Anatomy of the 10-Year Cycle in Crude Oil Prices

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John Wiley & Sons published *Twilight in the Desert* in 2005. The book's author, Matthew Simmons, contends the world will confront very high and rising oil prices shortly because the capacity of Saudi Arabia, the world's largest oil producer, is insufficient to meet the future needs of oil consumers. In 448 pages, Simmons extensively discusses his views regarding Saudi Arabia's future production levels. He asserts that the Saudis have refused to provide details about their reserves, insinuating at several points that the Kingdom's leaders withhold information to keep the truth from the public.

At its core, Simmons' book is no more than a long exposition of the peak oil theory first espoused by King Hubbert in 1956. Hubbert, it may be recalled, studied the pattern of discovery of super giant oil fields. His review led him to conclude that world productive capacity would peak and then begin to decline. In 1974, Hubbert suggested the global zenith would occur around 1995.

Simmons and other adherents to the "peak oil theory" enjoyed great prominence in the first half of 2008. Again and again, one read or heard that the oil price rise was occurring because the flow from world oil reserves had reached or was approaching the maximum while demand was still growing. Here's what one economist wrote just as prices peaked:

> Until this decade, the capacity to supply oil had been growing just as fast as demand, leaving plenty of room to expand production at the first sign of rising prices. In the last few years, however, supplies have not been keeping pace, thanks to problems ranging from mismanagement (Mexico, Venezuela, and Iran) to violence (Iraq and Nigeria) to depletion of older fields (the United States, Norway, and Indonesia). Today, only Saudi Arabia has capacity to significantly increase production in the short run.[1]

[1] Severin Borenstein, "Cost, Conflict, and Climate: Navigating the Global Oil Market," *Milken Institute Review*, Fourth Quarter 2008, p. 32.

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In November 2008, the IEA warned that hundreds of billions needed to be invested in the world's oil infrastructure to keep prices from surging. While not espousing the Hubbert theory, the agency's economists still cautioned that global oil output would shrink if such infusions were not made.

The phrase "twilight in the desert" cleverly captures the decline projected for global oil output and the anticipated price rise. In Simmons' view and no doubt that of many other peak oil adherents, Saudi Arabia was approaching the end of its role as the world's incremental oil producer just as many other firms and individuals were reaching the twilight of their roles.

The first part of this paper counters the arguments of those who rely on the Huppert/Simmons peak oil theory to explain the 1999-2008 crude oil price rise. I demonstrate here that the oil price increase resulted from badly implemented economic regulation along with Saudi Arabia's subtle but effective management of the world oil market. I assert that crude oil prices would never have passed $60 per barrel had the energy and environmental policies set in 2006 not been so incompetent. Furthermore I suggest that crude oil prices could easily have remained below $40 had the oil market been competitive rather than operated as a "quasi" cartel. In reviewing the events of 2007 and 2008, I also show that, contrary to the arguments of many, speculation played no role in the recent oil price rise.

The second portion of the paper examines the future. Changing economic circumstances will, I suggest, lay a foundation for a prolonged period of relatively low crude prices. I show that oil prices could easily stay in the $30 to $50 per barrel range for years, contrary to opinions put forward by peak oil enthusiasts.

However, oil prices will not remain at low levels in perpetuity. Just as day follows night (or the twilight), night will follow day. Oil prices will rise again. The next major hike will likely accompany the introduction of new regulations limiting sulfur content in fuels used by ships, otherwise known as bunker fuels. Imposition of these rules, combined with other mandates limiting the sulfur content of fuels, could easily squeeze global energy markets again and send prices back to double-digit territory. Indeed, if the lessons of the past are not learned, the world will certainly experience a second cycle of very high oil prices and renewed recession or worse.

This paper shows that the brute force implementation of environmental regulations relating to sulfur content in fuel was the primary cause of oil prices rising to $147 per barrel between 2007 and 2008 and has contributed to the economic troubles that followed. Again, it warns that the cycle could easily be repeated if we ignore what history teaches us.

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1999-2008 in Review

Dick Fuld, a now unemployed investment banker who used to be CEO of Lehman Brothers, noted during the surge in asset prices that credit grows arithmetically and then shrinks geometrically. The same can be said for commodity prices, particularly oil prices. In the 11 years since January 1998, oil prices moved upward almost monotonically from $10 per barrel, peaking above $145 in mid-July 2008. In the following six months, they dropped 80 percent. Prices fluctuated between $20 and $40 month after month during the first five years of this decade. Then beginning in 2005 they started a relentless rise through $50 per barrel, then $60, and on until they peaked in July 2008 at $147.

Many saw the surge to $147 as a permanent adjustment to a much higher price level. Peak oil theorists such as Matthew Simmons said the increase indicated the arrival of a period of tight supplies. The International Energy Agency supported the view through work presented in its *World Energy Outlook*.[2] The agency and others warned that prices would likely surpass $200 or even $300 per barrel within ten years.[3] Many companies, accepting forecasts of permanent structural change, responded to the 2005-2008 price rise by boosting exploration expenditures, often despite horrific hikes in drilling costs.

A close review of past movements of energy prices suggests, though, that writers who see the 2005-2008 events as setting a new permanent threshold for oil prices have committed a sin against George Santayana. The Spanish philosopher, it may be recalled, warned that "those who cannot remember the past are condemned to repeat it." In this case, forecasters—and more significantly many of those in the energy industry—viewed the price rise from 2005 to 2008 as permanent when historical data suggests that energy markets, like all commodity markets, experience periodic price cycles. The lessons of the past missed by those who forecast permanent structural change can be illustrated with three figures.

Figure 1 (page 4) traces the monthly nominal price of WTI and Brent crude from 1985 through the end of 2008. One can observe that the nominal oil price traded within a very narrow range for most of the period. For example, from March 1991 through December 2003, oil averaged $20 per barrel, while the standard deviation in prices was only $5 per barrel. During this period, prices peaked at $36 and the minimum monthly average was $12. (In this calculation and in other calculations, we use the monthly averages for Dated Brent.)

[2] See Matthew Simmons, *Twilight in the Desert: the Coming Saudi Oil Shock and the World Economy* (Hoboken, NJ: John Wiley & Sons, 2005), and the 2008 *IEA World Energy Outlook*.
[3] See Carola Hoyos and Javier Blas, "World Will Struggle to Meet Oil Demand," *Financial Times*, October 28, 2008, and "Investment Key to Meeting Oil Demand," *Financial Times*, October 28, 2008.

