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World Oil Demand and its Effect on Oil Prices

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Summary

The price of oil began rising in October 2003 and reached record levels in 2004 and again in 2005. As a result of these price increases, consumers' budgets have been under pressure, business costs have risen, and oil producers' profits have increased. The 109th Congress is considering broad energy legislation (H.R. 6), that addresses conditions in the oil and petroleum products markets.

A long term explanatory factor for increasing oil prices could be the decline of the world reserve base. The reserves to production ratio is the measure which indicates the world's ability to maintain current production, based on proved reserves. Over the past decade there has been little change in the reserve to production ratio, suggesting that, at least for now, long term forces are not driving up the price of oil.

A wide variety of cyclic and short term factors have converged in such a way that the growth of demand has been unexpectedly high causing upward pressure on oil prices. Those factors which have been identified as contributing to the high price of oil include the resumption of relatively rapid growth rates of gross domestic product in many countries around the world, a declining value of the U.S. dollar, gasoline prices, the changing structure of the oil industry, OPEC policies, and the persistently low levels of U.S. crude oil and gasoline inventories.

Expectations concerning future market conditions are quickly embodied in oil prices formed in futures markets like the New York Mercantile Exchange. The fear of terrorism and war, uncertainty concerning the relationship between the Russian government and the oil company Yukos, and other political factors are quickly reflected in price along with real political unrest like that experienced by oil producing Venezuela and Nigeria. Speculative buying and selling might also affect prices as financial traders adjust their investment portfolios to reflect expected market conditions.

Demand patterns for world oil and oil products show significant diversity by country, region, and product groupings. As a result of this diversity it is not possible to attach blame for the current level of price to any one nation, region, or product segment. The view that the oil market is international in scope and tightly interrelated is enhanced by the demand data.

As a result of the integrated nature of the world oil market it is unlikely that any one nation acting on its own can implement policies that isolate its market from broader price behavior. As new major oil importers, notably China, and potentially India, expand their demand, the oil market likely will have to expand production capacity. This promises to increase the world's dependence on the Persian Gulf members of the Organization of Petroleum Exporting Countries, especially Saudi Arabia, and maintain upward pressure on price.

This report will be updated.

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The world oil market was characterized by strong demand growth that began in 2003 and continued through 2004 and into 2005. As a result of this growth, and the resulting high prices, consumers' budgets were under pressure, the profits of energy producers were up, and consuming nations again had to face the economic and political costs of dependence on imported oil.

Appropriate policy responses to world oil market conditions may well depend on whether the factors that pushed the market to its current level are likely to be temporary or permanent. The lessons of past volatility in the oil market suggest that even transitory forces and market adjustments can yield not only changing prices, but changing patterns of consumption and production as well. Past performance also suggests that the expectation, or actuality, of a period of high prices or reduced availability of supply, can change economic incentives, as both consumers and producers adjust to the new perceived conditions.

This report analyzes the factors that have driven both demand and supply in the world oil market in the period 2003 through 2005. The report provides and analyzes basic information to inform debate on broad energy legislation (H.R. 6).

Background

While the primary focus of this report is on conditions in the U. S. market, analyses should be carried out in the context of the larger world market. Few actions by consuming, or producing nations, can be properly evaluated independently of the world market. Oil is a fungible, international commodity whose ownership and ultimate destination is determined by market forces once it leaves the producing country. No country can effectively isolate itself from changes elsewhere in the market, nor is it likely that any nation can take actions that do not indirectly affect other nations.

Oil prices are linked, like those of other commodities, to the levels of economic activity in the industrial nations. Demand, both from consumers and industrial users, tends to pick up when growth rates of gross domestic product increase and slow down when those growth rates decline. As a result, oil prices tend to be volatile, at least partly due to variations in the business cycle.

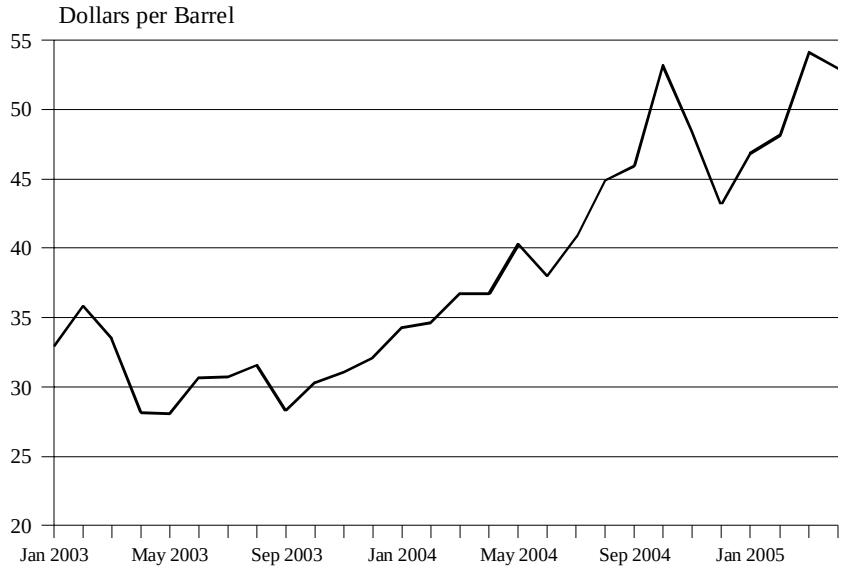
While oil markets may behave like other commodity markets much of the time, the oil market does have unique features. First, few commodity markets have an institution like the Organization of Petroleum Exporting Countries (OPEC). Since its creation in 1960, OPEC has had a variable influence on the price of oil through

its member nation quota system. Second, oil has been subject to supply disruption due to political instability as well as technical factors. Third, psychological or expectations effects, tied to real or perceived probabilities of market disruption, may lead to price volatility. Finally, world oil transactions are settled in U.S. dollars, which affects the value of the dollar in world currency markets, as well as the magnitude of international reserves held by petroleum importing and exporting nations around the world.

Oil Prices

Spot market price data for West Texas Intermediate (WTI) at Cushing, Oklahoma, is shown in **Figure 1**.[1] During the time period covered in **Figure 1**, the OPEC price band for crude oil was at $22 to $28 per barrel. Accounting for quality and location differences between the OPEC reference crude (Saudi Arabian Light) and WTI, prices in the U.S. spot market during 2003 remained close to, or were above, the upper end of the OPEC price band. However, prices moderated for several months after the beginning of the Iraq War in March 2003.

