisters were born out of the break-up. Although many countries are moving towards competition now, it has to be noted that dominant players rose one after another in the oil sector throughout its history. Rockefeller was followed by the Seven Sisters, and subsequently by OPEC.

In other parts of the world, Royal Dutch started producing oil in Indonesia in the 1890s and Shell Transport and Trading distributed and sold kerosene in a vast area including Russia and the Far East. Before the turn of the 20<sup>th</sup> century, Standard Oil and Shell were already competitors in the world market. Shell and Royal Dutch merged in 1907 and became the Royal Dutch / Shell Group. The Nobels and the Rothschilds started their ventures in Baku, Azerbaijan, under the then Russian Romanov Empire. However, their assets were expropriated during the Russian revolution of 1917. Before World War I, Winston Churchill (to become British Prime Minister during World War II) saw the need for oil to fuel the British fleet, and the UK government participated in Anglo-Persian (which was to become British Petroleum).

### 2.2 Majors

As oil prices plunged in the 1920s after World War I, Standard Oil of New Jersey (Exxon), Royal Dutch Shell and Anglo-Persian (BP) met at Achnacarry, Scotland, in 1928 and agreed to share the world markets. This cartel agreement came to be known as the Red Line Agreement or Achnacarry Agreement. Four companies (Chevron, Gulf, Mobil, Texaco) later joined them and these seven companies came to be known as the Seven Sisters,<sup>2</sup> also called the Majors. The Seven Sisters managed to stabilise world oil prices and supply.

The Majors held concessions covering vast areas, with only very low royalty payments. During this period, almost all crude oil stayed within the integrated companies, and was transferred among affiliates, from producing via transport to refining-marketing affiliates. What we call crude oil prices were mostly internal transfer prices of the Majors, which was artificially kept low to minimise the rent-taking of producing countries.<sup>3</sup> Only refined

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<sup>2</sup> Later, according to some researchers, the *Companie Française du Pétrole* joined this group, but the name 'Seven Sisters' was left unchanged.

<sup>3</sup> It is a difficult task for authorities to assess whether the price agreed by two parties is equal to what two independent parties would have agreed. In the Norwegian petroleum tax system, for example, norm prices may be used for calculation of taxable incomes, instead of actual incomes from the sales. The norm price is

products were sold at arms-length to final consumers. Therefore, caution is needed when examining historical crude prices, as first mentioned by M. A. Adelman of the Massachusetts Institute of Technology in the US.<sup>4</sup> Crude price data before 1960 were mainly based on isolated observations of arms-length sales. For 1960-1972, price estimates are better, because of the publication of Saudi Arabian Light spot prices.

## 2.3 OPEC

Since 1948, when Venezuela first achieved 50:50 profit-sharing in its concession agreements with foreign oil companies, oil-producing countries looked to this as a baseline for their petroleum arrangements with international oil companies (IOCs). Falling demand from the European recession and the rising world supply caused a major plunge in oil prices in the late 1950s. This caused a reduction in oil producing countries' tax revenue, which was already quite low due to the transfer pricing system implemented by the IOCs within their concession agreements with the host states. Against this background Venezuela, Iran, Iraq, Kuwait and Saudi Arabia formed OPEC (Organisation of Petroleum Exporting Countries) in 1960.

While OPEC did not manage to increase prices in the 1960s, it could start raising prices in 1969-1972. In 1973 OPEC raised prices unilaterally from 3 to 12 \$/bbl ("**first oil crisis**"). Prices rose again in 1979, after the Iranian revolution, from about 12 to more than 30 \$/bbl ("**second oil crisis**"). In 1981 some crude oil prices hit 40 \$/bbl. During this period, OPEC countries nationalised the Majors' producing assets in their countries and broke down the Majors' integrated system.

This rapid increase in prices, however, caused a reduction in oil consumption and an increase in production in the non-OPEC area. As a result, OPEC production fell by a third between 1973 and 1985, and OPEC's share of world oil markets fell from 55% to 30%. Saudi Arabia suffered the most, and in late 1985 decided to stop acting as a swing producer within OPEC. It increased its production; resulting in a fall of the oil price to \$10/bbl ("**reversed oil crisis**").

## 2.4 Spot and Futures Markets

The current spot transactions have their origin in the first and second oil crises. The OPEC<sup>5</sup> oil embargo of 1973 and the Iranian revolution of 1979 sparked fears of a shortage in crude supply. Crude buyers became nervous and wanted crude at any price. Spot prices rose to higher levels than the official selling prices and supply volumes under long-term contracts shifted to spot markets. At the same time, rising volumes of new oil production from the non-OPEC area went into the spot markets. Cargoes from the North Sea were sold in the 1980s exclusively on a spot basis.

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determined by an independent panel, the Norm Price Board, based on the sales reports by companies operating in the Norwegian sector and Brent prices. See Ministry of Petroleum and Energy, Norwegian Petroleum Directorate, FACTS, the Norwegian Petroleum Sector 2005, at <http://www.npd.no/NR/rdonlyres/537038C7-8181-4662-995E-F8FAE12919E7/0/Facts2005.pdf> (visited 12 February 2007).

<sup>4</sup> M. Adelman, World Oil Production and Prices 1947-2000, in *The Quarterly Review of Economics and Finance*, vol. 42, no. 2 (Elsevier, 2002).

<sup>5</sup> Organisation of Arab Petroleum-Exporting Countries.

Until 1985, most oil-producing countries nevertheless continued to offer long-term fixed price contracts. These contracts increasingly countered resistant from the buyers. Finally, in 1988 long-term fixed price contracts ceased to exist after an episode of netback pricing.

In the late 1980s there were as many spot markets as crude streams. But gradually Brent and WTI emerged as the two most influential benchmarks. Markets were re-organised into benchmark markers and the other grades that were indexed to them.

At the same time futures markets were being formed in the US. There was a desire on the part of oil companies to reduce price risks in light of high volatility after 1973. Developments in information technology, developments in financial theory and a political climate favouring markets over government administrative guidance led to the creation of financial derivative markets, including futures and options.

Oil futures markets are not new. Price volatility in the early days of the US oil industry resulted in the first oil futures contracts in Pennsylvania in 1860s, which took the form of pipeline certificates. During the next 30 years, more than 10 exchanges in the US, Canada and Europe traded crude futures. However, as Rockefeller established monopoly control and, later, the Majors controlled the market, prices became more stable and the need for market risk management disappeared along with earlier futures trading.

However, in 1979 heating oil became the first new futures contract at the NYMEX, and the International Petroleum Exchange (IPE) in London followed in 1981. Then, gasoline (petrol) futures trading started on the NYMEX in 1981. As for crude, WTI trading started in 1983 on the NYMEX and Brent in 1988 on the International Petroleum Exchange (IPE). The NYMEX launched natural gas futures in 1990 and the IPE in 1997.

The NYMEX still has an open trading floor, called outcry, but it began electronic trading after hours on NYMEX Access in 1993. At the ICE<sup>6</sup>, the open outcry system was abolished in 2005, and now all contracts are traded electronically on screen only.

Currently the NYMEX's WTI futures are the most actively traded commodity in the world. Some 545 MBD were traded in 2009, more than six times as much as the physical oil production / consumption. The contract trades in units of 1,000 barrels and is listed for up to 72 months. The delivery point is Cushing, Oklahoma. Meanwhile, the average trading volume of IPE's Brent futures was around 287 MBD in 2009. Like WTI, Brent contracts are 1,000 barrels per unit and listed for up to 72 months. The IPE has a delivery system called exchange of futures for physicals (EFP). Under this system Brent contract holders can cancel out a future contract with a physical spot contract. By doing so, the holders can have the same result as physical delivery of the commodity.

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<sup>6</sup> The IPE was bought by the Intercontinental Exchange Inc. (ICE) of the US in 2001 and renamed as ICE Futures in 2005.

### 3 SPOT AND DERIVATIVES

#### 3.1 Spot Market

Spot transactions (or, one can call them physical transactions<sup>7</sup>) are mainly conducted by telephone or computer network between two parties. It is an over-the-counter (OTC) market as opposed to an exchange. Spot markets do not necessarily have trading floors. The term ‘spot market’ applies to all spot transactions concluded in an area where strong trading activities take place. A key advantage of the OTC market is that the terms and conditions of a contract do not have to have the specifications required by an exchange. A disadvantage is that there is usually a lack of transparency in the market. Counter party risk also exists in an OTC trade, which is otherwise taken by the exchange.