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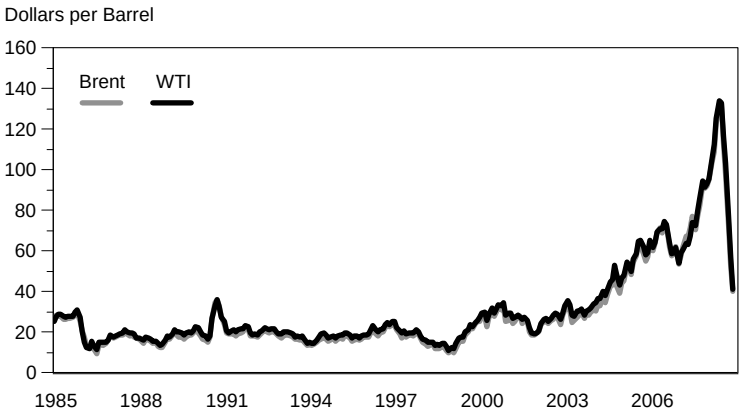
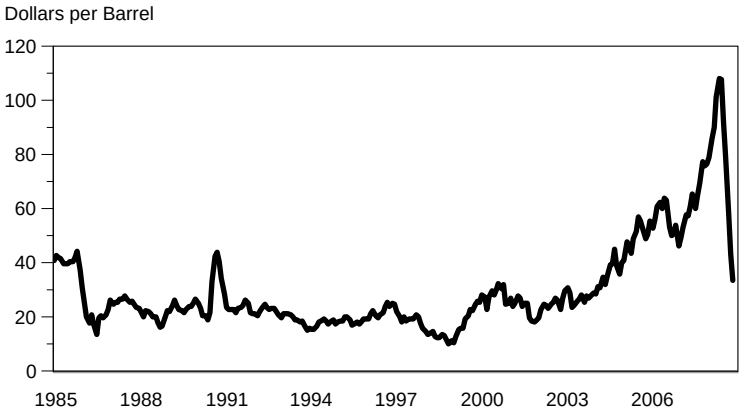
An expert on commodity prices unfamiliar with warnings regarding peak oil would observe the data displayed in Figure 1 and conclude that the price drop from the July 2008 peak to the current level represents nothing more than a reversion to the mean. Such a conclusion is reinforced by Figure 2. Figure 2 displays the Dated Brent price adjusted for inflation by month from January 1985 through December 2008. Here the reversion to the mean becomes even more obvious. Again, the period from March 1991 to the end of December 2003 is one of remarkable stability. The inflation-adjusted price (in 2001 dollars) averaged $21 per barrel during the period, with a standard deviation of $4.60. The peak in inflation-adjusted prices was $44, while the trough was $16. One can observe that the inflation-adjusted price in December 2008 was within two standard deviations of the average. On a statistical basis, then, it appears prices reverted to the mean.

Figure 1
The Arithmetic Rise and Exponential Fall of Crude Oil Prices, 1985-2008



Source: Platts.

Figure 2
Inflation-Adjusted Monthly Price of Dated Brent Crude, 1985-2008



Source: PKVerleger LLC.

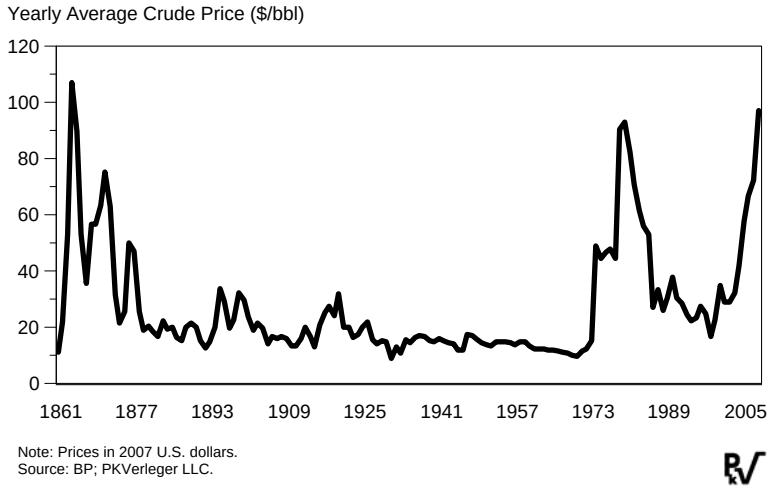
Some reading this analysis will object, though, to the suggestion that prices have reverted to the mean. They will argue instead that oil prices rose between 2005 and 2008 to a new basis and that the recent fall is only temporary. A recent presentation by Matthew Simmons, for exam-

ple, asserts that a new price surge will occur soon.[4] Simmons expects a sharp price "rebound" when the supply drop outstrips the drop in demand.

Simmons and others predicting a future surge in prices to a permanently higher plane may be right. However, their forecasts defy history. As can be seen from Figure 3, inflation-adjusted prices have remained low for long periods. Figure 3 shows the inflation-adjusted price of crude on an annual basis from 1861 through 2008. The data were developed by BP (except for the last observation.) For the historical period, prices averaged $27 per barrel over the 149 observations reported by BP, while the standard deviation is $20 per barrel. Prices would return to within one standard deviation of the historical average if Brent averages $47 per barrel in 2009. Thus far the average has been $44 per barrel.

In sum, the price decline in prices over the last eight months is entirely within the range of past experience. Historically, oil prices have averaged roughly $21 per barrel in 2000 prices or between $26 and $28 in current prices. Adjusted for statistical ranges, the peak of the historical range is in the 30s, not far from current levels.

Figure 3
Inflation-Adjusted Real Crude Oil Prices, 1861-2008



Note: Prices in 2007 U.S. dollars.
Source: BP; PKVerleger LLC.

A review of history also reveals that the very large price spikes, (excursions from the mean) can be explained by constraints within the market. The increase in 1973, for example, has been traced to the decision by Saudi Arabia and other Arab producers to cut production in response to the United States' support of Israel in the 1973 war. The 1979 price increase was caused by the Shah's collapse in Iran and associated sudden changes in marketing arrangements in the oil industry. The rise in prices from 1999 to 2008 and subsequent collapses are explained by a series of similar constraints that, while anticipated, could not be accommodated. Over the next ten years, other constraints will likely be imposed on the market. These too, while anticipated, probably cannot be accommodated. Thus future price shocks can be expected.

[4] Matthew Simmons, "Is Oil's Future Sustainable?," Presentation to the Dallas Council on Foreign Relations, January 14, 2009.

Here we begin by examining the causes of the price rise from 1999 to 2008. We separate the period into two segments: 1999 to 2006 and 2006 to 2008.

Causes of Price Movements from 1999 to 2006

A single explanation cannot be found for the steady rise in oil prices, despite the best efforts of various academics. Rather, the causes are various. The first years of the price increase can be explained by OPEC actions, particularly those of Saudi Arabia. In March 1998, Saudi Arabia and Venezuela convened a joint meeting of OPEC members and the non-OPEC producers Mexico, Norway, and Russia. At the time, the price for WTI, a light sweet crude, hovered around $10 per barrel and Middle East exporters received as little as $7 per barrel for their crude. Saudi Arabia's oil minister proposed that the other producers join the Kingdom in cutting output. Newly elected President Hugo Chavez of Venezuela was a significant backer of the proposal. Saudi Arabia also warned the producers gathered for the meeting that it would increase production and drive prices down further if they did not cooperate.