Figure 1. U.S. Spot Price of Oil, 2003-2005



Source: U.S. Energy Information Administration. *Weekly Petroleum Status Report, For Week Ending May 20, 2005*. Table 14. p. 27.

Price increases began in the late fall of 2003, and continued into 2004, reaching a yearly peak of over $53 per barrel in October 2004. Although prices fell by $10 per barrel by December 2004, they began to rise again in January 2005, and peaked again

[1] Spot market prices are for current delivery of physical oil, in this case, WTI, at Cushing, Oklahoma.

at nearly $53 per barrel in April 2005.[2] Some insight into future spot market prices might be gained by examining NYMEX futures market prices.[3] For example, in the five days before it terminated trading on July 20, 2004, the August 2004 contract on WTI at Cushing, Oklahoma was trading at over $40 per barrel. As of July 23, 2004 the September and October WTI futures contracts continued to trade at over $41 per barrel on the NYMEX.[4] On August 10, 2004 the NYMEX futures price for crude oil traded above $45, a first in the history of the exchange. On the same day, the spot market price for WTI was at $44.48.[5] These data accurately suggested that high crude oil prices were likely to continue for the remainder of 2004. By the end of May 2005, futures prices for the August 2005 contract were trading at nearly $50 per barrel and the September 2005 contract was trading at $50.41 per barrel. These prices suggest that, while the crude oil price might remain volatile, reacting to current market conditions, it is unlikely that prices will return to pre-2003 price increase levels for the remainder of 2005.

Figure 2 shows the behavior of spot market prices for reformulated regular gasoline at New York Harbor. The price of gasoline has shown a pattern of movement somewhat similar to that of oil prices.

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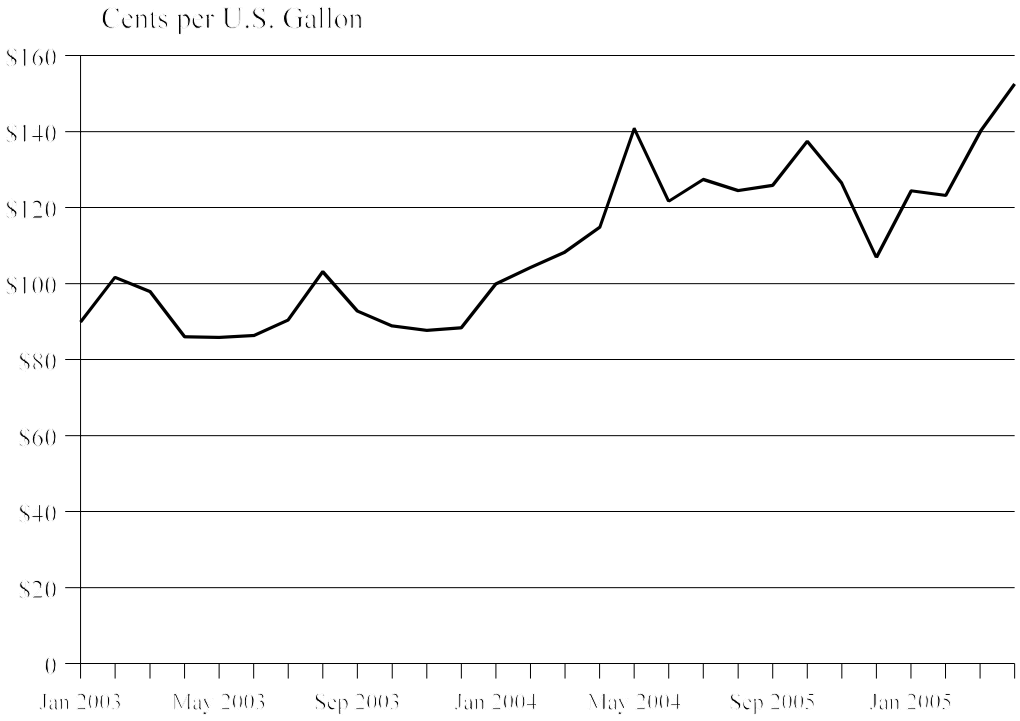
[2] Oil Daily, *Oil Nears $45/bbl on Iraqi Supply Concerns*, Vol.54, No.152, August 10, 2004, p.1.

[3] The NYMEX trades futures contracts on crude oil. Futures contracts obligate buyers and sellers to purchase or deliver crude oil one or more months in the future. However, delivery of crude oil rarely occurs in conjunction with futures contracts. The difference between the contracted future price and the actual cash price when the futures contract comes due, or expires is usually settled in cash. During the trading life of the futures contract, its value either increases or decreases on a daily basis depending on the current, spot value of crude oil. Futures contracts are thought to aid in price formation in that they process current information, and embody it in future price of oil. Trading in futures contracts terminates at the close of the 3rd business day, prior to the 25th calendar day, of the month preceding the delivery month of the contract. For example, the August 2004 contract terminated trading on July 20, 2004.

[4] Energy Information Administration, *Weekly Petroleum Status Report*, for the week ending July 30, 2004, Table 16, p.30.

[5] Oil Daily, *Oil Futures Take a Breather After Breaching $45/bbl Mark*, Vol.54, No.153, August 11, 2004,. p.3.

Figure 2. U.S. Spot Market Price for Reformulated Regular Gasoline, New York Harbor, 2003-2005



Source: U.S. Energy Information Administration. *Weekly Petroleum Status Report, For Week Ending May 20, 2005*. Table 16. p. 30.

Gasoline prices peaked in February and August of 2003. They then lagged oil prices, not showing price increases in the fall of 2003. However, they did follow oil price increases throughout the spring of 2004, also peaking in May of 2004. Gasoline prices were volatile for the remainder of 2004. After the May peak, the price remained approximately 12 cents per gallon lower for the next four months. Although the price went above $1.37 per gallon in October 2004, it finished the year at $1.07, about 24% off the May peak. Gasoline spot prices increased in 2005. By April 2005, the price peaked at over $1.52 per gallon. On June 3, 2005 the NYMEX future prices for gasoline in July, August, and September were above $1.50 per gallon.[6] As in the oil market, these futures prices suggest that there is likely to be only modest, if any, moderation in gasoline prices for the rest of the year.

Conclusions concerning projected spot prices based on the trading value of current futures contracts may or may not be accurate. Futures prices process new information and market conditions quickly and prices can change direction on a daily basis. The futures price on the NYMEX and other markets is conditional on information available today. As more information becomes available, futures prices will adjust. However, futures markets are providing little indication that either oil or gasoline prices might decline in the near term.

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[6] Energy Information Administration, *Weekly Petroleum Status Report for the Week Ending May 27, 2005*, Table 16, p.30.