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.

Formation of a spot market requires large trade volumes and various market operators. The Rotterdam market, sometimes referred to as the ARA area, ideally matches these conditions. It has both the European consumption centres and the North Sea production region nearby. The area itself is heavily industrialised, with many refinery plants. There are also large storage capacities available. The area is the largest port in Europe. It has access to the northern European market by sea. Also, barges go to Germany, Switzerland and France via the Rhine and other rivers and channels. Many financial institutions and oil brokerage houses (Eurol, Frisol, Transol, Vanol and Vito) are based in the area. Overall, the open Dutch and Belgian economies helped establish a large crude and product market place.

Spot transactions take place in a similar manner from one market to another. A buyer who seeks a cargo of crude available within one month contacts different producers and traders working in the area. Negotiations take place normally by telephone. Telephone conversations

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<sup>7</sup> In the previous sections “spot market” is used in a historical context, as a term opposing to supply under long-term contracts. In this section and onward, however, the term means rather “physical market”, opposing to derivatives markets.

are often recorded in case of disputes. Payment is normally made thirty days after loading of the ship for crude oil (payment deadlines are normally shorter for petroleum products). Spread trading mechanism governs most crude spot sales, in which negotiation does not centre on the price in absolute terms but on the price differential between the crude traded and the benchmark. Prices of North Sea crude (e.g., Ekofisk or Forties), for instance, are normally indexed to that of Brent.

In the OTC market, transaction prices are normally known only to the two contracting parties. This can become a major obstacle to active and fluid spot trading. Therefore, there are publications which list price records. Platt's Oilgram (McGraw Hill) and Petroleum Argus are the two most famous ones. To track prices, journalists contact sellers and buyers in the market and interview them on transaction prices during the day. The publications accordingly publish the previous day's quotations.

### **3.2 Forward Market**

Spot trading generated an additional risk of high price volatility. To hedge this risk, forward and futures markets were established. In Europe, however, crude futures exchange started trading only in 1988. Instead, forward markets were developed around Brent crude in the 1980s. Therefore, Brent has three price quotations. Spot markets handle cargoes within fifteen-day availability, called 'dated Brent,' while forward markets were developed for more distant future deliveries, named 'fifteen-day Brent.' Brent traded on the ICE futures market is called 'ICE Brent.'

The forward fifteen-day Brent market has more standardised operation than the spot dated Brent market. The cargo size is fixed at 500,000 barrels  $\pm$  5%. The delivery takes place at the Sulom Voe terminal in the North Sea. In the fifteen-day Brent trading, only the month of delivery can be designated (e.g., January delivery Brent, February delivery Brent, March delivery Brent, etc.). The buyer specifies the month and the volume and the seller indicates the delivery date of the cargo at least fifteen days prior. The name came from this practice. When a fifteen-day Brent cargo is named and dated, it becomes a spot dated Brent transaction. In addition to the Brent crude, there are forward markets of gasoline (petrol), diesel, kerosene, naphtha and heavy fuel oil in Europe.

Forward contracts are in between spot and futures contracts (see Table 2). In a hedging operation, a position is taken in the forward market in an opposite direction to a position in the physical market. However, speculation also takes place in the forward market, when an operator takes a position in order to gain profit from price fluctuation. A cargo of crude oil can be transferred from one trader to another many times between loading and delivery. Series of consequential transactions in the forward market are called 'Daisy Chains'. Most transactions are cancelled out by reversed transactions.

Participants in the fifteen-day Brent market are normally limited to oil companies and large traders, because of the high risks involved in trading. One standard fifteen-day Brent cargo of 500,000 barrels costs around \$35 million at mid-2010 prices.

Forward contracts are traded in OTC markets, which are not as well organised as the exchanges. Many elements are in the hands of the two parties in the deal. There is less price transparency in the forward market than in the futures market, despite the fact that Platt's, Petroleum Argus and other news services survey and report daily prices. Furthermore, unlike

in the futures market, there is no clearinghouse system. Therefore, there is the counter-party risk and all transaction records have to be kept track of individually.

### 3.3 Futures Market

Futures markets have grown considerably since the mid-1980s. Oil companies and traders as well as financial institutions use the futures markets for hedging against the risk of price fluctuations. Reasons for this growth are that trading futures in itself does not cost anything at the exchange and that, if a position is cancelled by an opposite position, the position holder does not have to take physical delivery. One can even gain profits (or suffer losses) in the futures market by taking positions and cancelling them out.

**Table 2: Characteristics of Spot, Forward, Futures, Options, Swaps Deals**

Contract	Spot	Forward	Futures	Options	Swaps
Trading	OTC	OTC	exchange	OTC / exchange	OTC
Derivatives	no	Yes	yes	yes	yes
Physical delivery	yes	(yes)	(no)	(no)	(yes)

Source: ECS

A futures contract is an agreement between two parties to buy or sell an asset at a certain future time for a certain price. Meanwhile, a spot contract is an agreement to buy or sell an asset on the day. A futures contract is a derivative. A derivative is defined as a financial instrument whose value derives from the values of underlying assets. Like a futures contract, a forward contract is a derivative, too. While a forward contract is traded in the OTC market, a futures contract is traded in the exchange. Less than 5% of futures contracts result in physical delivery. A futures holder normally has the opposite position in the market, so that the two contracts cancel out.

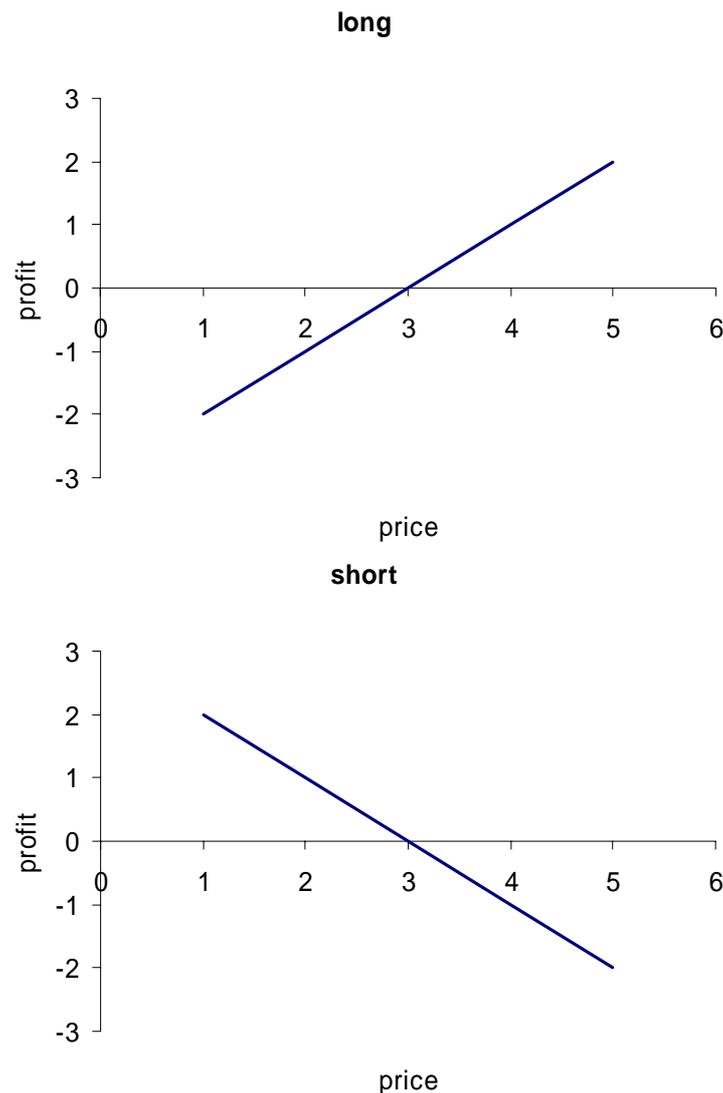
A derivatives exchange is an organised market where individuals trade standardised contracts. Derivatives exchanges have existed for a long time. In the US, the Chicago Board of Trade was created in as early as 1848, trading agricultural derivatives. The exchange specifies certain standardised features of the contract and acts as an intermediary, so that the two parties in the transaction do not necessarily have to know each other. The exchange also provides a mechanism that gives the two parties a guarantee that the contract will be honoured (counter party risk). The following sections explain some technicalities of the derivatives and exchanges.