The Saudi "offer" was accepted and prices rose steadily. For the next five or six years, OPEC focused on global inventories. In 1998, Saudi Arabia argued that the price collapse occurred when inventories rose, forcing markets into contango. In the subsequent six years, the Kingdom led a successful effort to keep markets in backwardation.

Saudi Arabia used market mechanisms to implement its strategy. Then and now, the Kingdom markets its oil to customers by setting prices relative to well-known and accepted benchmarks. It prices oil to be delivered to the United States relative to WTI, a crude oil widely traded on spot and futures markets. It prices oil bound for Europe relative to Brent, another crude traded widely in physical and futures markets. It prices oil for delivery in Asia off Dubai crude, which trades on yet another very liquid spot market.

To explain the Saudis pricing practice further, early each month they announce in advance the discounts buyers will pay for oil delivered in the next month. For example, in December 2008, customers learned that the price of Arab Heavy taken in January 2009 would be $9.50 per barrel below the WTI price for cargos destined for the United States. Then in January, buyers found they would pay $5 less than the WTI price for Arab Heavy lifted in February and $0.50 less per barrel for Arab Heavy delivered in March.

Buyers adjust their purchases based on the discount. They buy more oil when the discount is higher and less when it is lower. The petroleum press noted, for example, that Saudi

Arabia cut sales to the United States in February 2009 by 40 to 70 percent from January 2009.[5] Some observers asserted that less oil was being delivered because Saudi Arabia reduced production. Such interpretations are incorrect. Confronted with price increases for February oil, buyers simply cut their nominations.

Other oil-exporting countries follow Saudi Arabia's lead on pricing. For example, Iran and Kuwait use the Saudi pricing formulas. As a consequence, from 1998 through 2008, Saudi Arabia and OPEC managed global inventories in general and kept prices from collapsing again. During this period, OPEC surplus capacity swung from six to three million barrels per day. Some analysts suggest the 2008 price increases resulted from this loss of surplus capacity. They are wrong. Indeed, surplus capacity was available through all of 2008. However, the surplus available was almost all heavy, high-sulfur crude priced unattractively. As a result, much heavy crude sat idle in ships in June and July 2008 even as WTI prices touched $147 per barrel.

These analysts miss an important change in the nature of the oil market. Historically, crude oil was crude oil. Since the middle of the decade, though, the market has essentially been split. Today there are really two crude oils: sweet crude and sour crude. Sweet crude is as different from sour crude as coal is to natural gas. This split or bifurcation of the oil market was caused by the imposition of regulations requiring the removal of sulfur from most petroleum products. These rules mandate that refiners must remove sulfur from sour crude before they can produce marketable products. The processing of heavy sour crudes is particularly difficult. The refiners' capacity to remove sulfur limits the amount of heavy crude they can use. As noted below, desulfurization capacity is limited. As a result, not all supplies of sour crude can be processed.

Figures 4, 5, and 6 document the continued availability of capacity over the period. The analysis begins by noting that the four OPEC members that are the primary producers of heavy sour crude oil (Saudi Arabia, Kuwait, Iran, and Venezuela) account for approximately 55 percent of OPEC crude production capacity today. Figure 4 (page 8) traces the share of OPEC capacity owned by these countries by month from 1997 to the end of 2008. The data on capacity and OPEC production used to generate this graph were originally published by the Energy Intelligence Group in *Oil Market Intelligence.* In recent years, EIG has published capacity in *Global Stocks and Balances.*

[5] See Sheela Tobben, "U.S. Buyers of Saudi Crudes Cut 40%-70% for February Supplies," *Platts Global Alert*, January 9, 2009, p. 247.

Figure 5 traces the evolution of excess capacity in OPEC. Recall that many attributed the increase in oil prices to the loss of surplus capacity. For example, as noted earlier, Borenstein made the following assertion:

> Until this decade, the capacity to supply oil had been growing just as fast as demand, leaving plenty of room to expand production at the first sign of rising prices. In the last few years, however, supplies have not been keeping pace, thanks to problems ranging from mismanagement (Mexico, Venezuela, and Iran) to violence (Iraq and Nigeria) to depletion of older fields (the United States, Norway, and Indonesia). Today, only Saudi Arabia has capacity to significantly increase production in the short run.[6]

Figure 4
Percent of OPEC Capacity Accounted for by "Heavy Producers" — Saudi Arabia, Iran, Kuwait, Venezuela

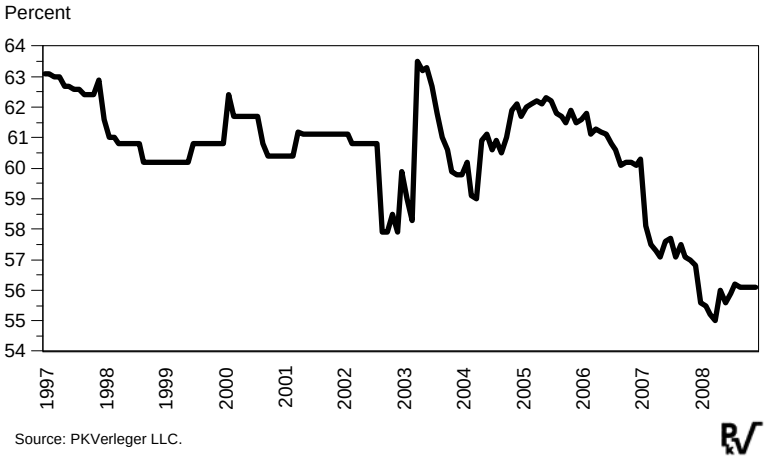
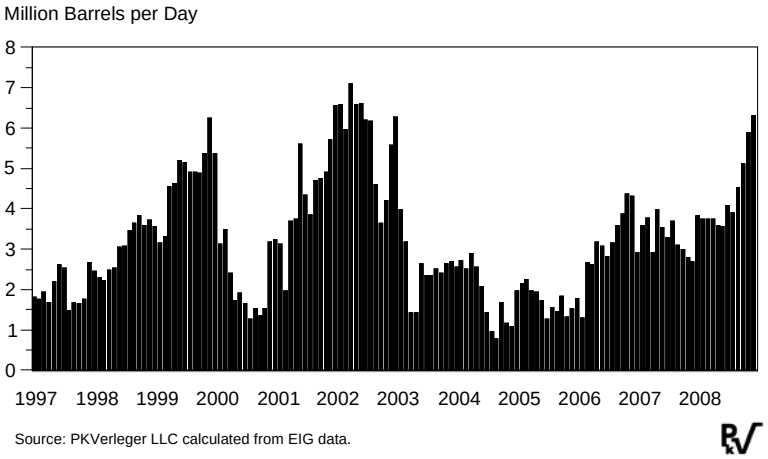


