CHAPTER 8

INTERNATIONAL OIL AND GAS MARKET

I. Supply and Demand

The world crude oil demand and supply have always presented an interesting imbalance, especially after the middle of the century. Industrialized countries have usually lacked the necessary resources to supply their own oil needs, while emerging countries with abundant resources and production capacity have not needed all they could produce for their own economies. This imbalance created a mutually beneficial situation where industrialized countries imported oil from resource-rich emerging countries which, in turn, developed their economies with revenues from oil exports. Although the oil supply shocks of the 1970s pushed industrialized countries to substitute alternative fuels for oil, and to increase conservation and efficiency efforts, oil remained a major fuel for these economies. Efforts to build oil stocks as insurance against possible future shocks as well as the slow nature of implementing the policies mentioned above kept demand for oil strong and created the financial environment for development of resources outside of the Organization of Petroleum Exporting Countries (OPEC). Lower prices during the 1980s and increasing demand from growing economies worldwide enhanced the market for oil.

Table 8.1 presents the data on the consumption and production balance in the world crude oil market for 1986 and 1996. It is clear that the imbalance between producing and consuming regions remains. Although production from non-OPEC sources in Europe, Asia Pacific and South and Central America increased, production from Former Soviet Union (FSU) republics declined significantly from 12.4 million barrels a day in 1986 to 7.2 million barrels a day in 1996. As a result, total non-OPEC output remained fairly stable. On the other hand, world demand has increased by more than 9 million barrels a day between 1986 and 1996. The Asia Pacific region's demand for oil increased by almost 8 million barrels a day, and Organization for Economic Cooperation and Development (OECD) demand increased by more than 5 million barrels a day. A decline of almost 4.5 million barrels a day in FSU demand also occurred. The discrepancy between world demand and non-OPEC output was met by OPEC, whose production increased from 19.5 million barrels a day in 1986 to 28.2 million barrels a day in 1996.

Table 8.1 World Crude Oil Consumption and Production (thousand barrels a day)

	1986		1996	
	Consumption	Production	Consumption	Production
North America	18,435	14,795	20,740	14,040
South & Central America	3,315	3,985	4,335	6,140
Europe	14,400	4,485	15,580	6,925
FSU	8,400	12,435	3,935	7,160
Middle East	3,020	13,305	3,960	20,375
Africa	1,695	5,445	2,320	7,485
Asia Pacific	10,970	6,135	18,675	7,560
Total World	60,235	60,585	69,545	69,685
OECD	36,455	19,505	41,775	21,375
OPEC	--	19,515	--	28,225

Source: BP Statistical Review, 1997.

Table 8.2 presents more detailed data on world oil demand and supply for 1996 (note that numbers may not match with those in Table 8.1 because of differences in data sources). During the

fourth quarter of 1996, for example, total oil demand among OECD members was 42 million barrels a day (about 57 percent of total world demand). During the same period, oil supplies from OECD countries was only 20 million barrels a day which amounts to about 28 percent of total world supply. The U.S., by far the single largest consumer of oil, produces 9.55 million barrels a day, about half of its demand for oil. Japan is almost totally dependent on imports to meet its demand of 6 million barrels a day. Note that the share of OECD in world demand and supply remain fairly constant throughout the year although world demand and supply fluctuate from one quarter to another.

Table 8.2 1996 World Oil Demand and Supply (million barrels a day)

	1996			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
DEMAND				
OECD				
US &Territories	18.50	18.10	18.26	18.82
Canada	1.78	1.69	1.81	1.80
Japan	6.42	5.21	5.36	5.99
France	2.02	1.86	1.93	1.97
Italy	2.15	1.88	1.97	2.06
United Kingdom	1.84	1.81	1.82	1.90
Germany	2.93	2.81	3.03	2.86
Other OECD Europe	5.61	5.33	5.62	5.82
Australia & New Zealand	0.97	0.95	0.92	0.95
Total OECD	**42.22**	**39.64**	**40.72**	**42.17**
NON-OECD				
China	3.51	3.56	3.60	3.65
FSU	4.75	4.27	4.27	4.65
Other NON-OECD	22.49	22.41	21.73	23.21
Total NON-OECD	**30.75**	**30.24**	**29.60**	**31.51**
TOTAL WORLD DEMAND	**72.97**	**69.88**	**70.32**	**73.68**
SUPPLY				
OECD				
US	9.36	9.43	9.43	9.55
Canada	2.40	2.43	2.49	2.57
North Sea	6.23	6.09	6.10	6.45
Other OECD	1.56	1.61	1.60	1.59
Total OECD	**19.55**	**19.56**	**19.62**	**20.16**
Non OECD				
FSU	7.10	7.08	7.06	7.08
China	3.09	3.14	3.14	3.16
Mexico	3.32	3.38	3.25	3.27
Other non-OECD	10.02	10.13	10.18	10.40
Total non-OECD, non- OPEC	**23.53**	**23.73**	**23.63**	**23.91**
OPEC	**28.10**	**28.05**	**28.30**	**28.65**
TOTAL SUPPLY	**71.18**	**71.34**	**71.55**	**72.72**
Stock Change	**-1.79**	**1.46**	**1.23**	**-0.96**

Source: Oil & Gas Journal, June 23, 1997.