#### *Long and Short*

A party assumes a long position in the futures market when it agrees to buy an underlying asset on a certain future date for a certain specified price. Conversely, when a party agrees to sell an underlying asset on a certain future date for a certain specified price, the position it assumes is called short. Payoff charts are shown in Figure 6.<sup>8</sup>

<sup>8</sup> These two charts show trader's profit or loss, according to a price change in the futures market. In the charts the futures price is 3 when a trader takes a long or short position. If the futures price rises to 4 next day, a long position holder will gain a profit of 1 and a short position holder will sustain a loss of 1. If the futures price falls to 2 a week later, a long position holder will suffer a loss of 1 and a short position holder will gain a loss of 1. The long and short positions are symmetry against the X axis.

**Figure 6: Profit vs. Price of Long – Short Positions**



Source: ECS

### *Convenience Yields*

For commodities which are bought and sold for consumption, instead of as an investment into a futures contract, there are additional benefits from holding physical inventories. This additional benefit is called convenience yield. For example, inventories can smooth out the production process by filling in during shortages, or when there is higher-than-anticipated demand. Futures contracts cannot do the same. A convenience yield would reflect the difference between the costs of physical inventories and the costs of using a financial instrument (see Box 1).

### *Contango and Backwardation*

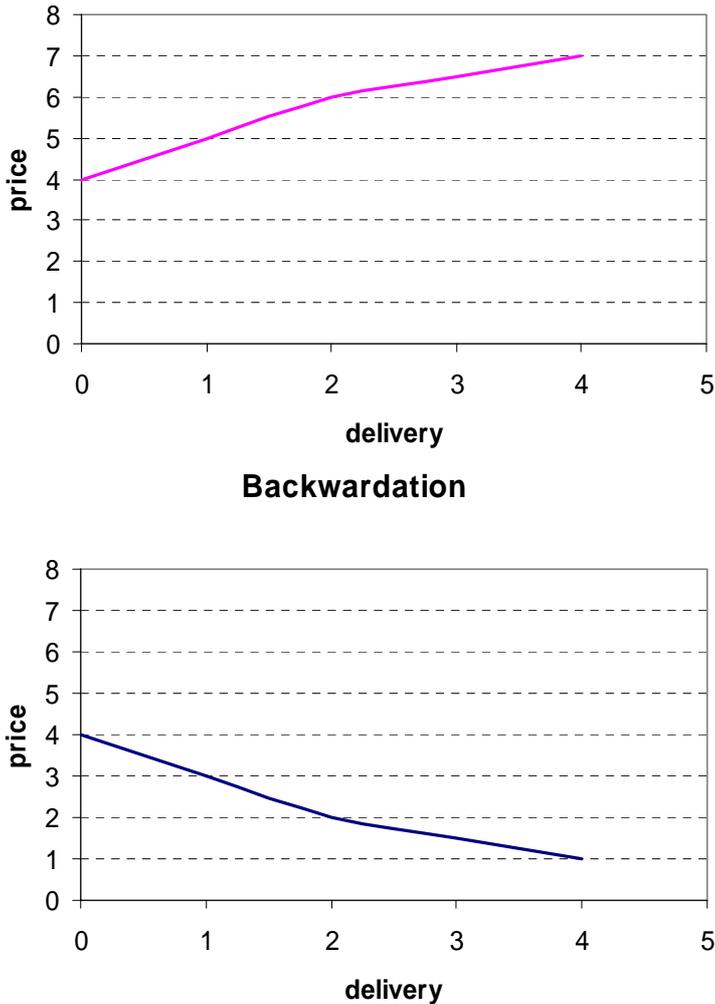
When the convenience yield is smaller than carrying costs (interests and storage fees), the market is in contango (the further out the delivery is, the more the futures price increases – see Figure 7). When the convenience yield is larger than carrying costs, the market is in backwardation (the further out the delivery is, the more the futures price decreases – see Figure 7). If there is a supply or demand shock with low inventories, the convenience yield is

high and the market is in backwardation. Conversely, if inventories are high, the convenience yields are low and the market is in contango.

The crude market is normally in backwardation. During the period of the Gulf Crisis, crude prices were high and the market was in steep backwardation. Prices and convenience yield were falling in 1997 and most of 1998, as Asian countries were hit by economic crisis. The market went into contango. In early 1999, OPEC agreed to cut production and Norway, Mexico and Russia joined OPEC's production cut. With production cuts and a recovery from the Asian financial crisis, prices and convenience yields once again commenced upward and the market returned to backwardation.

However, the situation changed in recent years. Oil prices went up in a contango market from 2005 to 2007. Analysts think that this was due to commodity index funds which took a position in distant delivery contracts. The market was back in backwardation from spring 2007 until the market crashed in autumn 2008. The crude oil market has been in contango since then, regardless of the rise / fall of prices.

**Figure 7: Price vs. Delivery Date for Contango – Backwardation**



Source: ECS

### Box 1: Relation between Spot and Futures Prices

The relation between spot and futures prices is expressed in the following equation:

$$F_t^T = S_t * e^{(r+u-y)*(T-t)}$$

Notation F: forward or futures price T: delivery date T t: trading date t

S: spot price r: risk-free interest rate u: unit storage cost y: convenience yield

According to this model, futures price of the trading date t for the delivery date T is given by the product of the spot price of the trading date t and  $e^{(r+u-y)*(T-t)}$ , which means continuous compounding at the rate of r+u-y for the duration of T-t. Here, r+u can be interpreted as the cost of carrying physical inventory and y as the benefit of it. As described above,

If  $r+u-y > 0$ ,  $F_t^T > S_t$  and the market is in contango

If  $r+u-y < 0$ ,  $F_t^T < S_t$  and the market is in backwardation

Furthermore, the relation between forward price curves (contango / backwardation) and upward or downward movements of spot price are normally as follows.

When there is not much benefit of holding physicals (which means the market is in contango), people do not buy physical commodity and spot prices go down. Therefore, stocks will be built up.

Conversely, when there is much benefit of holding physicals (which means the market is in backwardation), people buy physical commodity and spot prices go up. Therefore, stocks will be drawn down.

The concepts of contango and backwardation are often misunderstood. An example is the misunderstanding that spot prices will go up when the market is in contango. One should be aware that the X axis is the delivery axis (not the time axis) and that the Y axis shows futures prices (not spot prices in the future). With an interest rate and storage costs being counted in the model, the futures price becomes higher as the delivery period gets further away (with all other things being equal).

Convenience yields are known to take negative values. If the market thinks that there is a benefit of holding futures contracts over physicals, convenience yields would take negative numbers. Under the circumstance the market would be in steep contango (some call it "super contango"), which is different from the one in shallow contango. Lastly, it seems that this model equation does not stipulate behaviours of commodity index funds.

### *Marking to Market*

An important feature of the futures markets is 'marking-to-market'. At the exchange a broker requires a (financial) investor to deposit funds in the margin account so that contract

defaults are avoided. The funds, known as the initial margin, must be deposited at the time a contract is entered into. Gains and losses of the investor associated with their positions are settled at the end of each trading day. In the face of criticism of speculation in the market in 2008, many exchanges raised their margin rates. Therefore, current margin rates are much higher than before.

### *Clearinghouse*

A clearinghouse is a settlement mechanism in the exchange. It ensures performance of a contract by buying a contract from a seller and selling the contract to a buyer. Brokers have to be clearinghouse members themselves, or must channel their business through a member. Another important task of a clearinghouse is to keep track of all the transactions that take place during trading hours of the day so that it can calculate the net position of each of its members.

A financial investor is required to maintain a margin account with a broker, while a clearinghouse member is required to maintain a margin account with the clearinghouse. This account is known as a clearing margin. Brokers who are not clearinghouse members must maintain a margin account with a clearinghouse member.