Figure 5
Surplus Productive Crude Oil Capacity Held by OPEC Members (Monthly Data), 1997-2008

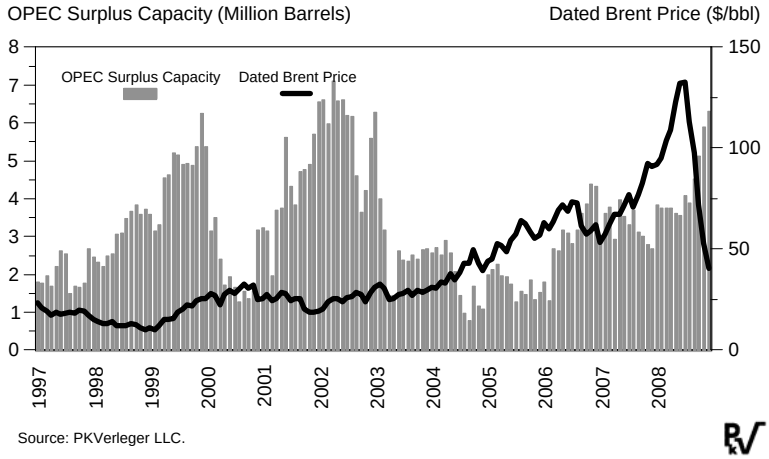


The data shown in Figure 5 present a very different picture. They reveal that at the end of 2007 OPEC had a surplus capacity of 3.8 million barrels per day. By the end of 2008, this sur-

[6] Severin Borenstein, "Cost, Conflict, and Climate: Navigating the Global Oil Market," *Milken Institute Review*, Fourth Quarter 2008, p. 32.

plus had increased to 6.3 million barrels per day. Clearly, the lack of surplus capacity was not the problem.

Figure 6
Movement of OPEC Surplus Productive Capacity vs. Movement of Dated Brent Prices, 1997-2008

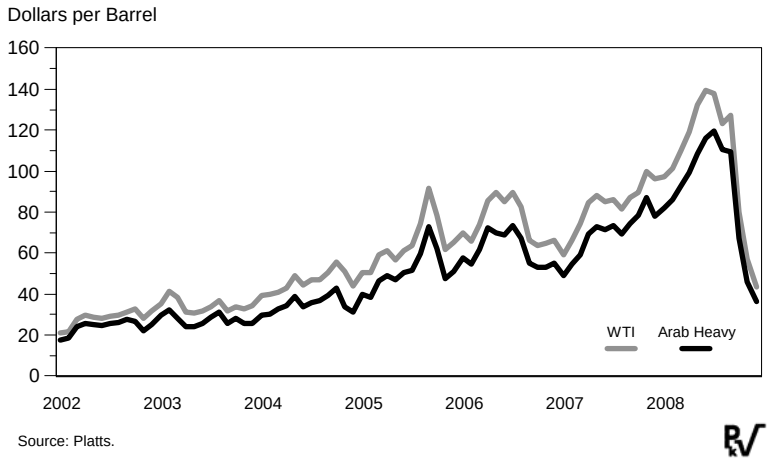


Source: PKVerleger LLC.

We can drive this point home by overlaying the monthly price of Dated Brent shown originally in Figure 1 on the Figure 5 data. Figure 6 shows the result. After reviewing the graph, one must wonder how Professor Borenstein came to his conclusions. Clearly, like many lazy academics, he chose to shoot from the hip, expressing his basic suspicions rather than doing the hard work of examining the data.

The increase in OPEC's surplus capacity would, in a competitive market, have caused crude oil prices to decline. To be precise, the increase in surplus productive capacity would have caused some crude oil prices to decrease. Between 2004 and 2008, the prices of heavy sour crude oil prices should have fallen. However, heavy crude prices did not decline. Instead prices followed light sweet crude prices up and down as can be seen from Figure 7.

Figure 7
Netbacks for WTI and Arab Heavy at a Cracking Refinery on the U.S. Gulf Coast, 2002-2008

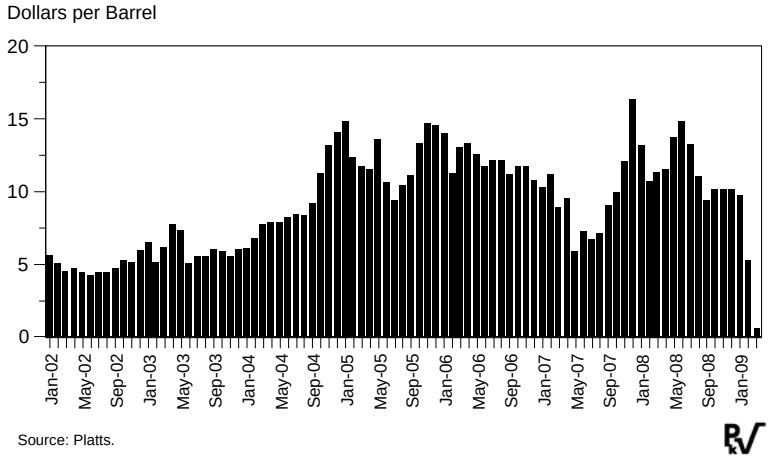


Source: Platts.

The close tracking of heavy and light crude prices is explained by Saudi Arabia's approach to setting prices for heavy crude. As noted above, Saudi Arabia announces a differential for heavy sour crude to light sweet crude, which buyers use to determine the volumes lifted. As can be seen from Figure 8 (page 10), the diffe-

rential has been as large as $16 per barrel and as small as $0.50 per barrel (for oil lifted in March 2009). Saudi Arabia sets differentials for several types of crude. Other countries follow the Saudi lead in setting their own differentials.

Figure 8
Discount to WTI for Arab Heavy Crude Delivered to the U.S. Gulf Coast



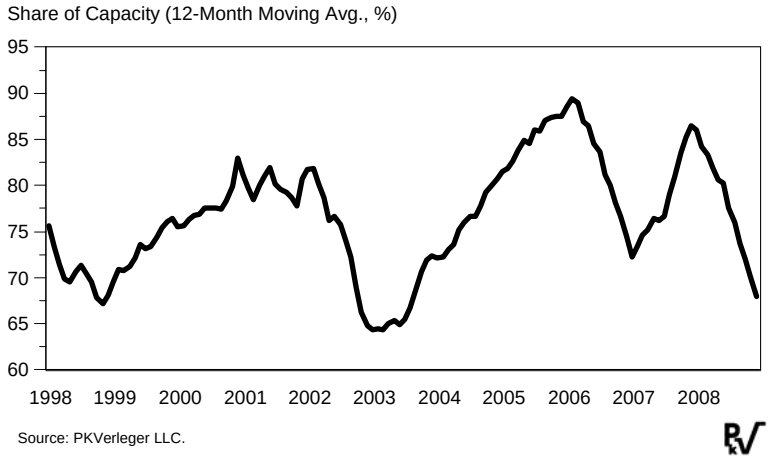
Source: Platts.