Reserves and Production

The long term ability of the oil market to meet demand depends on the magnitude of available reserves. An important category of reserves are proved reserves. Proved reserves are those quantities that geological and engineering analysis suggest can be recovered with high probability under existing technological and economic conditions. Proved reserves can be augmented through exploration and development of new discoveries, through technological improvements, as well as through the existence of more favorable economic conditions. In the past, all of these factors have contributed to augmenting the proved reserve base.

Whether the proved reserve base grows over time or not depends in part on the level of production. As production proceeds, the level of proved reserves declines. As new oil discoveries are made, recovery technologies improve, or as the price of oil rises, the stock of proved reserves increases. A standard measure of the potential availability of oil over time is the reserve to production ratio (R/P). The R/P can be interpreted as the number of years that the existing reserve base can sustain the current level of production. Since both proved reserves and production can change year-to-year, the value of the R/P is more descriptive as a measure of potential market viability when considered over time. **Table 1** shows the R/P over the past 20 years for the world as well as various regions.

Table 1 shows that on the world level there appears to be little cause for concern that oil is physically running out. While the R/P is lower in 2003 than in 1993 it is actually higher than it was in 1983.[7] A reasonable estimate, given the political changes since 1983 might be that the ratio has remained roughly constant over the past 2 decades, leading to the inference that 2003 levels of consumption seem to be about as sustainable as 1983 and 1993 levels of consumption were at those times, even though 2003 world consumption levels were 17% greater than those of 1993.

[7] As noted in the table the numbers for 1983 are not strictly comparable to those from later years because of the lack of clear data for the USSR. The 1983 data might be interpreted as reserves available to the market economies, as Soviet production and reserves did not enter the world oil market as a normal matter of commerce in 1983.

Table 1. Oil Reserve/Production Ratios, Selected Years

	1983	1993	2003
World	31.6	42.5	41.0
U.S.	7.0	7.7	11.3
North America	14.6	17.9	12.2
South and Central America	25.5	42.9	41.5
Europe and Eurasia*	Incomplete	16.2	17.1
Middle East	76.4	92.3	88.1
Africa	32.9	23.8	33.2
Asia Pacific	21.4	18.6	16.6

Source: For 2003 and 1993, *BP Statistical Review of World Energy, June 2004.* pp. 4, 6; and for 1983, U.S. Energy Information Administration. *International Energy Annual 1983*. Tables 14, 30. pp. 30, 84.

* Europe and Eurasian data incomplete because of lack of USSR data for 1983.

The reserve portion of the ratio shows that the world had access to more reserves in 2003 than in 1993 or 1983. Reserves in 2003 totaled 1.147 trillion barrels. Reserves in 1993 were 1.023 trillion barrels, and in 1983 were 723 billion barrels. These data represent over a 12% increase in reserves for the decade since 1993, and a 36% increase compared to 1983. Similarly, world production is greater in 2003, at 76.7 million barrels per day (b/d), than in 1993 when production was 66 million b/d, or 1983 when production was 57.9 million b/d. This represents an increase in production of over 32% compared to 1983.[8]

On a regional level, the most important change between 1993 and 2003 is the weakening reserve position of North America, and the reserve position of the United States. On one level, the data suggest that the U.S. position is improving. The U.S. R/P has increased from 7.7 years in 1993 to 11.3 years in 2003 and total U.S. reserves have also increased to 30.7 billion barrels from 30.2 billion barrels in 1993. However, the U.S. R/P has increased because U.S. production has declined, from 8.6 million b/d in 1993 to 7.4 million b/d 2003. As U.S. total consumption has increased over the period, the result has been that U.S. imports of oil have increased along with our dependence on other nations and the world oil market. The declining reserve position of North America in general means that, absent new major discoveries, the United States will continue to depend on the world market, and the OPEC, Persian Gulf nations for a large part of its supply.[9]

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[8] *BP Statistical Review of World Energy 2004*, June 2004, pp.4-6.

[9] In 2003, the United States imported over 9.6 million b/d of crude oil. OPEC provided the United States over 4.5 million b/d of crude oil, or about 47% of total imports. Saudi Arabia provided about 1.7 million b/d of total U.S. imports, or about 18%. Source: Energy Information Administration, *Petroleum Supply Monthly*, July 2004, Table S3, pp.8-15.

The Middle East, and especially Saudi Arabia, continue to be the largest holders of reserves in the world. Some of the other regional changes in the data reflect changing national and political borders as well as oil positions. European reserves are now dominated by members of the former Soviet bloc, including Azerbaijan, Kazakhstan, Romania, and others. Overall, the data suggest the continuation of an integrated world oil market. Any region, or nation, might well experience difficulty in trying to implement a singular oil policy, independent of the world market.

Another conclusion that might be drawn from the R/P data is that it provides little support for the escalated prices of the first quarter of 2004. Since little has changed in the long term balance between reserves and production, it is unlikely that the R/P has been the source of upward price pressures. Long term oil prices might be affected by reserve and production positions in the future, but R/P ratios do not appear to be a major cause of recent oil price increases.

The world R/P has stayed roughly constant over the past 2 decades because investments have been made in exploration, development, and production. The International Energy Agency estimates that over $3 trillion, or $103 billion per year will need to be invested in the oil sector through 2030 if its projections for increased demand materialize. It estimates that 70% of this total will be spent on exploration and development, with the remainder in refining, transportation and the development of non-conventional oil sources.[10]

Oil industry investment is only partly required to meet new demand. Only 16% of total investment is projected to meet new demand growth. The remaining 84% is required to compensate for declining production from the reserve base. The reason so much investment is needed to compensate for declining fields lies in the decline rates observed in producing fields. Decline rates depend on a wide variety of factors, including geology, extraction technology, field age, and production policies. Decline rates range from 4% to over 11% per year. If production levels are to be maintained, new reserves and production must continually be developed to compensate, financed by investment in exploration and development.[11]

Price and Markets

After averaging about $23 per barrel for the five year period 1998 to 2002, the average price of oil increased to $31 in 2003. For 2004, price remained high, reaching a peak of $53.28 per barrel in October.[12] As of April 2005, the price of oil continued to remain over $50 per barrel, and peaked at $54 per barrel in March

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[10] International Energy Agency, Paris, *World Energy Investment Outlook: 2003 Insights*, 2003, pp.101-115.

[11] Ibid. pp.107-112.

[12] Energy Information Administration, *Weekly Petroleum Status Report*, May 20, 2005, Table 14, p.27.