On the supply side, OPEC continues to dominate the market, producing about 28 million barrels a day. The share of OPEC supplies in total world supply of crude oil is about 40 percent. This share used to be around 50-60 percent in the early 1970s. Most of the increase in non-OPEC production has come from non-OECD regions with the exception of the North Sea. Total non-OPEC, non-OECD output

was around 24 million barrels a day in 1996, accounting to about 33 percent of the total world supply. Also note that demand fluctuates throughout the year, especially in OECD countries, but supply remains fairly constant for OECD and non-OPEC, non-OECD producers leaving OPEC to bear the decline in the market. For example, from first quarter to second quarter in 1996, OECD demand declined by 2.58 million barrels a day and total world demand decreased by 3.09 million barrels a day. During the same period, non-OPEC supply actually increased by 210,000 barrels a day while OPEC supply declined by 50,000 barrels a day.

World demand and supply of oil are not equal in any quarters presented in Table 8.2. There are seasonal fluctuations in demand for oil. Demand is highest during the first and fourth quarters which correspond to the winter season in the Northern Hemisphere. The second quarter has the lowest level of demand as there is very little need for heating oil and it is still too early for the summer driving season to start. As we have seen above, supply does not fluctuate as much, especially outside OPEC. As a result, supply falls short in high demand quarters and there is excess supply during low demand quarters. From the last row of Table 8.2, we can see that, in high demand seasons, countries turn to stocks built up during low demand periods.

II. Trade Movements

In this section, we provide three tables which contain 1996 data on exports of crude oil, products and natural gas by region (or country) and inter-area movements of petroleum (crude oil and products). Table 8.3 presents data on crude oil and product exports. Clearly, the Middle East is the largest exporter of crude oil (14.8 million barrels a day) as well as products (2.3 million barrels a day). The Middle East's share of total crude oil exports is about 51 percent. The second largest exporter is West Africa with 2.8 million barrels a day, or about 10 percent of total world exports. FSU exports are underrepresented in the table because there are about 621,000 barrels of exports a day from the FSU to Central and Eastern Europe.

The U.S. and Asia Pacific regions export significant amounts of products although their crude oil exports are relatively small. The U.S., alone, exports about 880,000 barrels of products a day (almost 10 percent of the world total). Even Japan with no crude oil resources, exports 129,000 barrels of products a day. These export patterns are related to the large downstream industries in these countries.

Table 8.3 World Crude Oil and Product Exports (1,000 barrels a day)

	Crude oil	Products
US	98	880
Canada	1118	367
Mexico	1550	106
South &Central America	2061	951
Western Europe	991	755
FSU & Central Europe	1534	1165
Middle East	14856	2314
North Africa	2095	661
West Africa	2860	56
Australasia	184	98
China	419	69
Japan	--	129
Other Asia Pacific	987	1034
Unidentified	258	390
Total world	29012	8975

Source: BP Statistical Review of World Energy, 1997.

Table 8.4 World Gas Exports (billion cubic meters a year)

US	2.2	Norway	38.1
Canada	80.1	UK	1.9
Mexico	0.4	FSU	123.9
Bolivia	2	Oman	0.3
Germany	1.8	Algeria	21.2
Denmark	2.9	Malaysia	1.5
Netherlands	45.7	Total	321.8

Source: BP Statistical Review of World Energy, 1997.

World gas exports in billion cubic meters (bcm) a year are reported in Table 8.4. The FSU, and especially Russia, is the largest exporter of natural gas with 123.9 bcm (almost 39 percent of total exports). Canada is the second largest exporter by 80.1 bcm (25 percent of total exports). Other significant exporters are Netherlands and Norway, with 14 and 12 percent shares of total exports, respectively. These four regions account for 90 percent of total gas exports. All have established markets in Western Europe (for FSU, Netherlands and Norway) and the U.S. (for Canada). The transportation of gas is not as easy as that of crude oil or products. Pipeline transportation is preferred, but it involves geopolitical considerations as pipelines cross borders. The market for natural gas is still growing at more than 3 percent a year. As transportation problems are resolved and demand continues to grow, the composition of major exporters may change. For example, exports from the Middle East have been increasing recently. There is also pipeline activity across borders in Latin America to transport natural gas. There are additional regions, including Central Asia, with the potential of being major gas exporters in the near future. Nevertheless, Russia will likely remain by far the largest exporter of natural gas. After all, Russia has 49,000 bcm of proved natural gas reserves and about 24,000 bcm of potential reserves. The country produces only about 600 bcm a year one third of which are exported.

Table 8.5 Inter-area Movements of Oil in 1996 (1,000 barrels a day)

TO → / FROM ↓	North America	South & Central America	Western Europe	Central Europe	Japan	Other Pacific Asia	Rest of World	**Total**
North America	2939	412	340	--	136	154	35	**4119**
South & Central America	2660	--	239	--	4	95	12	**3010**
Western Europe	1113	45	--	227	2	105	254	**1746**
FSU & Central Europe	28	44	1940	621	10	104	65	**3329**
Middle East	1753	567	3517	300	4221	6219	592	**17169**
Africa	1605	304	3021	82	38	452	167	**5669**
Asia-Pacific	186	44	44	--	1273	1290	23	**2920**
Total	**10395**	**1416**	**9539**	**1230**	**5684**	**8486**	**1180**	**38610**

Source: BP Statistical Review, 1997.