The approach taken by Saudi Arabia allows buyers to vary the amounts of heavy sour crude lifted by month. Liftings decrease when differentials are small.

Saudi Arabia's practices cause OPEC's surplus productive capacity to vary rather than the price of heavy crudes. This implies that the producers of heavy sour crude will account for larger shares of OPEC surplus capacity than they do total capacity. Specifically, when prices of sweet crude rise, as they did from August 2007 to July 2008, one would expect to see the surplus capacity accounted for by producers of sour crude to rise as well. The data confirm this conjecture.

Figure 9 shows the percentage of OPEC's surplus capacity accounted for by the four producers of sour crude. This share has fluctuated from a low of 65 percent to a high of 90 percent. (Recall that these producers account for 55 percent of OPEC capacity). The most recent peak in the share of OPEC's surplus capacity accounted for by these producers occurred coincidently with the peak in oil prices.

Figure 9
Share of OPEC Surplus Capacity Accounted for by "Heavy Producers" — Saudi Arabia, Iran, Kuwait, Venezuela



Source: PKVerleger LLC.

One may ask why all the producers of heavy sour crude cooperate with Saudi Arabia and use the same discounts. For example, Iran stored substantial volumes of crude on ships in July 2008 when prices peaked. In theory, Iran could have boosted sales by discounting their production.

The apparent answer to this question lies in a practice developed by DeBeers in that company's successful effort to control the diamond market. Over the years, DeBeers was the buyer to every seller and the seller to every buyer. When demand declined, DeBeers would hold diamonds in inventory. DeBeers enforced its system by threatening to drive prices down if producers attempted to go around the "Central Selling Organization" or CSO. The method worked very well for non-gem grade stones. Producers of such stones attempting to sell outside the CSO would find that prices for the stones they sold had suddenly dropped as much as 50 percent. Tanzania was once severely punished for a year when DeBeers discounted prices for the type of diamond the country sold as much as 70 percent. These enforcement actions encouraged cooperation with the system.

Saudi Arabia has the same power over producers of sour crude, particularly heavy sour crudes. It appears to threaten implicitly to discount sour crudes substantially if producers of these crudes do not cooperate. This threat is powerful even when buyers do not place a large premium on the value of sweet crude. At such times, all oil exporters are still subject to Saudi Arabia's ability to increase production and drive prices down. When sweet crude is in high demand, such as the second half of 2007 and the first half of 2008, producers of sour crude are most threatened. Thus one observes that the four countries producing sour crude (Saudi Arabia, Kuwait, Iran and Venezuela) absorbed most of the surplus during the 2007-2008 period. At other times, the other producers had shared in absorbing the surplus.

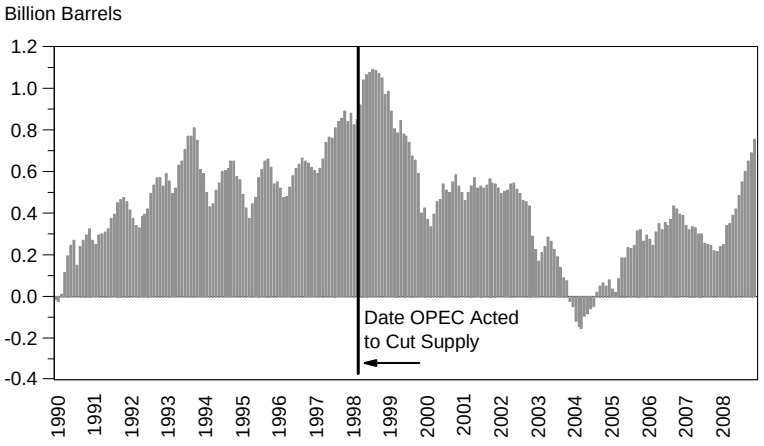
Saudi Arabia used its market power between 1999 and 2006 in an effort to regulate oil prices. During the period, the Kingdom's leaders focused particularly on inventories. Their focus began when OPEC members, particularly the Saudis, realized that a sharp rise in stocks in 1998 had shifted crude markets into contango with a resulting drop in spot crude prices.

Figure 10 (page 12) tracks the accumulation and liquidation of global crude stocks on a monthly basis from January 1990. The calculation is based on data on global oil production and consumption that EIG publishes each month. The difference between output and use translates to inventory accumulations or liquidations.

Through most of the 1990s, oil-exporting countries managed output to meet global demand. As a consequence, global inventories increased only 500 million barrels between the end

of the Gulf War in early 1991 and mid-1996. Stocks then began to accumulate rapidly as the global economic situation deteriorated. Inventories rose a further 300 million barrels over the next two years. Much of the increase occurred during the Asian financial crisis. Contango rose as stocks built. The deterioration became particularly acute in early 1998. The vertical line in Figure 10 marks the stock level at that time.

Figure 10
Accumulation of Global Crude Oil Stocks, 1990-2008

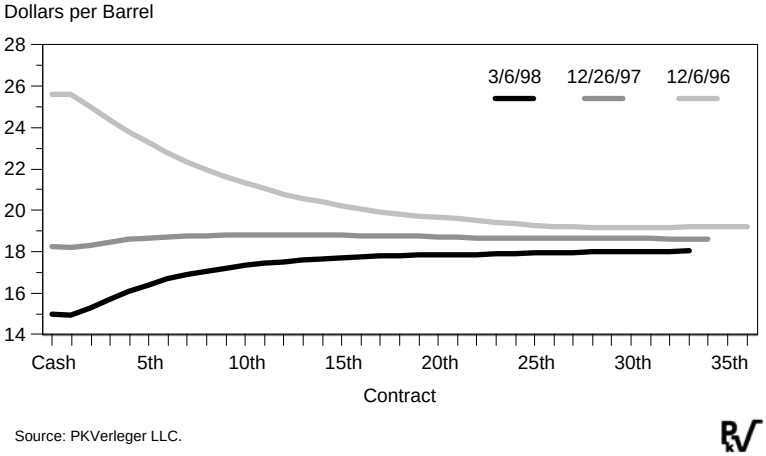


Source: PKVerleger LLC calculated from EIG data on supply and demand.

As inventories declined, the crude market shifted from contango to backwardation. Figure 11 shows the forward curve for WTI at the end of 1996, the end of 1997, and the beginning of March 1998. Note that forward prices were relatively unchanged but prompt prices dropped from $26 per barrel to $15. The shape of the forward curve changed as inventories increased, just as studies of the relationship between inventories and price spreads predict.