2004.[13] R/P analysis showed that there has been little change in the underlying long term balance in the oil market that might be used to justify high prices. However, a number of short term economic fundamentals as well as the coincidence of a set of singular events affecting the market may have interacted in such a way that prices were pushed up.

Economic Growth

Economic growth in oil consuming nations increases the demand for oil and pushes up oil prices. The world economy continued its recovery in 2003 and 2004 with gross domestic product (GDP) growth rates increasing in many regions. The strongest growth performances were in oil importing United States and China, but better performance was also observed in Japan and Russia, as well as the emerging growth nations of Asia. U.S. growth was 3.1% in 2003, and forecast to reach 4.6% during 2004. Chinese economic growth was 7.4% in 2003 and projected to be 6.8% in 2004, moderating only slightly for 2005.[14] In the United States, economic growth has been linked to high levels of oil consumption, of which increasing gasoline demand is an important component. In China, expanding exports have increased the industrial demand for oil, and rising consumer income has increased consumers' demand for gasoline. U.S. oil demand increased by 1.9% in 2003 to over 20 million b/d. Chinese oil demand increased by 11.5% in 2003 to almost 6 million b/d.[15]

In both the United States and China the increase in GDP growth, and economic activity in general, has led to increases in energy demand. However, a feedback relationship exists which can mitigate this effect. To the extent that oil prices rise, reflecting increased oil demand, GDP growth rates might decline for two reasons.[16] If the monetary authorities interpret increasing oil costs as generalized price inflation, they may adopt restrictive monetary policies which could slow the economy's growth. Also, if oil product prices rise, and consumers are unable or unwilling to reduce oil product consumption, consumers may reduce expenditures on other goods and services, again potentially slowing the rate of GDP growth.[17]

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[13] Prices are for West Texas Intermediate crude oil located at Cushing Oklahoma. Analysts frequently monitor two prices in the oil market, the spot price, and the futures price as traded on the New York Mercantile Exchange. Both provide useful information. The spot price is a good measure of current tightness in the physical product market. The near month and succeeding futures prices measure the markets' expectations for future supply and demand balance. The two price sets are related because at expiration, the near month future price must equal the then current spot market price, to avoid an arbitrage opportunity.

[14] International Monetary Fund, *World Economic Outlook 2004*, April, 2004, Table 1.1, p.3.

[15] *BP Statistical Review of World Energy 2004*, June, 2004, p.9.

[16] Both of these reasons are relevant to current monetary policy decisions. See Washington Post, *Predicting Growth, Fed Lifts Key Rates*, August 11, 2004, p.1.

[17] For further analysis on the effects of oil price shocks on the macroeconomy, see (nam e redacted), *The Effects of Oil Shocks on the Economy: A Review of the Empirical Evidence*, CRS Report RL31608, updated June 25, 2004.

While the United States and China increased their demands for crude oil and petroleum products as a result of their GDP growth, Russia, an oil exporter, improved its GDP growth rate as a result of the expansion of the petroleum industry. For Russia, it is likely that expansion of the oil sector *led* the growth in Russian GDP. This behavior is typical of nations whose oil exporting sector is a major component of their GDP. For nations in this category, high oil prices, based on rising oil demand, create an inflow of oil derived revenue, increasing GDP growth. The danger for these nations is that if prices go too high, and stay high, GDP growth in the consuming nations might decline, reducing the demand and price of oil. An additional factor is that high prices lead to increases in exploration and development budgets around the world. As new oil is found and brought to market, supply increases and prices might be reduced, damaging the oil exporting nation's growth or high oil prices can make alternative fuels more competitive potentially reducing the demand for oil.

Exchange Rates

Changes in the exchange rate of the U.S. dollar can affect the level and distribution of world oil demand. The U.S. dollar achieved a recent peak value in February of 2002. Since that time, the index measuring the value of the dollar has declined by over 20%.[18] The decline in the dollar's value has not been uniform against all currencies. Most of the change has been against nations in the Euro area. The Japanese and some of our other Asian trading partners have intervened in the currency markets in an attempt to prevent the dollar from declining in value relative to their currencies. China maintains a fixed exchange rate against the dollar; as a result, the yuan has experienced no appreciation against the dollar.

Exchange rate variations in the U.S. dollar can affect the world price of oil because oil is priced in dollars and generally paid for in dollars. Several results may follow from this relationship. First, if the value of the dollar declines against other currencies the dollars received by oil exporting nations are worth less in terms of world purchasing power. If oil exporters are able to exert market power in setting prices, or if market conditions permit oil exporters to dictate higher prices, they have incentives to increase the money price of oil in an attempt to preserve the purchasing power they earn through selling a barrel of oil.

The effect of a declining dollar on oil importing consumer nations varies with respect to how their currency has adjusted to the changing value of the dollar. For the United States, of course, any increase in the dollar price of oil is immediately felt as an increased price burden, possibly leading to decreases in demand. For the Euro area consumers, the situation is different. Since the value of the euro has increased in terms of dollars, the effect of any increase in dollar denominated oil prices is offset by the amount of euro appreciation. For example, if the euro appreciates by the same percent that the price of oil in dollars increases the two effects cancel each other. The

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[18] Federal Reserve Board of Governors, *Price Adjusted Major Currencies Dollar Index,* available at [http://federalreserve.gov/releases/] viewed on August 10, 2004.

result is that the demand for oil in the euro area is less likely to be affected by high oil prices as long as the euro appreciates.[19]

Nations that intervene in world currency markets to prevent the dollar from falling relative to their currencies, for example, Japan, Korea and Taiwan, are implicitly choosing to forego the associated real reduction in oil prices an appreciating currency would bring, to preserve the export advantage for their goods that a lower exchange rate brings. Since these nations are both large oil importers as well as major exporters on world markets, the choice can have important implications for their economies. China, which maintains a fixed exchange rate against the U.S. dollar, also foregoes any exchange rate based benefit with respect to oil purchases in favor of supporting export industries.

Gasoline Prices

Crude oil is the major physical input in the production of gasoline and accounts for over 40% of its cost.[20] As a result, changes in the cost of crude oil will be reflected in gasoline prices. Recently, it might be that the relationship has been reversed: the high price of gasoline may have become a factor in keeping the price of oil at elevated levels, especially on the New York Mercantile Exchange (NYMEX).