## **3.4 Options Market**

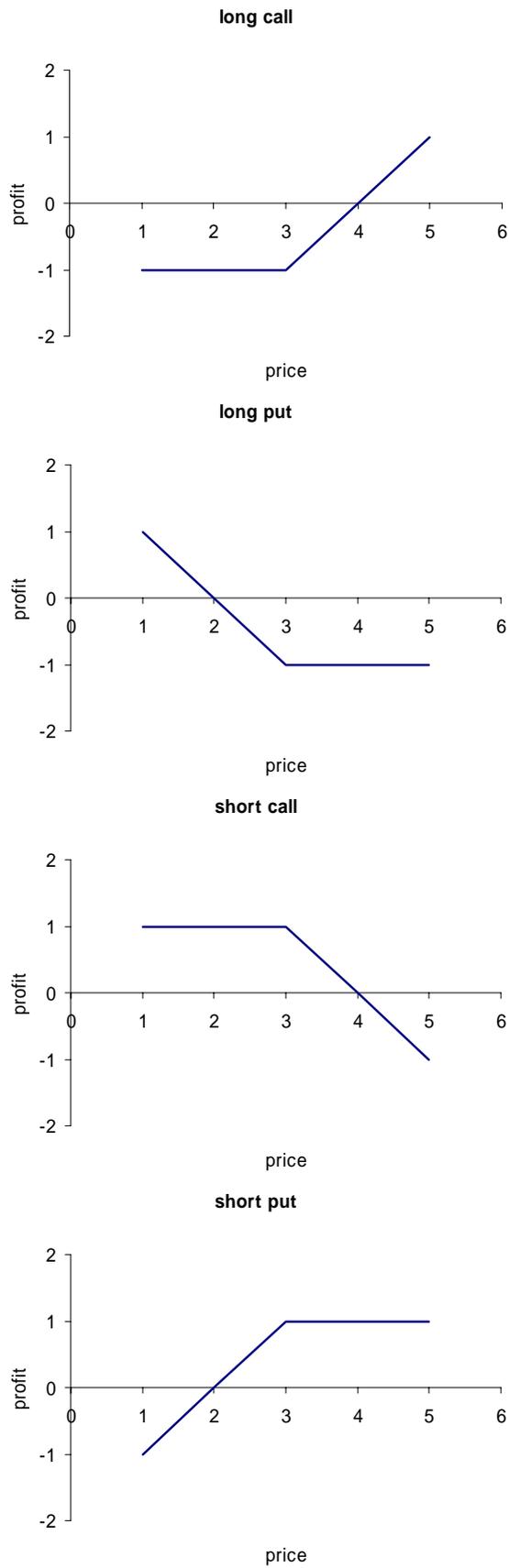
Options on tulips were traded as early as the 1600s in the Netherlands, while the London Stock Exchange listed options on stocks in the 1820s. The first modern energy options were WTI on the NYMEX in 1986. In recent years, trading volumes of options are increasing and their influence on the futures market is enhanced. However, options markets remain as an expert area. A small number of traders with the finance background engage in options trading. Here, only a few basics are described.

Options are traded both on the exchange and in the OTC market. There are two basic types of options; call and put. A call option gives the holder the right to buy the underlying asset by a certain date for a certain price. A put option gives the holder the right to sell the underlying asset by a certain date for a certain price. This price is known as the exercise price or strike price. The date is known as the expiration date or maturity. 'American' options can be exercised at any time up to the expiration date, while 'European' options can be exercised only on the expiration date. Please note that 'American' and 'European' here are just labels and have nothing to do with the location or the market.

In addition, there are two positions to an option contract. Therefore, in total there are four option positions; long call, long put, short call and short put (see Figure 8).

Entering into a forward or futures contract costs nothing, while the purchase of an option requires an up-front premium. There are models to determine the theoretical options premium. The most famous is the Black and Scholes model. The model is named after Fisher Black of Goldman Sachs and Myron Scholes of Long-Term Capital Management (LTCM). Scholes and his colleague at LTCM, Robert Merton, received the Nobel Prize in Economics in 1997 (Black died in 1995). However, LTCM itself suffered huge losses in 1998 and had to be bailed out by other financial institutions led by the US Federal Reserve Bank.

**Figure 8: Profit vs. Price Curves for Long Call – Long Put / Short Call – Short Put**



Source: ECS

## **4 HEDGING AND SPECULATION**

### **4.1 Hedging**

Derivatives (including futures) contracts are developed as an instrument to reduce price risks. Hedging means reducing a risk of loss in the business, resulting from an unexpected change in the value or cost of a product. This section looks into how futures contracts and futures markets are used to hedge risks.

Companies hedge and fix unknown variables in order to concentrate on their main activities. Take a manufacturing company as an example. If the company has no particular expertise in such areas as interest rates, exchange rates and commodity prices, then it makes sense for the company to hedge the risks associated with these variables and fix them. By doing so, the company can focus on its main manufacturing activity which it knows very well.

It is important to know that hedging sometimes results in a decrease in profit. As a result of a hedging operation, a company may earn more or less profit than it would without hedging. However, the objective of hedging is to fix unpredictable variables, and is not to make more profit. Therefore, if a company engages in a hedging operation, it needs to have clear understanding of how hedging operations work. It is also important to recognise that there is no such a thing as a perfect hedge in practice. No hedges can completely eliminate the risk.

If hedging is not a norm in an industry, then companies in the industry should be careful about how they hedge. This is because there is competitive pressure in the industry, which in the long-run adjusts the raw material costs, interest rates and exchange rates as well as the prices of goods and services the company produces. A company that does not hedge can, therefore, expect its profit to be roughly the same in the long run, while the profit of a company that hedges may fluctuate. In such a case hedging can have the opposite effect to the intended one.

In 1998, when the crude oil price was declining, several oil companies arranged and entered into long-term oil price hedging contracts. Although the NYMEX and the ICE provide futures contracts up to 72 months ahead, it is not very common for companies to hedge crude oil prices further than several months. Few companies went bankrupt in 1998-99, as oil companies made efforts to reduce costs and streamline operation to adjust themselves to the low-oil-price business environment. However, those companies that had entered into a hedging contract suffered from low revenues when oil prices started moving upwards a few years later and some of them were acquired by their competitors.

### **4.2 Long Hedge and Short Hedge**

Hedging operations use the property that futures prices converge with spot prices at the time of delivery (see Figure 9). That is, when the delivery takes place, the futures price equals the spot price. Therefore, in hedging on the futures market, the operation goes in the opposite direction to the physical transaction. If one buys a physical commodity, it sells a futures contract (long hedge). If one sells a physical commodity, it buys a futures contract (short hedge).

#### *Long Hedge*

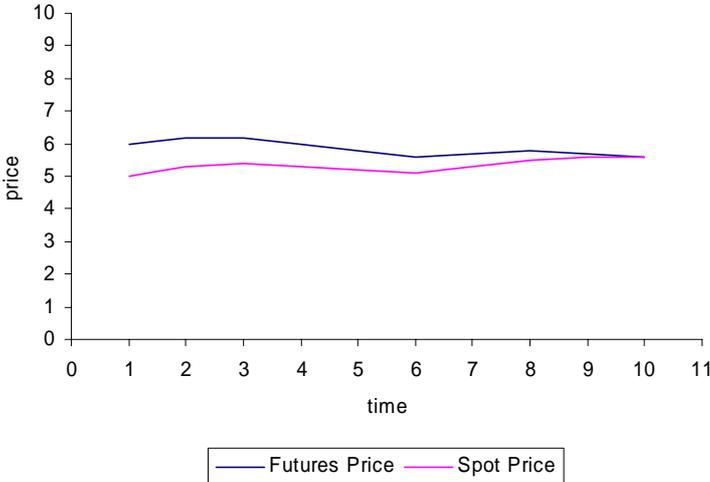
A refiner who needs to buy crude in the physical world buys a futures contract on the futures market now and is going to sell a futures contract on the futures market at the time of

purchase of the physical. Note that, when a hedging operation is completed, the refiner does not have a futures contract in his hand.

*Short Hedge*

A producer who is going to sell crude in the physical world sells futures contract on the futures market now, and is going to buy futures contract on the futures market at the time of crude sales. In order to sell a futures contract now, the producer (who does not have a futures contract) borrows one from someone (there are brokers in the exchange who arrange borrowing deals). When the producer buys a futures contract, the producer will return it to the lender. If there is no-one willing to lend a futures contract, the situation is called squeezed. This is one reason why liquidity is important in the market.