Coerced by the threat of increased Saudi production, OPEC members agreed in March 1999 to lower production and bring down stock levels. OPEC surplus capacity surged from 2.3 million barrels per day in March 1999 to over six million barrels in December 1999. Inventories declined as output was cut. Figure 12 (page 13) compares the rise and decline in inventories from January 1998 through December 2000 with the rise

Figure 11
Forward Price Curve for WTI — December 1996, December 1997, and March 1998

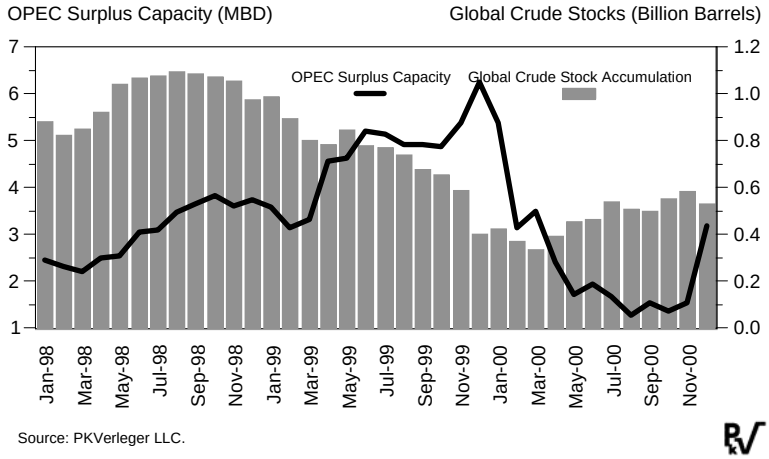


Source: PKVerleger LLC.

Date of this Draft: March 1, 2009

and following decline in OPEC surplus capacity. As can be seen from the graph, OPEC continued to cut production until the end of 2000. Further, stocks declined from the middle of 1999 through the end of 2000.

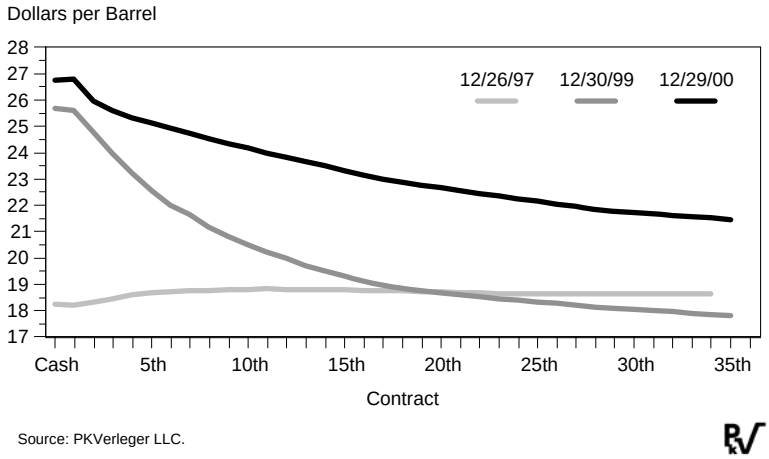
Figure 12
Accumulation of Crude Inventories vs. OPEC Spare Productive Capacity, 1998-2000



Source: PKVerleger LLC.

OPEC's production cuts had precisely the impact sought by Saudi Arabia and the other members: eliminating contango and reestablishing backwardation in the market. Figure 13 shows forward price curves for WTI at the end of 1997, 1999, and 2000. Note that the market shifted from contango to backwardation during 1999 as the output cuts took effect. Cash prices rose by $7.50 per barrel (40 percent), while forward prices were essentially unchanged. Over the next year, forward prices rose $3.65 per barrel, while cash increased another $1 per barrel.

Figure 13
Forward Price Curve for WTI — End-1997, End-1999, and End-2000



Source: PKVerleger LLC.

OPEC, led by Saudi Arabia, continued to follow similar procedures over the next four years. Through the end of 2005, member countries adjusted production with the goal of preventing inventories from accumulating. By the end of 2003, the production cuts had eliminated all the inventory accumulation that occurred from 1990 to 1999. More than 800 million barrels were drained from stocks. Markets were firmly backwardated, and the prices received by members had increased. The curve's movement can be seen in Figure 13.

Causes of Price Movements from 2006 to 2008

The forces determining global crude prices shifted after 2006. OPEC was displaced by environmental authorities in consuming countries and by investors purchasing crude oil or financial claims on crude oil to diversify portfolios.

Environmental authorities took effective control of the market when regulations mandating sulfur removal from principal petroleum products went into effect. On President Clinton's last day in office, the Environmental Protection Agency issued rules requiring refiners to cut diesel fuel sulfur content to 10 parts per million by June 2006. In 2003, the European Union adopted similar standards to be effective January 1, 2009. The U.S. began adjusting to the new rules in 2005. European countries started in 2008. The new cleaner fuel is called "ultra-low-sulfur diesel," or ULSD. The increased demand for ULSD caused the price of sweet crude oil to rise to record levels.

Crude oil markets were simultaneously buffeted by a second force: passive investors. Beginning around mid-decade, pension fund managers and other investors began to purchase commodities to diversify portfolios. The investors' entry altered inventory behavior and seems at times to have changed oil price behavior. Some observers claim investors caused oil prices to reach record highs in 2008. The data suggest otherwise. While investor actions apparently distorted the market at times, they did not contribute to the price surge.

Here we discuss the role of the new investors in the oil market first. We then focus on the impact of environmental regulations.

Goldman Sachs promoted commodities as an investment as early as 1991. Kenneth Froot, an academic teaching at MIT, wrote an article showing that portfolios containing a well-structured basket of commodities along with two traditional elements, equities and bonds, could earn the same returns as a portfolio containing just equities and bonds.[7] He also showed that the portfolio had a lower variance. The results should have encouraged investors to move quickly into commodities.

The concept did not become popular until the middle of the current decade, however. The beginning of the Internet and dotcom bubbles in the early 1990s no doubt caused many portfolio managers to shelve examining commodities as an alternative investment. The idea did, however,

[7] See Kenneth Froot, "Hedging Portfolios with Real Assets" in *The Commodity Analyst* (New York: Goldman Sachs Commodity Research, January 1994). Froot's first writings on the subject were published in 1991.

become popular in 2005 with the publication of a working paper by Gary Gorton and K. Geert Rouwenhorst. (The paper was eventually published in *Financial Analysts Journal*.[8])

Gorton and Rouwenhorst essentially replicated Froot's results. However, their paper, "Facts and Fantasies about Commodity Markets," also showed how a well-structured portfolio of commodity futures and Treasury bills could improve investor returns through diversification and provided detailed, replicable calculations in this regard.

Gorton and Rouwenhorst advised investment managers to purchase fully funded baskets of commodities. Because futures were margined transactions (meaning buyers deposit only a small sum with the exchange), the authors advised those investing in commodities to buy Treasury bills with the monies not required by the exchange. They presented return calculations that showed how this procedure would yield good results even though Treasury investments earn low returns.