Gasoline prices have achieved record levels since they began increasing in the first quarter of 2004. Although the rising price of crude oil is one factor, other factors exist which are independent of the oil market in general. The high utilization rates of refinery capacity in the United States, the lack of investments in new refining capacity, the extra costs associated with producing the variety of different gasoline mixes to satisfy environmental requirements in various regions of the country, low inventories as the summer driving season 2004 approached, and the high cost of refinery investment to meet both product and site environmental requirements all contribute to the record levels of gasoline prices. Additionally, on the NYMEX a condition known as "backwardation" was common during the first half of 2004. In this situation the near-month futures contract, in this case regular grade gasoline delivered to New York harbor, is persistently priced higher than the price level of the same gasoline, scheduled for delivery months further in the future. The effect of this pricing condition is to make the acquisition of inventories in the present month more expensive than acquiring them further in the future. Backwardation provides an incentive to keep current inventories low. The low current inventory position then acts as a factor keeping prices high, because low inventories are taken to be indicative of a tight supply situation in the market.

It is possible that the high price of gasoline, a price that is highly visible in the U.S. market, might contribute to keeping the price of oil high through an expectations

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[19] The results of an appreciating currency are not all positive. Economists believe that an appreciating currency raises the cost of that nation's exports on the world market. This cost increase reduces their sales, and if the reduction in sales is large enough, might reduce the GDP growth in the nation with the appreciating currency.

[20] Energy Information Administration, *A Primer on Gasoline Prices,* 2004, p.2.

based effect. Traders could hypothesize that since the price of gasoline is high, this might be the result of tight oil markets. If not, there would be more oil refined, and gasoline produced, driving down the price. These expectations could be acted upon through the NYMEX futures markets. This position ignores the importance of the independent factors, cited in this report, that suggest that gasoline prices in the United States would likely have risen even if the price of crude oil moderated.

Industry Structure

A recent study by the Government Accountability Office (GAO) asserted that a total of over 2,600 merger transactions took place in the oil industry from 1991 through 2000. These mergers fell into two main classes: asset mergers and corporate mergers. Asset mergers accounted for approximately 80% of the total, and the remaining 20% were corporate mergers. Asset mergers are defined by the GAO as one company purchasing a part, or a specific asset from another company. For example, Tosco Petroleum's acquisition of Unocal's refining and marketing assets on the West Coast in 1997 was an asset merger. Corporate mergers are defined as those in which one company acquires the other company's total assets, resulting in one company. Examples include Exxon-Mobil and Chevron-Texaco, which produced two of the super major oil companies.[21]

A possible outcome of mergers and acquisitions is that the resulting companies, larger and more capable of exerting market power, raise prices to the detriment of consumers. GAO carried out econometric analysis on a set of these mergers and found that mergers and the resulting higher concentration ratios observed in the oil industry resulted in wholesale price increases of about 2 cents per gallon in six of the eight specific cases it examined.[22] The Federal Trade Commission and its staff have challenged the GAO finding on methodological grounds and question the validity of their conclusions.[23]

If the mergers that took place in the U.S. oil industry did raise wholesale gasoline prices, it is possible that retail gasoline prices also increased as a result. If that was so in a period when oil markets were perceived to be tight, those price increases might have fed back through the futures market process described in a previous section of this report to help support high oil prices.

OPEC Policy

OPEC seeks to create favorable oil prices for its members by assigning production quotas to its member nations with the goal of limiting the supply of crude oil available on the world market. The ability of the quota system to control price has been questioned because of the well known propensity for OPEC members to produce beyond their assigned production levels. Even so, the very existence of

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[21] United States General Accounting Office, *Energy Markets Effects of Mergers and Market Concentration in the U.S. Petroleum Industry*, GAO-04-96, May, 2004. p.34.

[22] Ibid. p.6.

[23] Ibid. pp.153-158, 171-193.

OPEC has influenced conditions in the petroleum market as buyers and sellers await decisions taken at OPEC meetings, and monitor the institution's behavior. At certain times in its history OPEC has had relatively clear influence on oil prices, as in 1996, when a flood of Saudi crude oil came on the market and drove down prices
.

In response to recent price increases, OPEC has maintained that a shortage of crude oil on the world market is not the reason. OPEC has asserted that the market is well supplied, and its actual production has exceeded quota levels. OPEC official production for June 2004 was announced as 25.5 million b/d by the OPEC 10, to increase to 26 million b/d on August 1, 2004.[24] Actual OPEC production for June was thought to exceed 29 million b/d.[25]

Although gross volumes are consistent with a market that is not suffering from supply tightness, the effects of product segmentation must be considered. A fundamental breakdown in the crude oil market exists between sweet, or low sulfur content, and sour, high sulfur content, oil. It may be that OPEC volumes of sour crude make the over-all market appear in balance while a tightness in the sweet crude market underlies this over-all balance. Sweet crude oil is useful in efficiently producing the low sulfur transportation fuels, both gasoline and diesel, that environmental regulations increasingly require, and is important to nations with relatively strict air quality standards.

The role of OPEC in the 2004 market price may be more traceable to actions taken in 2002. In 2002, OPEC production declined from an average of over 30 million b/d to approximately 28.5 million b/d, a decline of some 5%. This production cutback changed the nature of the market in 2003, as economic growth began to recover and enhance oil demand growth. Production in 2003 not only had to satisfy the growing demand requirements of 2003, but also to compensate for the reduced availability in 2002 which reduced inventories. The result of these conditions is that as the market evolved in late 2003 and into 2004 with economic growth strengthening, persistent shortfalls in inventory levels were observed.

Inventories

The United States holds petroleum stocks in three ways. The oil industry holds stocks of crude oil in inventory as well as stocks of petroleum products. These stocks are held to insure the efficient operation of refineries in the face of shifting seasonal product demand and potential disruptions in crude oil supply. Seasonal fluctuations in product demand are managed through varying the stocks of petroleum products, mainly gasoline. If inventories of either crude oil or gasoline are low relative to the past average, or in the perception of market traders, this is taken to be an indication that the market is tight, implying that demand is nearly equal to, or might even exceed, potential supply at current price levels. As a result, upward pressure on price occurs, even if there is no physical shortage observable.