**Figure 9: Convergence of Futures Price and Spot Price**



Source: ECS

**Box 2: Crack Spread**

Derivatives can be combined in one trading strategy. One such strategy is called crack spread. A refiner, who buys crude and sells gasoline (petrol) / heating oil, makes money on price differentials. Refiners are, therefore, more interested in the price differential between crude and gasoline (petrol) / heating oil than in the absolute price levels. A refiner can simultaneously long hedge on crude and short hedge on gasoline (petrol) / heating oil, to lock in the spread.

**4.3 Hedgers, Speculators and Arbitrageurs**

One important reason why derivatives markets have been successful is that they have attracted many different types of traders and have had large liquidity in their trading. In order for a transaction to be agreed upon, it is necessary to have players on the both ends of the deal, a buyer and a seller. In the market, there are three categories of players; hedgers, speculators and arbitrageurs.

**Hedgers** use futures and other derivatives to reduce the risks that they face from potential future movements in market variables. A hedger is a buyer or seller of a physical commodity, such as an oil producer or refiner, who takes the opposite position in the forward or futures market.

Hedgers want to avoid an exposure to the price risk, while **speculators** wish to take a position in the market. Speculators bet that the price will go up, or, that the price will go down. A speculator neither buys nor sells the physical commodity but takes on a risk for a profit in the futures market.

**Arbitrageurs** take offsetting positions in two or more instruments to lock in a profit. In other words, arbitrageurs lock in a riskless profit by simultaneously entering into corresponding transactions in two or more markets.

#### **4.4 Regulatory Authority**

In the US, the Commodity Futures Trading Commission (**CFTC**), established as an independent agency in 1974, regulates commodity futures and options markets. The mission of the CFTC is to protect market users and the public from fraud, manipulation and abusive practices related to the sale of commodity and financial futures and options, and to foster open, competitive and financially sound futures and option markets. The CFTC is also responsible for ensuring that prices are communicated to the public and that futures traders report their outstanding positions.

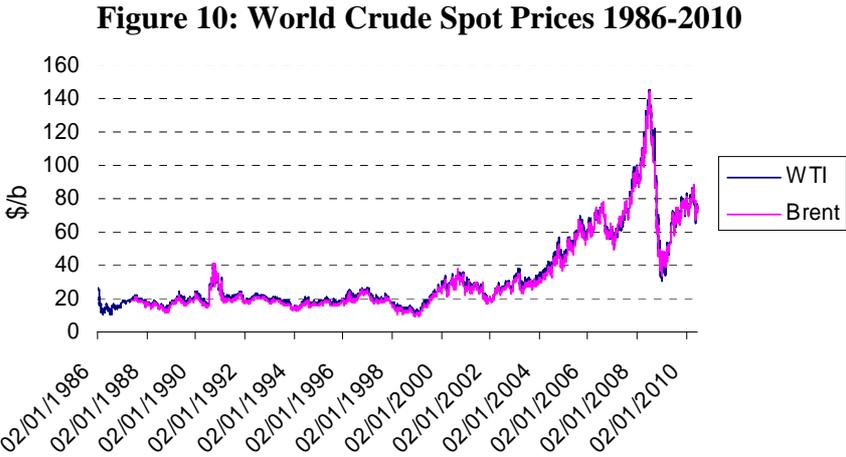
In the UK, the Financial Services Authority (**FSA**) is the regulator of the financial services industry and commodity markets, including London-based ICE. The FSA is an independent body, given statutory powers by the Financial Services and Markets Act 2000. At the time of writing the UK government has announced a plan to overhaul regulatory system in the financial sector. According to it, the FSA will be broken up and the function to monitor the financial institutions will be transferred to the Bank of England. This process of reforming the regulatory system will be completed by 2012.

## 5 BUBBLE AND BURST OF OIL PRICES

### 5.1 From the Gulf War to the Rise of the Chinese Economy

Between 1990 and 2000 crude oil prices stayed at around \$20 per barrels, except for two occasions – the Gulf War in 1990 and the Asian economic crisis in 1997-1998 (see Figure 10). In August 1990, Iraq invaded Kuwait and oil prices started a steady increase. However, within a week after the US and allies began air attacks on Iraq in January 1991, oil prices fell back under 20 \$/bbl. Both Iraqi and Kuwait oil was out of the market. (Some 20 years later Iraqi oil production has not returned to the pre-Gulf War level yet. The country has been outside of OPEC’s quota since 1990.) During the same period production and exports from the FSU were also decreasing, due to political and economic transition. But production increases from OPEC and the North Sea made up the drops, and oil prices were sliding.

In 1996, the strong world economy pushed up oil prices. However, oil prices were hit hard by the Asian financial crisis in 1997 and 1998. Nonetheless, OPEC decided to increase production at the meeting held in Jakarta in November 1997. Oil prices fell to below the \$10 level. OPEC countries re-united and agreed to cut production one and a half years later, in March 1999. Norway, Mexico and Russia joined this production cut. With recovering Asian economies, prices once again commenced an upward movement in 1999 and 2000.



Source: US DOE/EIA

However, oil prices deviated from this range of around \$20, starting in around 2000. Oil prices rose and fell during the “dot-com bubble” from 2000 to 2002. They did not react immediately to the terrorist attacks in New York and Washington on 11 September 2001. However, oil prices rose strongly in 2003 and 2004. Both fundamentals and expectations pushed up the market very strongly. In the wake of the war in Iraq, there was growing fear of terrorist attacks on oil facilities in the Middle East (which have not happened to this date). China’s economy grew strongly, along with its oil demand and imports. The country became the second largest consumer in 2003, surpassing Japan. Global oil demand grew at the highest rate in recent years in 2004, with one third of the 3MBD growths for the year coming from China. On the supply side, ‘peak oil theory’ (that the earth may not have enough hydrocarbon resources to meet the rising demand) was talked about. Spare production capacity was just 2 MBD against an 80 MBD consumption. Bottlenecks in the refining system, notably for gasoline (petrol) production in the US, added pressure to product and crude prices.

## **5.2 Commodity Index Funds**

In around 2004 a new factor was added to the oil market – influx of a large amount of money through commodity index contracts / funds. They have existed since the late 1980s but have become active in the market in around 2004. Commodity index contracts are a financial vehicle linked to performance of commodity markets including energy, precious metals, industrial metals, agricultural products and live stocks. The returns are calculated based on the composite of benchmarks from these commodity markets. Since the oil portion weighs heavily in the composite, the movement of the index looks very much like that of oil prices.

A large amount of money went into the oil markets from institutional investors and pension funds by way of commodity index contracts, which the oil market had never seen before. When oil prices were in their ascendant, there were estimates that commodity index funds would account for more than half of the WTI market. However, there was no systematic data published by the authorities.

One effect of the commodity index funds was a contango-shaped crude market. As mentioned earlier, prices are normally depressed and stocks are built in the contango market. But the crude market was in contango between the beginning of 2005 and spring 2007, when prices were rising. The exceptions are autumn 2005 when hurricanes hit the US.

Commodity index funds have a so-called ‘long-only’ strategy, in which they hold a long position in distant delivery contracts for a long time. This is contrary to hedge funds and other traders which buy and sell contracts in prompt delivery months. There is a working theory that as speculative money from commodity index funds goes into distant delivery contracts where liquidity is thin, the prices there go up. In addition, this ‘long-only’ strategy requires a backwardated market to produce profits when roll-overs of the contract take place. The funds, therefore, invest in further delivery months which still remain in backwardation and, as a result, the contango portion of the market expands further from the prompt month.

## **5.3 Sub-Prime Crisis, Financial Crisis and Euro Crisis**

Factors behind the upward price movement after 2000 were multiple, including both fundamentals and expectations. Oil demand in China, India and the Middle East was increasing rapidly. China in particular took over Japan as the second largest consumer after the US and its growths showed no signs of abiding. On the supply side, production growths in the non-OPEC countries slowed and the OPEC countries were unwilling to expand their capacities. There were some people who talked about “Peak oil theory”, which was a perception that petroleum resources on the planet (or at least in the non-OPEC area) were running out. Geopolitics was a favourable subject at seminars and conferences, as China and Russia gained influence in the international political scenes. Military conflicts arose in the Middle East (including Iraq, Iran, Palestine and Israel). Economy was booming – not only oil prices but also production costs were rising. Funds were active and markets were flooded with influx of speculative money.

In summer of 2006 WTI went up to \$76/bbl in light of the Hezbollah-Israeli conflict. This price spike was recorded in a contango market. After the conflict ended, oil prices fell to \$50/bbl in January 2007. The oil market returned to a backwardation in spring 2007, and oil prices were increasing again soon after. The reason for the backwardation was thought to be a result of portfolio realignments by commodity index funds in commodity markets.