Table 8.5 presents inter-area movements of crude oil and products. Note that total number (38,610,000 barrels a day) is different than the total of crude oil and products exports in Table 8.3. This is because Table 8.3 does not include 621,000 barrels of exports a day from FSU to Central Europe. Also, there are about 650,000 barrels traded but whose exact origin and destination cannot be identified. This value is not represented in Table 8.5 which explains why row and column totals do not equal 38,610,000 barrels as they should.

North America (mostly the U.S.) and Western Europe are the two largest petroleum importing regions. North American imports are about 10.4 million barrels a day (the U.S. imports are 9.4 million barrels), and 9.5 million barrels a day are imported by Western Europe. These two regions account for more than half of world oil trade. Japan and the rest of Asia Pacific accounts for 37 percent of the oil trade (more than 14 million barrels a day). As we discussed above when studying Table 8.3, the Middle East and Africa dominate world oil exports with a combined share of more than 60 percent. Their main customers are, not surprisingly, the U.S., Western Europe, Japan and the rest of Asia Pacific. Although the latter two regions are mostly served by the Middle East, Western Europe countries have balanced their imports more evenly between the Middle East and Africa. For the U.S., Mexico, Canada and Venezuela have replaced the Middle East and Africa as primary sources of oil.

III. Petroleum Markets

A. Functions of Spot and Futures Markets

Markets for crude oil, like those for other commodities, have two functions. First, they provide a medium for discovering the market-clearing (or, equilibrium) price for oil. Second, they render the transfer of stocks from the current period to future periods possible. Accordingly, there are basically two types of trade in oil markets; one based on the immediate delivery handled by "spot" markets, and another based on delivery at some future date carried out through "forward" and "futures" markets. The difference between current and future prices provides a good signal about market conditions. The spot price will tend to be higher than futures (or, forward) prices if inventories are perceived to be too low or are expected to be low in the near future relative to long-term expectations (this is known as "backwardation"). For example, during the Gulf Crisis following the invasion of Kuwait by Iraq, spot prices increased significantly relative to prices for contracts 6 to 12 months into the future. The main factors were expectations of a particularly harsh winter combined with the supply disruption. Alternatively, the futures price may become larger than the spot price if current inventories are considered plenty but a decline is expected in the long-term (this is known as "contango"). For example, during 1986, increased production from Saudi Arabia and other countries lowered prices considerably and raised inventories in consuming countries that took advantage of low prices. As markets did not expect the excess supply situation to continue, futures prices remained higher than spot prices.

B. History of Spot and Futures Markets

Historically, most crude oil used to be traded on the world market under long-term contracts at "official" prices of exporting countries. Although spot markets for oil existed since the 1960s, only after the first oil shock, they started to claim a larger share of the trade. Trading in spot markets accounted for only 3 to 5 percent of the total trade before 1980, but this share reached 50 percent internationally and 20 percent in the U.S. during the first half of the 1980s. The shift toward the spot market was also expedited by the second oil shock accompanying the Iranian Revolution which rendered contract prices unreliable. Contract prices started to be adjusted so frequently that they were practically indistinguishable from spot prices. After the crash in 1986 major oil-exporting countries adopted “formula pricing” which tied contract prices to spot prices, calculating the former as the spot price of a certain benchmark crude oil plus or minus an adjustment factor. For example, Saudi exports to the U.S. were priced based on the U.S. Gulf Coast spot price of Alaskan North Slope (ANS) until 1994, and based on the West Texas

Intermediate (WTI) spot price since then. The spot price for WTI is usually considered to be following its futures price, which we will discuss next.

In March 1983, the New York Mercantile Exchange (NYMEX) introduced trading in a crude oil futures contract with delivery of light sweet crude oil at Cushing, Oklahoma. Although several streams are deliverable (including U.K. Brent, Norwegian Ekofisk, Algerian Saharan, etc.), the futures contract tracks West Texas Intermediate (WTI). During the first year, daily crude oil futures trading rose as high as 10,000 contracts and averaged around 6,000 (one contract involves the purchase or sale of 1,000 barrels). The success of the NYMEX experiment and the ending of official pricing by OPEC initiated the formation of a futures market for U.K. Brent at the International Petroleum Exchange (IPE) in the late 1980s. Unlike the NYMEX contract, the IPE contract does not provide physical delivery, but instead tracks the Brent forward contract and employs cash settlements.