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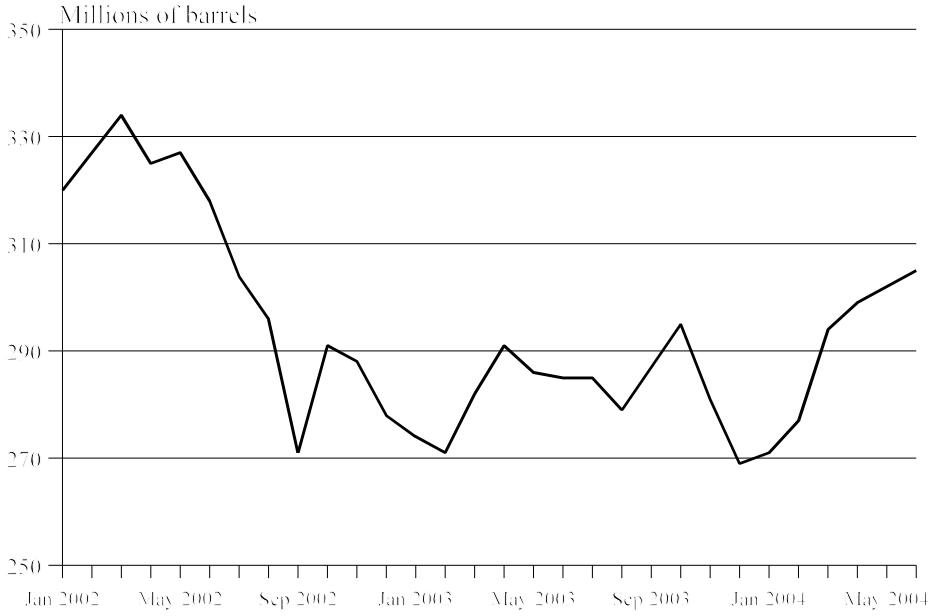
[24] The OPEC 10 nations does not include Iraq which is excluded from quota restrictions.

[25] Oil Daily, *Opec Turns Up the Volume, But Will Markets Respond in Kind?*, Vol. 54, No. 123, June 29, 2004. p.6.

Figure 3 shows the behavior of crude oil stocks in the United States, excluding the Strategic Petroleum Reserve. The level of reserves in 2003 is relatively low compared to 2002. Stocks are increasing in 2004 on a month to month comparative basis with 2003, but satisfying growing demand at the same time that stocks are growing contributes to the strong demand that has been a major factor in oil price increases. It has been reported that U.S. crude oil inventories during the last week of July 2004 reached 298.6 million barrels, which on its own was judged to be consistent with a price of oil of around $26 per barrel.[26]

Figure 3. U.S. Crude Oil Stocks Excluding Strategic Petroleum Reserve



Source: U.S. Energy Information Administration. *Petroleum Supply Monthly, July 2004*, Table S2, p. 7.

Several factors have contributed to the decline in stocks held by the private sector. A long term trend in the refining sector particularly, and the oil industry in general, is cost reduction. Inventory is expensive to hold, and one way to minimize costs is to reduce the size of inventory and expand the use of efficient inventory management techniques. While this strategy benefits the profitability of the companies, it has the side effect of providing less of a buffer in times of surging demand. Second, when the futures market for commodities is in a "normal" price relationship, prices for future delivery tend to be somewhat higher than current prices, making inventory accumulation economically viable. Recently, oil future markets have reversed the more typical price structure, and the future price has been lower than the current price, providing a disincentive to accumulate inventories at current prices. The third factor contributing to low inventories in the private sector is the tight market. Refineries are near full capacity production, and supplies of

[26] Oil Daily, *Analysts Weigh Impact of Fear in Oil Price,* Vol.54, No.151, August 9, 2004, p.1.

light, low sulfur crude oil are perceived to be tight on the world market.[27] Taken together, this is a difficult set of circumstances within which to expand stocks of oil for inventory. However, since inventories remain low in the view of some market traders, they are one more factor contributing to the high price of oil.

The third way the United States holds stocks, in this case crude oil, is in the Strategic Petroleum Reserve (SPR). This government-held reserve was established to provide a buffer against a physical disruption in the delivery of imported crude oil. Recently, there have been calls to either suspend deliveries to the SPR, or to release oil from the SPR to the market with the intent of increasing market supply, reducing speculation, and moderating prices.[28]

Exceptional Events

This section briefly identifies and discusses a set of factors that may exert an influence on oil prices, but seem to be more in the nature of a "one time" event rather than a trend or cyclic factor. The effect of each of these factors tends to be made more important by the general tightness of the market. In some cases, there is an interactive relationship between two or more of these factors, again possibly increasing the over-all effect on price.

The war in Iraq has contributed to high oil prices in different ways as events have progressed. The predominant effect of the conflict on oil prices has been an increase in uncertainty. During the early stages of the conflict, concerns about a possible disruption of oil supply out of the Persian Gulf and disruption of Iraqi production due to military operations were prominent, until it became clear that the military would quickly oust the government of Saddam Hussein. Later, market uncertainty revolved around the ability of Iraq to export oil in the midst of political transition in which pipeline and other oil facilities were attacked by hostile groups within the country. Uncertainty with respect to terrorist attacks, both in Iraq, and spilling over to other Gulf nations, including Saudi Arabia, continue to unsettle the oil market and contribute to a "fear factor" being built into the price of oil.

Recent terrorist attacks in Saudi Arabia, directed at the oil industry and its personnel, are more than a psychological influence on the market. Recent reports have asserted that as of July 2004, world spare production capacity was between one and two million b/d, almost all in Saudi Arabia.[29] This level of spare capacity is close to the minimum amount required to cover a supply disruption from one exporting nation. A major disruption in Saudi oil production would cause that cushion to disappear and would likely cause upward volatility in world oil markets.

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[27] Energy Information Administration, *Weekly Petroleum Status Report*, for the week ending August 6, 2004, Table 2, p.2.

[28] Use of the SPR to moderate gasoline prices is discussed in (name redacted) and (name redacted), *The Strategic Petroleum Reserve: Possible Effects on Gasoline Prices of Selected Fill Policies*, CRS Report RL32358, April 19, 2004.

[29] Oil Daily, *Robust Demand Propels Crude Oil Past $41 Despite Solid Supply*, Vol. 54, No. 136, July 19, 2004, p.3.

The concern the market has shown regarding supply disruption has been borne out by events. Political unrest and strikes have disrupted oil exports from both Nigeria and Venezuela. Indonesian oil production has been declining, leaving it unable to meet its OPEC quota. The legal conflict between Yukos, the major Russian oil company and the Russian government over back tax obligations threatens to bankrupt the company, or force the sale of producing assets. Markets are concerned that bankruptcy, or significant asset sales, might lead to an oil supply cutoff, or reduction, of exports from Russia, the world's largest non-OPEC producer.[30]

Another factor that some feel might be influencing the price of oil is the influence of financial investors and financial instruments. At the time of the first oil shock in 1973/1974, the primary market for oil price formation was the Rotterdam spot market, where physical cargoes of oil for near term delivery were bought and sold, generally by traders who had a real commodity interest in the market.[31] Today, the primary market in price formation may be the NYMEX, supplemented by the International Petroleum Exchange (IPE). In these markets, the focus is not on physical supply for current delivery, but on the open interest in a financial contract, generally a future or options contract, that will expire in the near month, generally the month after the current month. The goal of financial traders is to make a profit on the contract, which may necessitate the price of the contract rising or falling depending on the trader's position in the market and current prices. The implication of this is that financial traders may have an interest in the price moving either up or down, almost without regard to the underlying fundamentals of the market.