Gorton and Rouwenhorst's findings were predicated on "normal backwardation" in commodity markets. Citing work by John Maynard Keynes, the authors asserted that commodity markets are usually in backwardation. Thus investors were promised a return even if prompt commodity prices did not change. Their assumption can be illustrated this way. Say an investor purchases a June futures contract for crude oil at $50 per barrel in February when cash crude oil is trading for $60. That buyer would earn $10 per barrel if the cash price stayed the same until the June contract expires.

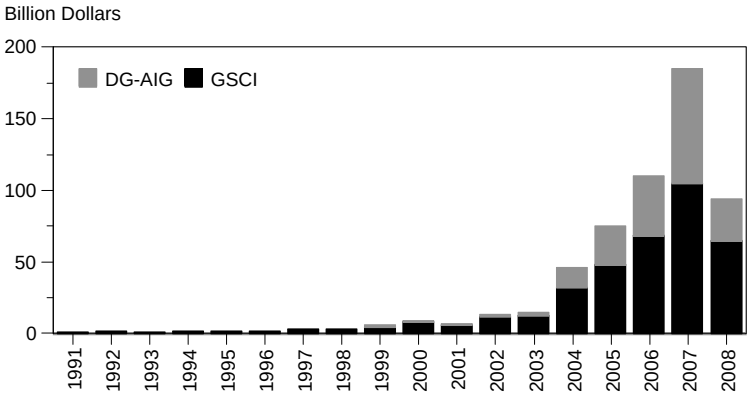
As noted, Gorton and Rouwenhorst and others advised investors to purchase baskets of commodities. To facilitate this, two indices were introduced. Each included energy, metal, and agricultural commodities. The more popular of the two, the S&P Goldman Sachs Commodity Index (GSCI), was heavily weighted toward energy. The fund weights were determined by estimating the share of the commodity in global economic activity. The weights were also dollar-based, meaning that those managing the indices were supposed to keep the share of money invested in a commodity equal to the weight assigned by the index authors. Thus, in the GSCI, the manager should have roughly one-third of the investment in WTI. This means that if the WTI price rises relative to other commodities, the manager needs to sell futures.

Commodities gained popularity as an alternative investment class beginning in 2006. Figure 14 (page 16) tracks the amounts invested in two commodity indices: the GSCI and the Dow Jones-AIG (DJ-AIG) from 1991 through 2008 by year. From less than $15 billion in 2003,

[8] See Gary Gorton and K. Geert Rouwenhorst, "Facts and Fantasies about Commodity Futures," *Yale ICF Working Paper No. 04-20,* Yale International Center for Finance, June 14, 2004, or "Facts and Fantasies about Commodity Futures," *Financial Analysts Journal* 62, No. 2 (March/April 2006), pp. 47-68.

the funds following the indices rose to $185 billion at the end of 2007 and then dropped to $94 billion at the end of 2008. The amounts peaked at roughly $250 billion in mid-2008, as Figure 15, which tracks the weekly investment flow, shows.

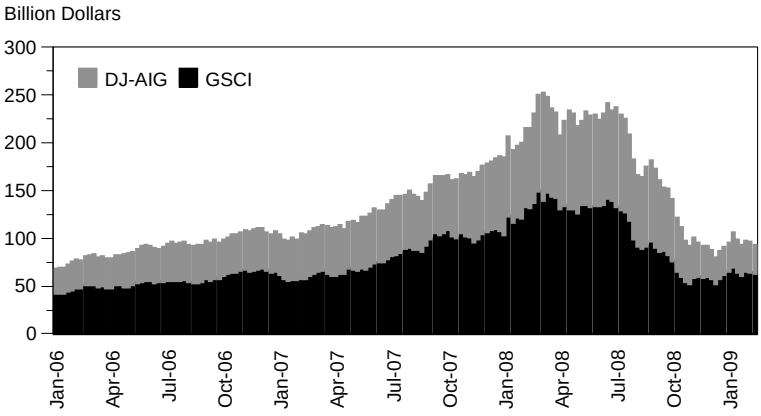
Figure 14
Estimated Amounts Invested in Two Principal Commodity Indices, 1991-2008



Note: Data as of end of year shown.
Source: PKVerleger LLC from Goldman Sachs, Citigroup, and Financial Times reports.

The rush of cash into commodities initially changed the structure of commodity prices and affected inventory management decisions in the oil industry. Promoters of commodity indices claimed that investments would earn good returns because commodity markets were normally backwardated. However, the flow of cash converted backwardation into contango. The shift in the forward price curve can be observed from Figure 16 (page 17).

Figure 15
Estimated Weekly Investments in Two Principal Commodity Indices, January 2006-January 2009



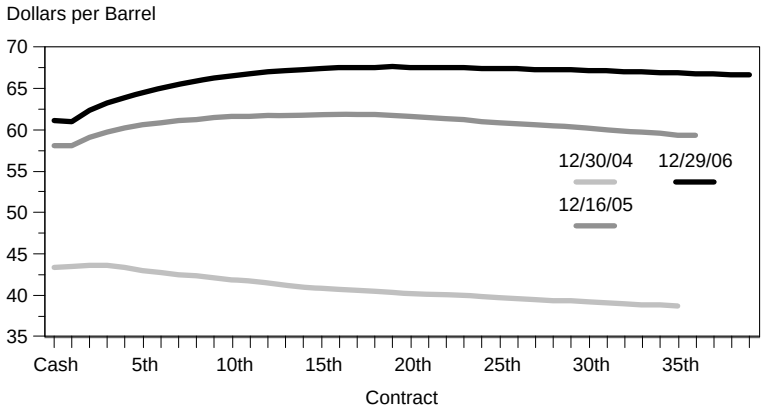
Source: PKVerleger LLC.

Figure 16 shows the forward price curve for WTI at the end of 2004, 2005, and 2006. Note that the front of the curve was in backwardation at the end of 2004 but in contango at the end of 2005 and 2006. The shift in the curve converted the expected profit from owning commodities as described by Gorton and Rouwenhorst into a loss. Referring to the example above, if the investor bought a future at $50 per barrel when the cash price was $40 and the cash price remained at $40, the buyer ultimately lost $10 per barrel.