In the 1990s, crude oil futures have been in the top five contracts worldwide in terms of the largest open interest. As of early 1997, light sweet crude oil traded in NYMEX has an average volume of about 100,000 contracts and an average open interest of about 400,000 contracts a day, securing the contract's popularity in the top five. At the same time, trading in Brent crude reached an average of about 50,000 contracts and an average open interest of over 150,000 contracts. The volume of trade in these futures markets amounts to more than half of total oil trade which is estimated at about 300 million barrels a day. The fact that these futures contracts reached such volume and share of the market in a relatively short period of time is significant, especially considering that there are about 100 trading institutions (including spot, futures and informal markets). Moreover, many experts consider NYMEX and IPE oil futures prices as global benchmarks. The electronic trading at NYMEX through NYMEX ACCESS^{SM} allows traders around the world to buy or sell even when the exchange is closed. Accordingly, crudes heavily traded in Asia (“heavy” within the region, not relative to overall trade), such as Dubai Fateh or Malaysian Tapis, are priced by adding fairly fixed spreads to closing prices of WTI and Brent contracts.

C. Characteristics of Spot, Forward and Futures Markets

Spot Markets. Transactions in spot markets involve the delivery of oil within two to four weeks of closing the deal. Two to four weeks may seem like a long time for an exchange considered to be "current," but moving large volumes of oil over long distances may take that long. Contracts in larger spot markets are uniform in quality, quantity and terms in order to make transactions simpler and less costly. Transactions may occur any time of the day between parties located anywhere in the world.

Forward Markets. Unlike spot markets, forward markets administer transactions of contracts with future deliveries. No cash is required at the time of transaction, and contracts are mostly settled by cash payments before the expiration of the contract without physical delivery. The transaction between a buyer and a seller is direct without an intermediary body. Forward markets are used as a hedging device. For example, in order to avoid potential increases in the cost of oil, a refiner may prefer purchasing its future feedstocks at current prices.

Futures Markets. Similar to forward markets, futures contracts involve delivery at some time in the future and therefore serve as another hedging device. Unlike forward markets, payments are made at the time of transaction. Also, the inclusion of a clearinghouse (operated by the futures exchange) between a buyer and a seller makes changing positions ("short" versus "long") easier for traders. A trader in a short position can change his/her position by buying futures. Alternatively, a long position can be altered by selling futures. These transactions do not require the consent of the buyer and the seller of the original contracts since transactions are carried out through the clearinghouse. Because of the ease of changing positions, futures markets have become primary modes of hedging. Every day, producers

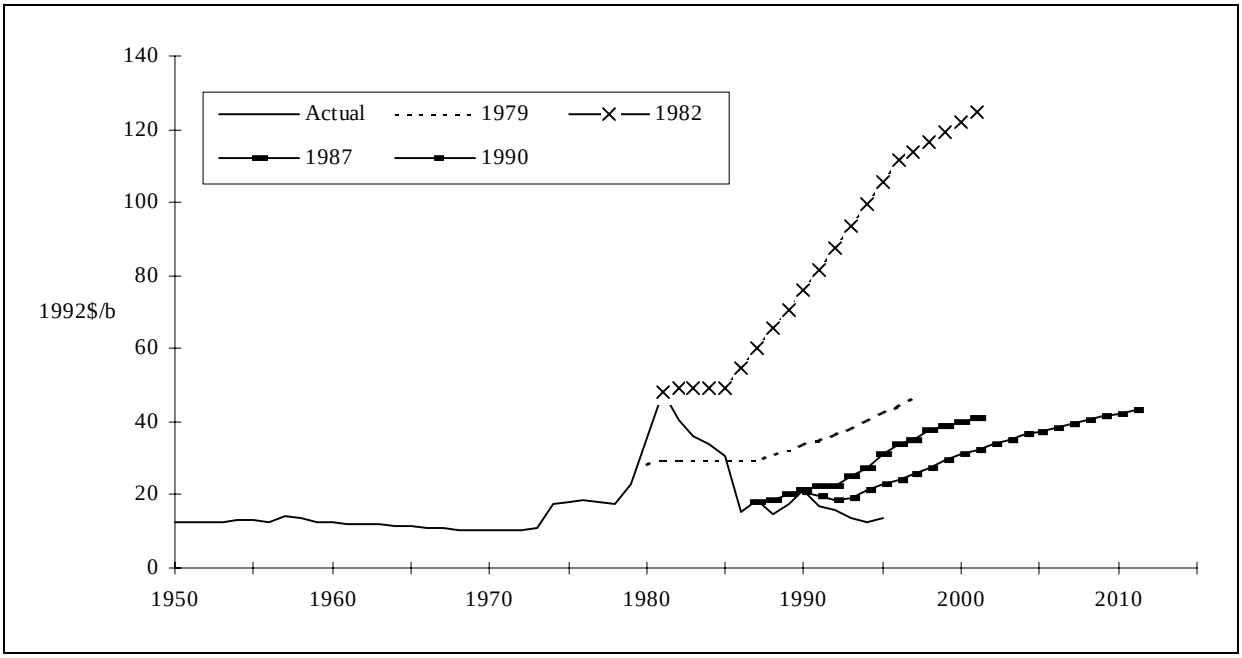
sell futures to protect themselves against future declines in the price of oil, and consumers buy futures to protect themselves against price increases in the future.