The rationale for this view is that financial traders have entered the NYMEX oil market in large numbers seeking profits that stock and bond markets have not produced since the boom years of the late 1990s. Profits can be earned on futures and options markets when prices of the underlying commodities go steadily up, or down, stay the same, or even when they exhibit more or less random volatility, depending on the strategic position the trader has created.

Sectoral Demand Patterns

Global oil demand was over 79 million b/d in 2003, an increase of about 1.8% over 2002 levels. Demand for 2004 was over 82 million b/d, an increase of about 3% compared to 2003 levels. Demand projections for 2004 were increased for nine consecutive months by the IEA since its estimate in November 2003. World oil demand is expected to exceed 84 million b/d in 2005.[32] Within this pattern of world growth, differences among regions, as well as individual countries, exist. In addition,

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[30] Oil Daily, *Opec's Output Pledge Fails to Check Price*, Vol. 54. No. 140, July 23, 2004, p.1.

[31] Most oil bought and sold at that time was by long term contract between the major international oil companies and the oil producing nations.

[32] International Energy Association, *Oil Market Report*, June 10, 2005. p.5.

increased demand is not evenly spread across the product mix that is produced at refineries.

Countries and Regions

As shown in **Table 2**, North America was the largest oil consuming region in the world, with the United States accounting for about 83% of the total. However, growth in the region was less than world growth, and the growth in Canada, at 4.5%, was more than double that of the United States at 1.9%. Asia Pacific was the second largest consumer of oil, with China moving ahead of Japan in total consumption, to be the second largest oil consuming country in the world. The Asia Pacific regional growth of 4% was the highest in the world, and China had the highest yearly growth in demand of any of the major consuming countries at 11.5%.

Table 2. World Demand for Oil, 2003
(millions of barrel per day)

	2002	2003	% Change 2003 over 2002
U.S.	19.7	20.0	1.9%
North America	23.6	24.1	2.1%
South/Central America	4.7	4.6	-1.2%
Europe/Eurasia	19.6	19.7	1.0%
Middle East	4.4	4.5	0.8%
Africa	2.5	2.6	2.2%
Asia Pacific	21.7	22.6	4.0%

Source: *BP Statistical Review of World Energy, June 2004.* p. 9.

European/Eurasian oil demand growth was roughly flat, with demand falling in Germany, Italy, and the United Kingdom, by -1.8%,-0.9%, and -1.8%, respectively. Within the region, most of the large gains in demand are in nations with small initial consumption levels led by Azerbaiijan, Belarus, Austria, and Poland. These nations account for 1.2% of world demand. Although lower than average European oil demand growth may be tied to levels of economic activity, they may also be tied to changing consumption patterns and conservation, especially in Western Europe where motor vehicle transportation costs are very high.

Russian oil consumption grew by 23,000 b/d, to 2.5 million b/d in 2003, while production rose by 845,000 b/d, to over 8.5 million b/d, enhancing the nation's role as a major exporter. However, the Russian economy has been in trouble for many years. If economic growth picks up and the economy restructures and stabilizes, consumption might return to levels similar to those in 1993 when 3.8 million b/d were consumed. Russian consumption at that level might reduce the amount of oil available for export, pushing other consuming nations to become increasingly dependent on Middle Eastern supplies.

The Asia Pacific region includes some nations with the highest year-to-year growth rates in the world, while other nations in the region experience declining demand. In 2003, China strengthened its position as the second largest oil consuming nation in the world by increasing its margin over Japan from only 20,000 b/d in 2002, to 431,000 b/d in 2003. Given the disparity of economic growth rates, geographic and population factors, as well as the comparative density of transportation, it seems that the Chinese lead over Japan may widen. At current growth rates, a more relevant question might be when China will overtake the United States as the world's largest consumer. This is most likely not a competition either nation will directly benefit from winning. The United States imported about 63% of the oil it consumed in 2003, and production has fallen every year since 1993. China imported about 45% of the oil it consumed, and production increased by only 1.5% for 2003, less than the 11.5% increase in demand. The growing demands in both the United States and China make it likely that the world oil market will become increasingly dependent on Middle Eastern oil in the coming years and keep exerting upward pressure on price.

Petroleum Product Demand

Product demand analysis reveals that there are regional and country differences in the mix of oil based products consumed. Gasolines, middle distillates, fuel oil, and other products are the main groups.[33] At the world level, gasolines comprise 31.6% of consumption, middle distillates 35.7%, fuel oil 12.2%, and other products 20.5%.[34,35]

The consumption pattern in the United States differs from the world averages. The U.S. demand is 46.2% gasoline, 29.3% middle distillates, 3.8% fuel oil, and 20.7% other products.[36] This mix reflects the U.S. use of oil as a transportation fuel, with car and light truck use responsible for the relatively high gasoline percentage. The U.S. refinery industry is unable to supply adequate gasoline to the domestic market. As a result, imports of finished gasoline and gasoline blendstocks have increased to almost one million barrels per day. U.S. refineries operate at near full capacity, but a lack of new capacity expansion by the industry suggests further increases in imported gasoline, if available on the world market.[37]

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[33] Gasoline includes aviation and motor gasoline as well as other light distillates, middle distillates includes jet fuel, heating kerosene, and other products, fuel oil includes marine bunkers and crude oil used as a fuel, others includes refinery gas, lubricants, wax, solvents, refinery fuels and other products.

[34] Product demand data for the world exclude the nations associated with the former Soviet Union.

[35] *BP Statistical Review of World Energy,* June 2004. p.12.

[36] Ibid.

[37] Imported gasoline must meet U.S. performance standards, which themselves are a multitude of federal, state, regional, and local regulations. If these requirements are different than those a foreign refiner is prepared to meet, product may not be available to the U.S. market. Foreign refiners must undertake refinery investments to adapt processes

(continued...)

Europe has different preferences in transportation fuels than the United States. Middle distillates dominate the European product slate at 44%, with gasoline at 24.4%. These values reflect the on-going shift to diesel engines in European passenger vehicles. As product demand shifts, refiners are following by investing in the technology needed to produce greater proportions of middle distillates and less gasoline. As this transformation proceeds, European refiners may find that they have less surplus gasoline available for export to the United States. This outcome could lead to tightening U.S. gasoline markets, keeping an upward pressure on the price of gasoline, and indirectly supporting high oil prices.