In economy in general, the sub-prime crisis, which is now seen as the first wave of the global economic and financial crisis, started in summer of 2007. In July 2007 Bear Stearns, which was to be acquired by JP Morgan Chase nine months later, had to bail out its sub-prime hedge funds. A few days later the US Federal Reserve chairman Ben Bernanke in a congressional hearing warned of the extent of the sub-prime crisis.

In August 2007 BNP Paribas said in a statement that “The complete evaporation of liquidity in certain market segments of the US securitisation market has made it impossible to value certain assets fairly regardless of their quality or credit rating.” This is widely regarded as the start of credit crunch. The European Central Bank started pumping money into the banking market to try to improve liquidity, followed by the central banks in the US, Canada and Japan. Stock markets also started declining then.

Meanwhile, oil prices were on the rise throughout 2007 and surpassed the \$100 line at the beginning of 2008. WTI kept increasing in the first half of 2008 and hit the record of \$147/bbl in July. While there were debates then whether market fundamentals or speculations caused this rise in oil prices, in retrospect speculative money shifting from the stock market played a significant role in the oil market.

WTI kept rising in the first half of the year and hit the record of \$147/bbl in July. However, the market turned to a contango a few days prior to posting this record-high price. By that time, the US government had to step in and rescue two government sponsored enterprises, Fannie Mae and Freddie Mac. Oil prices started falling sharply in September 2008, as economy in general and financial markets in particular started their downturns. Oil prices along with stock markets started a sharp fall, as Lehman Brothers fell, Merrill Lynch was acquired by Bank of America and AIG was rescued by the US government. During autumn and winter 2008, the governments of the industrialised countries started an unprecedented intervention into financial markets. Stimulus packages were released, banks were injected public money and some forms of short selling were banned in the stock markets. WTI fell to \$35/bbl by the end of the year.

Oil prices started recovering in early 2009. They went up to \$85/bbl in spring 2010 but fell again in light of the Euro crisis. In this new market paradigm, focus of the oil market is on the recovery in economy, which leads to increases in oil demand. In this context the oil market is no different from stock, currency and other financial markets. And, oil is traded in relation to the dollar-euro exchange rate, or the stock market indices.

### *Trading Volume*

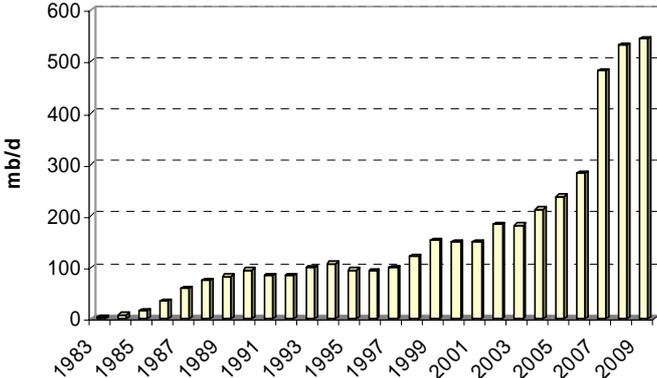
Looking into the NYMEX WTI futures market activities, its trading volume has been steadily increasing since its launch in 1983. The trading volume doubled between 2000 and 2006, with the space of increases accelerated in 2003-2004. Extraordinarily, it increased by 70% in one year from 2006 to 2007. The trading volume continues to increase after the financial crisis in 2008, averaging 545 million barrels per day equivalent in 2009 (more than six times the world oil production of 85 million barrels per day).

### *Commitments of Traders*

The CFTC publishes various data including outstanding futures and options positions by trader type, called “the Commitments of Traders”. They are useful ones to learn the market conditions. The categories used to be divided into three groups of traders: commercial, non-

commercial and non-reportable. A commercial was a trader who had physical facilities to “commercially” engage in the business of the derivative’s underlying commodity. A commercial is normally a hedger who faces price risks in its business and tries to offset them in the futures market. A non-commercial is a speculator, who traditionally takes an opposite position to commercial traders. A nonreportable is a trader who is not obliged to file a daily report to the CFTC. Many of them are small-scale speculators. Non-reportable positions in the report are derived from commercial and non-commercial positions.

**Figure 11: NYMEX WTI Futures Trading Volume (1983-2009)**



Source: NYMEX/CME

However, when oil prices were rising in the first half of 2008, there was criticism that the CFTC data did not reflect the reality of the market. The trader categories were basically more than 20 years old and there were new types of traders – hedge funds, swap dealers and commodity funds – with new trading strategies. In 2008 the CFTC conducted a legally obligatory survey on traders and published two studies<sup>9</sup>. Following the studies, the CFTC began publishing “the Disaggregated Commitments of Traders” in September 2009.

The new report has five trader categories: producer / merchant / processor / user; swap dealers; managed money; other reportables; and nonreportable. According to the CFTC:<sup>10</sup>

A “**producer/merchant/processor/user**” is an entity that predominantly engages in the production, processing, packing or handling of a physical commodity and uses the futures markets to manage or hedge risks associated with those activities.

A “**swap dealer**” is an entity that deals primarily in swaps for a commodity and uses the futures markets to manage or hedge the risk associated with those swaps transactions. The swap dealer’s counterparties may be speculative traders, like hedge funds, or traditional commercial clients that are managing risk arising from their dealings in the physical commodity.

A “**money manager**,” for the purpose of this report [the Disaggregated Commitments of Traders], is a registered commodity trading advisor (CTA); a registered commodity

<sup>9</sup> “Interim Report on Crude Oil: the Interagency Task Force on Commodity Markets” (July 2008); “Staff Report on Commodity Swap Dealers & Index Traders with Commission Recommendations” (September 2008).

<sup>10</sup> Disaggregated Commitments of Traders: Explanatory Notes by the CFTC <http://www.cftc.gov/ucm/groups/public/@newsroom/documents/file/disaggregatedcotexplanatorynot.pdf>.

pool operator (CPO); or an unregistered fund identified by CFTC. These traders are engaged in managing and conducting organised futures trading on behalf of clients.

Every other reportable trader that is not placed into one of the other three categories is placed into the “**other reportables**” category.

### *Hedge Funds*

A hedge fund is a private investment fund that manages investment from a limited range of professional or wealthy investors. Hedge funds are active in oil futures markets. While hedge funds are flexible and employ many different strategies, they often engage in spread trading. In spread trading, hedge funds or other traders simultaneously buy one delivery month and sell another delivery month, or simultaneously buy one commodity and sell a different commodity; or simultaneously buy one commodity in one market and sell the commodity in another market, to take advantage of changes in price relationships.

### *Swap Dealers*

A swap is a financial derivative in which one stream of assets is exchanged with another stream of assets. Financial institutions first developed the OTC currency and interest swaps in the 1980s. Swaps can function as a competitor or a complement to futures and options. But the advantage is, unlike the standardised futures and options in the exchange, that swaps as an OTC product can be customised to fit customer’s specific needs. Swap dealers, who are normally affiliated to large financial institutions, participate in the oil exchange to seek to hedge price risks arising from their OTC swap arrangements. In a sense they connect OTC markets with exchanges. Swap arrangements related to crude oil and petroleum products appeared in the late 1990s and swaps dealers became active in the NYMEX in around 2000.

More importantly, the CFTC granted swap dealers a hedge exemption from the speculative position limits, to manage price risks resulting from the OTC activities. Furthermore, the CFTC used to classify activities of swap dealers as commercial rather than non-commercial in the Commitments of Traders report on the ground that swap dealers used futures markets for the commercial purpose of hedging their price risks. The major improvement in the new Disaggregated Commitments of Traders report is that swap dealers are counted separately from other traders.

### *Commodity Funds*

Many things about the commodity funds have already been touched upon in the previous sections. To summarise, commodity index contracts are a financial vehicle linked to performance of commodity markets including energy, precious metals, industrial metals, agricultural products and live stocks. The returns are calculated based on the composite of benchmarks from these commodity markets. There are several large financial institutions (commodity funds) that sell index contracts to institutional investors and pension funds. They typically go into the futures markets through swap dealers. Often institutional investors and pension funds themselves go into the market through swap dealers.