IV. Forecasting Long-Term Crude Oil Prices

Since the first oil shock, forecasting the price of oil has proved to be quite challenging. Researchers from academia, industry and organizations such as the U.S. Department of Energy (DOE) and the International Energy Agency (IEA) have undertaken regular forecasting analyses. Historically, however, forecasts have failed significantly in accuracy. Chart 8.1 presents four price forecasts from different periods performed by the DOE. For comparison purposes, the actual price is also presented.

Forecasts indicate that prices are expected to increase at a significant rate after the second oil shock (1982 forecast), but also after the crash of oil prices in 1986 (1987 forecast). The exhaustible resource theory we covered in Chapter 1 implies that such an increase in the price of exhaustible resources will occur as their cumulative production rises. However, we also discussed the flawed assumptions of the model leading to this conclusion of rising prices. For example, the model does not allow for reserve additions. Indeed, additions to the resource base have been very significant since the 1970s and remain a crucial factor affecting the accuracy of predictions about future supply of oil. Forecasters also failed to incorporate into their models technology development which enhanced production from existing fields. Nor were the effects of conservation and efficiency programs, and the increasing role of alternative fuels assessed properly. In retrospect, one can also claim that in the 1970s and 1980s forecasters overemphasized or misinterpreted the power of OPEC. All of these factors led to underestimation of the world oil supply. When combined with usually overestimated demand, it is no wonder we ended up with increasing price forecasts.

Chart 8.1 Historical Price of Crude Oil and Price Forecasts



Source: Michael C. Lynch. "The Failure of Long-Term Oil Market Forecasting." in Advances in the Economics of Energy and Resources, Volume 8, 1994.

The failure of forecasts in the past does not imply that forecasting cannot be useful. The future price of oil has significant bearing on evaluating oil projects. Decision makers would very much like to

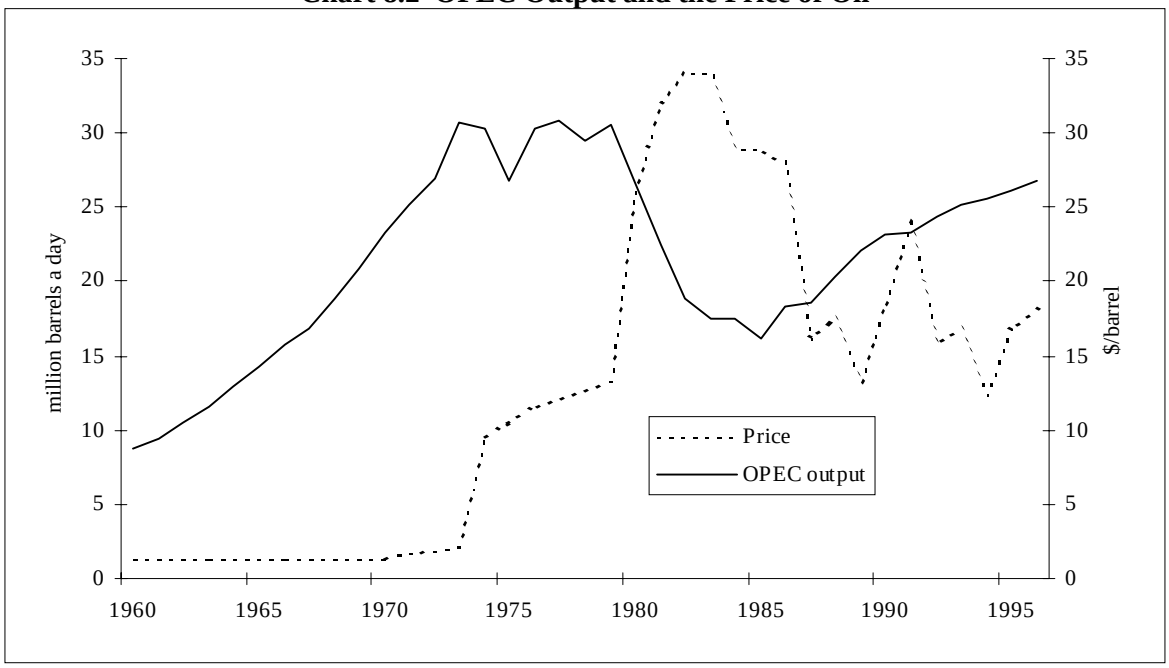
know future price trends with as much accuracy as possible. Forecasting can be very helpful in that area if it is carried out with meticulous attention to every relevant variable.

V. The Role of International Organizations

A. Organization of Petroleum Exporting Countries

The Organization of Petroleum Exporting Countries (OPEC) was formed by Venezuela, Saudi Arabia, Kuwait, Iran and Iraq in 1960. At that time, these five countries owned about 67 percent of the world's proved oil reserves, and produced 36 percent of the world's oil. As the significant shares of these countries in oil production and reserves of the world indicate, their intention was to influence the price of crude oil and eventually increase their oil revenues. The rest of the members joined the organization during the 1960s and the early 1970s (Qatar, 1961; Libya and Indonesia, 1962; Abu Dhabi, 1967; Algeria, 1969; Nigeria, 1971; Ecuador 1973; Dubai and Sharjah, 1974; and Gabon, 1975). By 1973, the organization accounted for 70 percent of the world oil reserves, and its share in production increased to 56 percent. The failure of the organization to maintain a successful quota system and lower oil prices brought about by the crash in the mid-1980s led to frustration among some members. As a result, Ecuador left the organization in December 1992 and Gabon withdrew as of January 1995.