The Asian pattern of product demand, especially China's, includes a larger portion of demand, 13.8% in the case of China, dedicated to fuel oil. This percentage is approximately three times that of the United States. The use of fuel oil in industry accounts for the difference, as well as the lower requirements for gasoline for private automobile use.

Future Projections

The International Energy Agency recently reduced its forecast for global oil demand in 2005. It estimated that world demand would be 84.3 million barrels per day in 2005. This value represents a growth of 1.77 million barrels per day, or 2.2% above 2004 levels.[38]

In a typical manufacturing or service market, demand growth of this magnitude might be welcomed, and met with increased job creation and facility expansion, or more intensive use of existing facilities. Conditions in the oil and oil products industries might not be so accommodating. Excess capacity in the crude oil market is low, with most estimates averaging less than 1.5 million barrels per day. If we add the increased estimate of consumption in 2004 to the projected increase in 2005 it is clear that the crude oil industry is likely to be at full production capacity through 2005.

It has been reported that Aramco (Saudi Arabia) has a plan in place to expand production by 1 million barrels per day within a year. Non-OPEC production is expected to increase by about 1.4 million barrels per day in 2004, but only smaller increases are expected in 2005.[39] High prices, if they persist, can be expected to increase exploration and ultimately production in the longer term if the current market follows past patterns.

The EIA's Annual Energy Outlook, 2004 (AEO) provides a projection of U.S. energy balance out to 2025, and includes scenarios based on different market price

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[37] (...continued)
that allow for the production of U.S. compatible fuels.

[38] Oil Daily, *IEA Again Lifts '04 Demand, Sees Slower '05,* Vol.54, No.133, July 14, 2004, p.1.

[39] Oil Daily, *Oil Production Capacity in Saudi Arabia Needs to Rise Soon,* Vol.54, No.147, August 3, 2004, p.5.

assumptions. Price is taken to be an assumption, rather than a predicted value, because it is assumed to be determined on the world market. For the base case, the AEO assumes a crude oil price of $23.61 per barrel in 2010 and $26.71 per barrel in 2025. For the high price case, AEO assumes a price of $32.80 per barrel in 2010 and $34.90 per barrel in 2025.[40] If the factors that are influencing the current market continue in the future, it may be that even the high price case assumptions are too low.

Conclusions

The world oil market, as a result of the convergence of a number of factors, has experienced significant tightness since the end of 2003, continuing through 2004 and the first half of 2005. Some of the factors influencing the market might be temporary, some may be cyclical, and others may possibly be permanent. While the high prices that resulted from the tight balance between oil demand and supply caused increased energy expenditures for consumers, business, and industry, it also led to higher incomes for energy producers. It is possible that the economy as a whole might experience macroeconomic effects, not only from the high oil prices themselves, but as a result of the monetary and fiscal policy responses that might be taken if the high prices persist and are determined to constitute inflation.

Although it has been under pressure in 2003, 2004, and into 2005, the oil market has shown that the market process is functioning. The factors discussed in this paper that affected oil and gasoline demand as well as the supply response of OPEC and other producers caused prices to rise, but there has been little, or no, evidence of physical shortage or supply disruption.

Effective policies to mitigate high oil prices are difficult to define at the national level. The price of oil is determined on a world market. It is unlikely that any consuming nation can insulate itself from the forces driving the world market. For example, if a nation decided to reduce or eliminate its direct dependence on the Persian Gulf, it might succeed in doing that by buying oil from other nations. However, this would reduce the total amount of non-Persian Gulf oil available to other nations, increasing their dependence on the region and leaving the level of world dependence unchanged. If political events in the Persian Gulf caused the price of oil to rise, that price increase would be transmitted to all oil produced around the world. It is not possible to isolate oneself from the world market, except perhaps by cutting domestic consumption to the level of domestic production.

The market in 2004 was likely affected by a "fear factor" premium on the price of oil, raising its price above that indicated by market fundamentals. Some estimates of the "fear factor" run as high as $15 per barrel, while others rate it at only a few dollars, or nothing at all.[41] The threat of supply disruption due to potential terrorism or political instability appears to be the source of this price factor. An important

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[40] These prices are expressed in 2002 dollars to control for inflation.

[41] Oil Daily, *Analysts Weigh Impact of Fear Factor in Oil Price*, Vol. 54, No. 151, August 9, 2004. p.1.

question is, how long this factor will influence price? In the past, fears of political instability, especially in the Persian Gulf, tended to be quelled in relatively short time-frames. Today, with the war on terrorism perceived as a long term reality, it may be that oil prices will incorporate a "fear factor" for a significant time.

The nature of the exploration and production cycle in the oil industry encourages major swings in the price of oil even in more politically stable times. This cycle makes it difficult for governments to time oil policies effectively. In the past, periods of high oil prices have led to a rapid expansion of exploration, and given improving technology, have led to substantial oil finds in many places in the world. As newly discovered extra oil comes on the market several years later, the increased supply tends to overwhelm demand, causing price to drop. While demand tends to increase incrementally, by a few percent per year, supply tends to increase discrete amounts in response to a period of high prices. This relationship leads to cyclic price volatility. Set against this record is the opinion of some that world oil production is soon to peak as a result of geological factors and the likelihood that the largest oil reserves have already been discovered.[42]

A major continuing factor in the market is the emergence of China as a major importer of crude oil. In addition, the possibility exists that India, and perhaps other Asian nations, might expand their imports of oil as industrial production expands in those nations. Although the 2005 projection of Chinese import growth moderates to approximately 7% from the 2003 level of 11.2%, in the longer term much depends on whether oil use for private automobiles in China expands very quickly or is moderated by the government. However, either of these yearly growth rates imply stress for the world oil market. Based on China's consumption of almost 6 million barrels per day in 2003, it may generate increases of demand of 500 thousand b/d or more in the next few years. In a market with very limited excess capacity, and possibly facing the discovery of fewer giant fields, increases in demand of these magnitudes promise to contribute to an upward pressure on price.

The 2004, and potentially for 2005, oil market reflects the influence of a number of factors all of which have led to upward pressure on price. Although some of these factors might have been judged temporary in the past, there is a danger that in the current political environment they may perpetuate themselves, keeping oil prices well above the OPEC price target.

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[42] C.J. Campbell, *Industry Urged to Watch for Regular Oil Production Peaks, Depletion Signals*, Oil and Gas Journal, July 14, 2003, pp.38-45.