## **5.4 Regulatory Reforms**

When the oil price continued its ascendancy in the first half of 2008, regulators and lawmakers launched regulatory reforms on the US commodity and oil markets. The US Congress in

particular focused on speculation in the oil markets by commodity funds, investment banks and hedge funds. They said that these market participants were exploiting “loopholes” on the regulations and identified three of them – the Enron, London and Swap loopholes.

### *Enron Loophole*

The Enron loophole, named after an energy trading company that went into bankruptcy in late 2001, implies a loose regulatory oversight on the OTC market. In 2000 Enron along with other financial institutions lobbied and successfully created a deregulated OTC market, “Enron On-line”, which had been prohibited under the so-called Shad-Johnson Accord of 1982. The Enron loophole was enacted by the Commodity Futures Modernisation Act of 2000, signed by President Clinton in December 2000. In September 2007 a bill to close the loophole was introduced by Senator Carl Levin of Michigan (Democrat), which was later attached to the Farm Bill of 2008. The bill was enacted in June 2008 as the House and Senate overrode President Bush’s veto. However, other forms of the OTC market remain unregulated. This is one of the main areas where current efforts on the financial sector reforms are concentrated.

### *London Loophole*

The London loophole meant that trading at the Intercontinental Exchange (ICE) in London was out of the sight of the CFTC. However, in June 2008 the CFTC reached an agreement with the ICE in London, to receive enhanced data on its crude oil trading under the same information requirements as the US markets.

### *Swap Loophole*

The swap exemption is perhaps the most important of the three. Commercial traders that take positions in the US futures and options exchanges to hedge price risks do not face the same limits on trading as non-commercial traders (speculators) do. As mentioned the above, a 1991 ruling extended the definition of a commercial hedger to swaps dealers. Under this exemption a pension fund or an investor can enter into a swap contract with a financial institution that has a swap dealer under its umbrella, and the swap dealer in turn can go into the market and take positions. But neither the financial institution, nor the swap dealer, nor the original investor faces speculative trading limits. While many analysts and lawmakers say that this loophole allows funds and financial institutions to build their positions in the market but avoid restrictions placed on other financial investors, the Swap loophole has not been plugged yet.

Going through the financial crisis in 2008, the entire financial sector is under criticism for its excessive and unregulated risk taking. The issue of speculation in the oil market has been included in the issues in the financial sector. Reforms on financial / derivatives markets are ongoing on an international level, led by Europe and the US, at the time of writing. The efforts centre on re-regulating banks and funds, OTC derivatives markets, new taxes on the financial institutions, etc.

## 6 CURRENT OIL MARKET FUNDAMENTALS

### 6.1 Demand

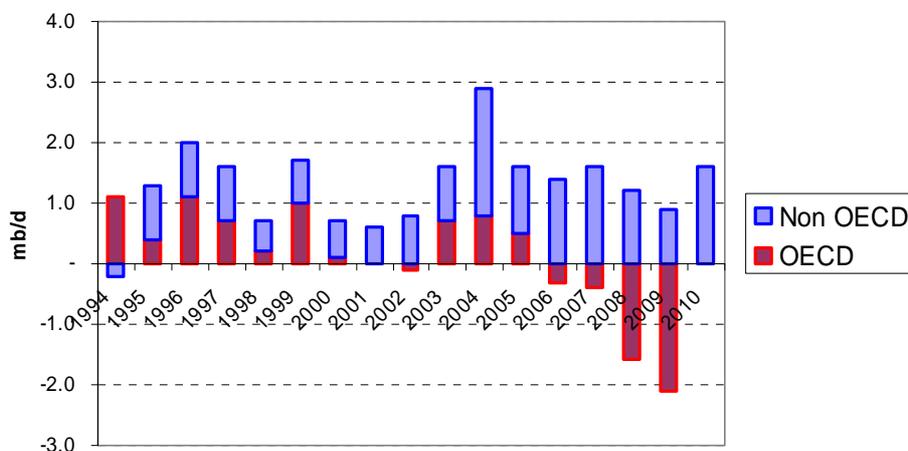
Economies need energy to sustain their activities. Increases in energy consumption are closely linked to economic growth, although changing consumption patterns and improvements in the efficiency of energy use (reducing ‘energy intensity’) can mitigate the growth in oil demand. In relation to oil, the linkage between economic growth and oil consumption has been established econometrically and is often used to forecast oil demand. Geographically, oil demand is increasing in China, India and the Middle East during the period following the financial crisis. Meanwhile, oil demand remains flat or is falling in North America, Europe and OECD Pacific.

In industrialised countries, the only area where oil demand is growing is the transportation sector. The share of the transportation sector in oil demand has been increasing for the last few decades, despite that the governments promote such alternative fuels as electricity, hydrogen, compressed natural gas (CNG) and biofuels. Oil demand for power generation is decreasing in industrialised countries, as shares of natural gas and coal are increasing. Demand for transportation fuels is also growing in developing countries, as income levels rise and infrastructure is developed. In addition, other sectors, including power generation, are contributing to growth in developing countries.

However, the economic downturns brought down oil demand, with automobile companies worldwide experiencing sharp declines in their sales. Looking into the oil market, it is worthwhile to note that the OECD oil demand already peaked at just below 50 million barrels per day in 2005 and has been declining since then (see Figure 12). This decline in the OECD slowed down the global demand growth after 2005 and brought it in the negative territory in 2008 and 2009. According to the IEA, the OECD oil demand growth will be nearly zero in 2010, with all the growth coming from non OECD countries.

If one tries to have an outlook for the future, it would depend on how severe the current economic downturn is and how long it will last. The IMF forecasts that the world GDP growth will return to the positive territory in 2010, with advanced economies expanding at a rate of 2.3% and emerging and developing economies at 6.3% (see Figure 12).

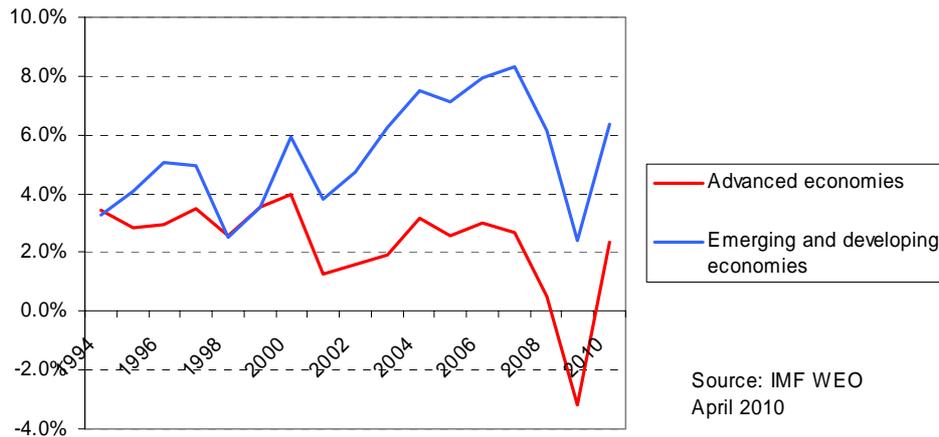
**Figure 12: Oil Demand Growth (1994-2010)**



*Note: Numbers for 2010 are forecasts*

*Source: IEA Oil Market Report*

**Figure 13: GDP Growth (1994-2010)**



Source: IMF WEO, April 2010

## 6.2 Supply

The earth has a finite amount of hydrocarbon resources. The debate on how large hydrocarbon resources are and how soon mankind will run out of oil reserves has been going on for a long time. A key point of contention is the prediction (made at various times) that the peak of oil production is nearing (called 'peak oil theory'). American geologist Marion King Hubbert originally wrote about the peak oil theory in the 1950s, and this theory drew wide attention. One school of thought claims that oil production will soon peak and that the consequences for the world economy will be dire, for humankind is dependent on oil. On the other side of the debate, another school of thought argues that the peak of Hubbert's curve will continue be postponed for some time due to new explorations and improvements in technology. The United States Geological Survey (USGS) says that there are enough remaining petroleum reserves to continue current production rates for another 50 to 100 years.