Chart 8.2 OPEC Output and the Price of Oil



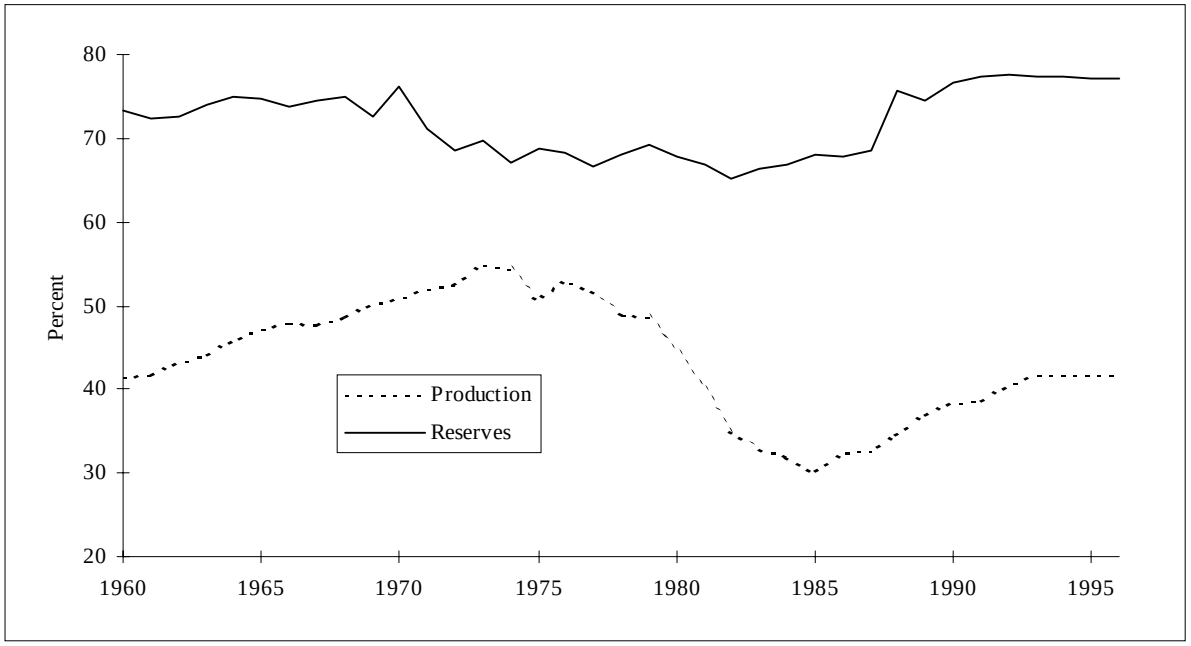
Source: Oil & Gas Journal.

The unexpected four-fold increase in crude oil prices in December 1973, following the October war in the Middle East, has been widely attributed to the activities of OPEC operating as a cartel. Prices are accepted to be substantially higher than if they had been solely determined by market conditions and OPEC is accused of curbing production in order to raise prices. Chart 8.2 indicates that significant increases in oil prices are usually matched with a considerable decline in OPEC production. This is most apparent for the second shock of the 1979-82 period where rising prices coincide with falling production by OPEC. Alternatively, the decreasing prices of the 1980s, especially the crash in 1986, coincide with significant increases in OPEC output. In early 1986, Saudi Arabia increased its output by more than 3 million barrels a day.

Over the years, especially after 1973-74, OPEC production declined while their reserves increased. In 1973, OPEC countries were responsible for 56 percent of total world production while they owned almost 70 percent of total world reserves. By 1992, the percentage of world reserves owned by the members of OPEC increased to 78 percent, while the production share of the organization settled around 40 percent after a historical low of 30 percent during the mid-1980s (Chart 8.3). The 11 current members of the organization produce approximately 40 percent of the world's oil and own more than 77 percent of the world's proved oil reserves. Obviously, the absence of Ecuador and Gabon did not affect the position of the organization in the world crude oil market. The increase in OPEC's share of world oil reserves and the decline in its production share are consistent with the behavior of a cartel trying to keep the world price of oil high by curbing its production in response to increasing non-cartel output.

OPEC did not show the characteristics of a textbook cartel until the early 1980s. The organization did not have an explicit policy of production or profit sharing, or policing devices to detect and punish overproducing members. The Arab-Israeli war and the accompanying oil embargo to the western world by Arab exporters in 1973-74, the revolution in Iran and the beginning of the war between Iran and Iraq at the end of the 1970s were events mostly outside the control of OPEC. Nevertheless, these developments caused the price of oil to increase significantly and allowed the organization's members to reap substantial benefits.

Chart 8.3 OPEC's Share in World Oil Production and Reserves

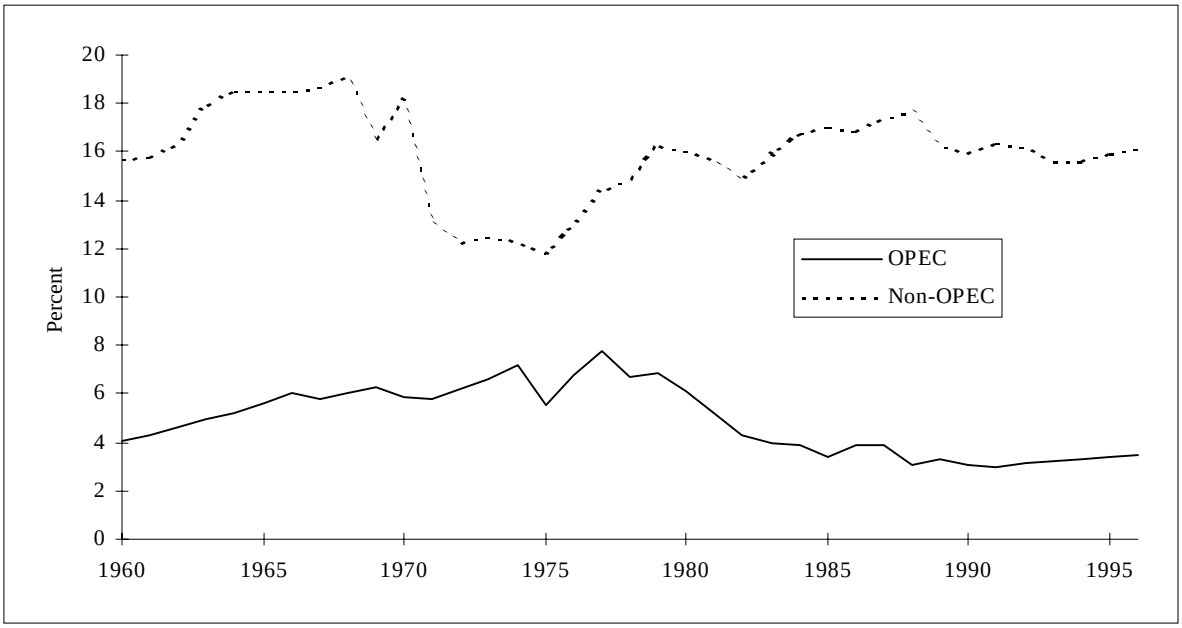


Source: Oil & Gas Journal.

Also, the transfer of property rights from multinational oil companies to host governments that took place mostly in the 1973-74 period provided another vital change in the market. Perhaps most important of all, the rapid industrialization of the world in the 1960s increased the demand for crude oil. Alternative energy sources were considered scarce and costly. All these circumstances provided an opportunity for large producers to charge much higher prices for crude oil than their cost of extracting it. In short, OPEC did not really have to act as a cartel in those years; the economic and political conditions provided the organization with a chance to enjoy monopoly profits. This was only natural for a group of producers that owned 70 percent of world's total oil reserves and that had excess capacity (OPEC depletes 1 - 2 percent of its reserves annually as compared to 4 - 7 percent by the rest of the world - see Chart 8.4).

OPEC members also account for about 40 percent of the world's gas reserves. Members in the Persian Gulf alone are estimated to own more than 1,400 trillion cubic feet of gas (28 percent of the world's gas). Despite significant reserves, OPEC's share in world gas production is only around 10 to 11 percent. That is mostly production from Indonesia, Algeria and Venezuela. The gas production-to-reserves ratio in the Middle East is below one percent. However, this is quickly changing as significant resources are being allocated to development of natural gas fields by Qatar, Saudi Arabia and others in the region. The production of natural gas is projected to increase by about 6 percent a year during the next ten years. This rate can increase if Iran and Iraq can overcome international restrictions and finance their projects.

Chart 8.4 Production to Reserve Ratio



Source: Oil & Gas Journal.

B. International Energy Agency

The International Energy Agency (IEA) is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA was established in November 1974, in response to the first oil shock, to implement an energy program that would provide energy security for its members. In those days, governments were most concerned about receiving uninterrupted oil supplies. One of the immediate actions taken was to create oil inventories in order to avoid the economy-wide impact of another oil shock.

IEA has 23 members (as compared to 27 members of the OECD). Its basic goals are:

- cooperation among IEA participating countries to reduce excessive dependence on oil through energy conservation, development of alternative energy sources and energy research and development;
- an information system on the international oil market as well as consultation with oil companies;
- cooperation with oil producing and other oil consuming countries with a view to developing a stable international energy trade as well as the rational management and use of world energy resources in the interest of all countries;

- a plan to prepare participating countries against the risk of a major disruption in oil supplies and to share available oil in the event of an emergency.

Although these activities remain fundamental for the IEA, the Agency extended its operations and focus to emerging markets, especially in Asia. These countries are expected to account for more than half of world energy demand early in the next century. The increased consumption of fossil fuels and reliance on nuclear power in order to avoid dependence on imported oil are already causing environmental concerns. Also, the emergence of Central Asia and, to a certain extent, Latin America as potentially significant suppliers of oil and gas have changed the structure of the world energy markets.