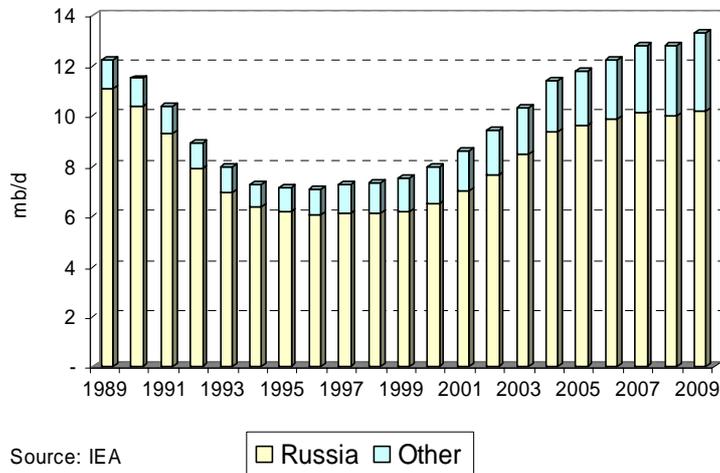
The issue is that there are not enough scientific data available to settle the debate authoritatively in one way or the other. Moreover, much of the existing data is kept confidential due to security and commercial reasons. Furthermore, the amount of exploitable reserves (including extra-heavy oil, bitumen and oil shale) are dependent not only on physical existence but also on technological and economic factors. Therefore, the amount of the reserves will change, as technology progresses and economic conditions change.

Currently OPEC has 12 member countries, producing 33 MBD in 2010, equivalent to 41% of world production. It holds some 1 trillion barrels of oil reserves, equivalent to 77% of world reserves. Among the members, Iraq has been outside the quota system since 1991, while Indonesia became a net oil importer in 2004 and suspended the membership in 2009. OPEC's surplus production capacity currently stands at around 6 MBD (there is almost none in non-OPEC countries). In addition to crude oil, OPEC countries have 5 MBD of natural gas liquid (NGL) production, which is outside the OPEC quota.

The Soviet Union once was the world's largest oil producer in the 1980s. Its production peak exceeded 12 MBD in 1988. In the wake of political and economic transition, however, output fell to 7 MBD in the mid-1990s. It started to recover in the late 1990s and has shown robust growth over the last ten years (see Figure 14). The combined production of Russia and other former Soviet republics was just over 13 MBD in 2009, exceeding even the height in the Soviet days. This is thanks to increases in the Caspian output (Tengiz, Azeri-Chirag-

Guneshli) with pipeline infrastructure (CPC, Kazakhstan-China, BTC) in operation. The Kashagan field in the Kazakh sector of the Caspian Sea will soon be onstream. Meanwhile, Russian production is stable at round 10 MBD in recent years.

**Figure 14: FSU Oil Production (1989-2009)**



Source: IEA

IEA data suggest that non OPEC production is increasing slightly from 51 MBD to 52 MBD. Production increases in Russia, Brazil, the US and others are outweighing declines in the North Sea and Mexico. Since the growths in Brazil and the US are taking place in deepwater and the remaining undeveloped prospects lie in the deepwater North Sea, the accident of the *Deepwater Horizon* drilling rig and the subsequent oil leakage in April 2010 could have serious implications on the future non-OPEC production.

Economic downturns starting in 2008 and a sharp fall in oil prices associated with it hit non-conventional oil production hard, resulting in postponing and curtailing projects and plans. Canada's tar sands are producing at just below 2 MBD, while Venezuela's extra-heavy oil output is averaging 0.5 MBD at this time. Biofuel production is totalling at 1.5 MBD, with Brazil (0.5 MBD), the US (0.7 MBD) producing the bulk of it. Nonetheless, biofuel accounts for a significant portion of the non OPEC production growth.

### 6.3 Refining

The refining sector faces many challenges. Refineries were running at around 90% of capacity, virtually the upper limit, in industrialised countries for more than a decade. Historically, oil demand was dampened by two oil crises in the 1970s, creating excess refining capacities. The refining sector suffered from the excess capacities until the early 1990s. Since then, however, the difference between refining capacity and demand has been tightening. However, the economic downturns has eased it and currently refineries are operating at around 80%.

In industrialised countries it is very difficult to expand or upgrade facilities in refineries due to environmental regulations and local opposition. This results in increases in product imports and expansions in refining capacities outside industrialised countries. Nevertheless, introduction of new, more stringent fuel specifications has created the need to upgrade refining facilities. Furthermore, product demand is shifting toward lighter gasoline (petrol), diesel and jet fuel, while crude quality is becoming heavier and more sour. This mismatch was one driving force behind the oil price increases since 2000.

Refining margins have improved since 2004, in particular for complex refineries with upgrading capacity (which produce only gasoline (petrol) and middle distillates and virtually no fuel oil). These refineries have higher utilisation rates than those with simpler facilities. New refining capacity additions are taking place in China, India and the Middle East. New refineries in China and India will be for domestic consumption, while those to be built in the Middle East will serve for both domestic customers and export.

**6.4 Stocks**

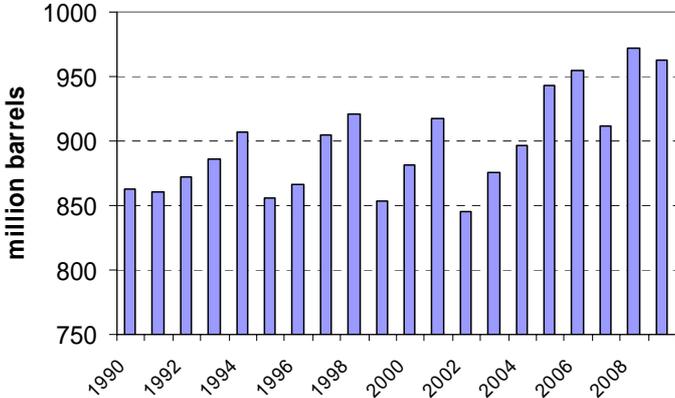
Stocks have a close relation to prices. Price is where supply curve and demand curve meet, while changes in stocks equal supply quantity minus demand quantity. Therefore, markets are very responsive to stock level movements. Markets react immediately to stock data releases from the IEA (for OECD countries), API (for the US) or DOE / EIA (for the US). Oil stocks are held in the form of both crude and products. Oil stocks are held by industry as commercial running stock and by the IEA governments as strategic stocks. Militaries have oil stocks, and most of them are stored in the form of petroleum products. In many cases military stocks are counted as demand when they are bought in the market. The OECD / IEA reports on industry and government stocks in OECD countries (see Figure 15).

There is no systematic reporting system for non OECD countries today. There are independent storage facilities held by producers in non OECD countries. Stock movements involving these facilities are thought to be a part of ‘missing barrels’ which are not caught in the OECD / IEA oil statistics. In addition, because of the increasing significance of non OECD countries like China, India and the Caribbean countries, there have been calls to establish a global reporting system.

Industry stocks held by refineries, port facilities and terminal operators are defined as primary stock holding, which is counted as stocks. However, secondary stock holding held in distributors’ storage facilities and tertiary stocks held by consumers are not counted as stocks. When oil (normally in the form of products) moves from primary storage to secondary- and tertiary-level storage, it is regarded as consumed, thus falling into the demand category.

To improve transparency of the market, covering not only stocks but also all the other activities in the oil sector, six international organisations (APEC, Eurostat, IEA, OLADE, OPEC and UNSD) are working to establish a worldwide statistics reporting system, called the ‘Joint Oil Data Initiative’ (JODI).

**Figure 15: OECD Industry Crude Stocks (1990-2009)**



Source: IEA

## 7 CONCLUSIONS

The market mechanism took over the central role in oil pricing from OPEC's system of official selling prices in the mid-1980s. Since then, it has evolved itself, with the progress in finance theories and information technologies, to highly sophisticated commodity derivatives market. The commodity derivatives markets now cover SO<sub>2</sub> and CO<sub>2</sub> emissions as well as weather, in addition to traditional commodities – energy, metals, agricultural products and others. Among them oil is the largest commodity by trading volume.

However, the financial crisis / economic downturns in 2008 have brought the oil market to a new paradigm. The oil market is now fully integrated into the wider financial market, which is being criticised as fraught with excessive risk taking and no regulatory oversight. At the time of writing efforts are continuing to re-regulating the financial sector.

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## **ABBREVIATIONS AND ACRONYMS (ADDITIONAL)**

ESPO East Siberia-Pacific Ocean [crude / oil pipeline] (Russia)

FSA Financial Services Authority (UK)