Recently, IEA started to assist non-member countries in developing energy strategies and adopting energy policies that will contribute to their economic development and enhance global energy security. Liberalization of the marketplace is considered a priority by the Agency which suggests building transparent and open markets and increasing competition through privatization and less government intervention. This will attract foreign investment and technology to help develop the economies of these countries. Finally, the Agency advises these countries that improving energy efficiency can help ease import dependence as well as environmental concerns.

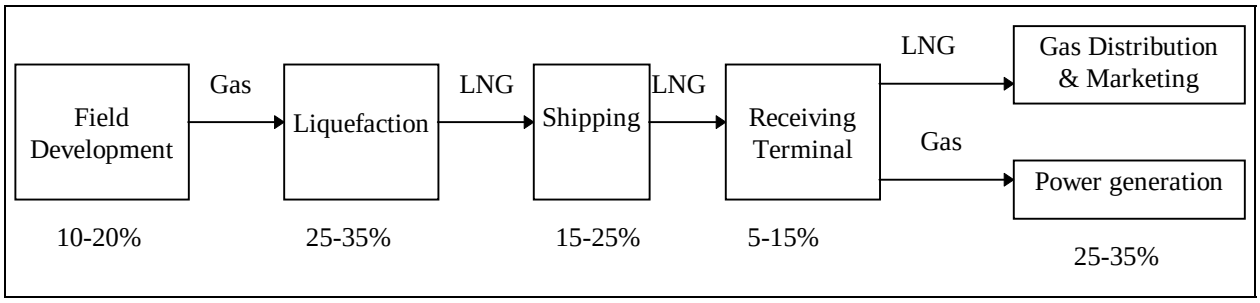
VI. International Gas Markets

The world has more than 5,000 tcf (140,000 bcm) of proved reserves as of 1996, and another 5,400 tcf (151,200 bcm) are considered as probable (or potential) reserves. On the other hand, 1996 production of gas was only 82.6 tcf (2.31 bcm). However, the abundance of resources and clean-burning qualities of natural gas is raising the demand for natural gas. Already, natural gas meets about 20 percent of world energy demand. Improving technology of gas-fired power plants and environmental concerns render gas the preferred fuel of the future.

Currently, about 80 percent of gas is consumed in the area of production and the rest is traded internationally. As discussed in Chapter 6, pipelines provide the major form of gas transportation, about to 75 percent of traded volume. The rest moves as liquefied natural gas (LNG). Natural gas becomes LNG when it is cooled to -258^{o} F (-160^{o} C). This process reduces the volume of the gas and makes transportation in insulated tankers possible. The tankers deliver LNG to special receiving terminals where it is "regasified" in order to be ready for consumption. Despite the fact that "liquefaction" and "regasification" are expensive, the demand for LNG is expected to grow at about 7 percent a year in the next decade. This growth rate is quite significant when compared to 2-3 percent growth expected for oil and gas. Nevertheless, the market share of LNG will remain very low at about 2 percent.

Algeria was the first commercial exporter of LNG with exports to British Gas and Gaz de France in the mid-1960s. However, LNG established itself after the oil shocks of the 1970s in countries such as France and Japan that were trying to diversify their sources of energy. The Middle Eastern LNG supplies to the Pacific region, mainly to Japan, started in the 1970s from Abu Dhabi. More recently, Qatar has become a major exporter of LNG. In addition to established consumers such as Japan and South Korea, China, Taiwan, Thailand, India, Turkey, Poland and Croatia are looking for LNG supplies.

Chart 8.5 LNG Value Chain



Source: Oil & Gas Journal, June 2, 1997.

The early introduction of LNG in the 1960s helped the development of gas infrastructure and technologies using gas, such as combined cycle power plants. Liquefaction technology also improved over the years lowering the cost. Today, a typical LNG project capable of producing 6 million tons of LNG a year may cost between $5 to $10 billion. The cost includes field development, production and treatment, liquefaction, shipping, the regasification terminal and a power plant. Chart 8.5 presents the value chain for LNG. More than 45 percent and possibly up to 75 percent of the costs associated with an LNG project are incurred during the liquefaction, shipping and regasification stages that are necessary to get the gas from producing areas to markets. Usually, buyers have contributed to construction of receiving terminals. As the value chain demonstrates, LNG projects consist of several stages that are closely integrated. For this reason, LNG markets and therefore its pricing function differently than other fossil fuels such as crude oil and its products. LNG projects have historically been characterized by long-term agreements between buyers and suppliers. LNG is purchased mostly under long-term contracts (sometimes as long as 25 years). Only 5 percent of LNG trade is carried out under short-term contracts. At the same time, the complex and unique nature of LNG projects and their significant cost necessitate a longer preparation period for getting all parties together and securing financial resources.

The price of LNG is proportional to that of crude oil plus an adjustment factor calculated based on the rate of inflation. The destination of the LNG cargo also has an impact on the determination of the price. For example, Algerian exports to Europe and Japan are priced based on crude and/or product prices in respective regions. Prices can also be tied to the price of alternative fuels, such as coal in the case of power plants. This way, power plant managers will be able to see that using LNG is comparable to using coal in generating electricity. Eventually, as the market for LNG increases in volume and more buyers and sellers interact, spot and futures markets may be developed.