Figure 17 (page 17) presents the information shown in Figure 16 in percentage terms. The forward prices in Figure 17 appear as a percentage of the cash price for the curve. Thus the

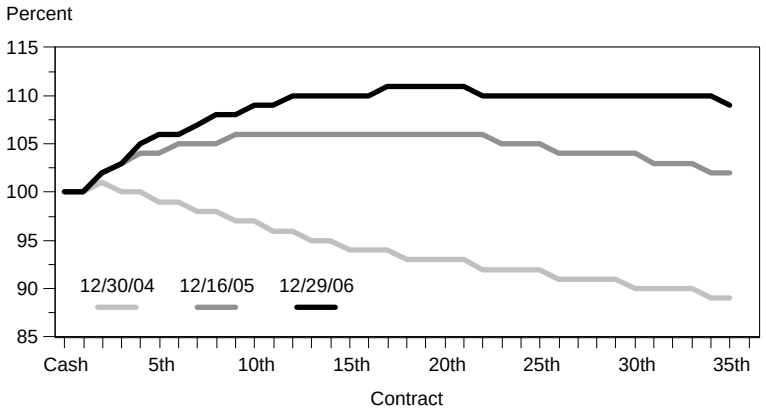
price for the twelfth futures contract at the end of December 2004 was 96 percent of the cash price (indicating backwardation), while the same contract at end-December 2005 and 2006 was at a premium of 106 and 110 percent to cash (contango).

Figure 16
Forward Price Curve for WTI — End-2004, End-2005, and End-2006



Source: PKVerleger LLC.

Figure 17
Forward Price Curve for WTI — End-2004, End-2005, and End-2006 Expressed as a Percentage of the Cash Price



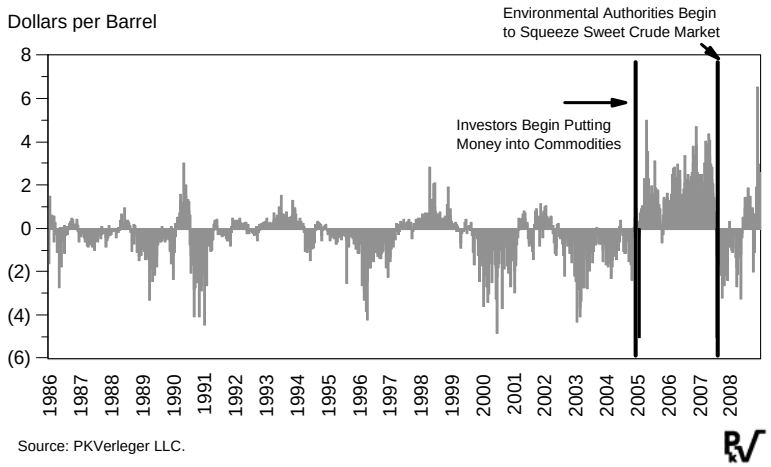
Source: PKVerleger LLC.

Figure 18 (page 18) tracks the data presented through the price curves over a 23-year period. The graph shows a single weekly price spread, the third future less cash, from January 1986 through January 2009. Also shown in Figure 18 are two vertical lines. The first marks January 2005, the date when investors began to pour cash into the market. The second marks the date when environmental authorities began to squeeze the sweet crude market. Between these dates, the market was in contango almost the entire time (only four of the 130 weekly observations were negative). There was a real structural change from the prior period. From January 1986 to December 2005, the average spread had been a negative $0.40 per barrel. During the twenty-plus year period highlighted, the average spread was $1 per barrel.

The entry of investors also changed the dynamic of the oil futures market. As can be seen from Figure 19 (page 18), open interest in the three key futures contracts rose from one million contracts to three million contracts over the same period. As in Figure 18, vertical lines mark the period of significant cash injections by passive investors.

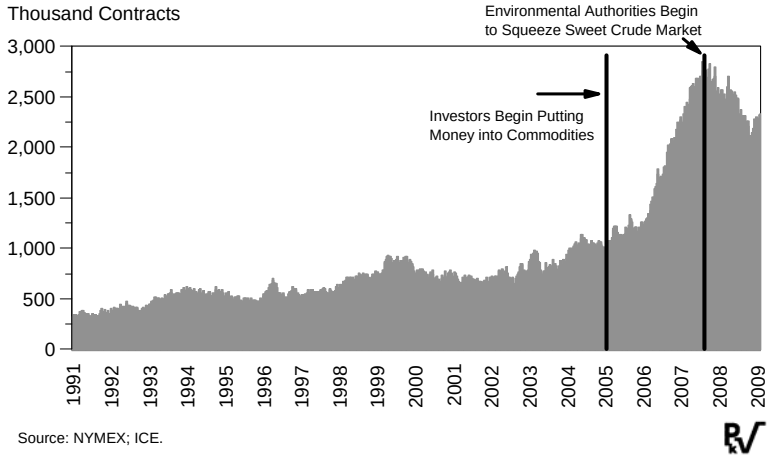
From Figure 19, one can note that open interest actually began to decline after August 2007. This decrease seems to be explained by the formulas governing the principal commodity funds. As noted, managers using the DJ-AIG and S&P GSCI formulas must allocate the money in their portfolios on a percentage basis between commodities. For example, the GSCI formula requires that 33 percent of the funds be invested in WTI. This means managers must, over time, double the number of futures purchased if prices decline by 50 percent. This also means that managers must cut WTI holdings over time by 50 percent if prices double. From January 2005 to August 2007, WTI prices rose from $45 to $70 per barrel. Absent additional cash input into the fund, managers would have been required to cut holdings by 36 percent. However, during this period, the cash invested in commodities more than doubled, allowing oil holdings to be increased at least 30 percent.

Figure 18
Weekly WTI Price Spread (Third Future less Cash), January 1986-November 2007



Source: PKVerleger LLC.

Figure 19
Weekly Open Interest in Three Key Futures Contracts, January 1991-January 2009



Source: NYMEX; ICE.

The situation was different after August 2007, however. From August 2007 to July 2008, oil prices doubled while the amount invested in funds rose only 22 percent. The price rise would have required a 50-percent reduction in the oil position. This would have been offset only in part by the 22-percent increase in funds. On balance, then, the number of crude contracts held by

funds should have declined from August 2007 to July 2008 by 30 percent. The drop in open interest shown in Figure 19 reflects this underlying relationship.

The entry of investors affected the real oil market. Some observers have argued that it sent prices to $150 per barrel. For example, one hedge fund manager, Michael Masters, asserted that oil futures purchases by investors in commodity funds such as the DJ-AIG and GSCI caused an oil price bubble.[9] Richard Eckaus, an academic unfamiliar with commodity markets (and as uninformed as most of the public), reached the same conclusion.[10]

The actual effect of investment was quite different. As noted above, the purchase of oil futures by investors converted normal Keynesian backwardation into contango. The contango made it profitable to acquire inventories. Firms in the oil business responded by building stocks.

The economic incentive to add to stocks is determined by the "cash and carry." When markets are in contango, oil firms or any commodity business can acquire title to physical stocks while simultaneously committing to sell the commodity to another buyer in the future at a *higher price*. For example, on November 3, 2006, a buyer could contract to take delivery of crude in December for $59 per barrel while simultaneously selling a futures contract for delivery in May 2007 for $64.50. The transaction would net the buyer a $5.50 profit before deducting incidental costs that might range from nothing to perhaps $2 per barrel. In the ideal situation, the investment return would be 24 percent.

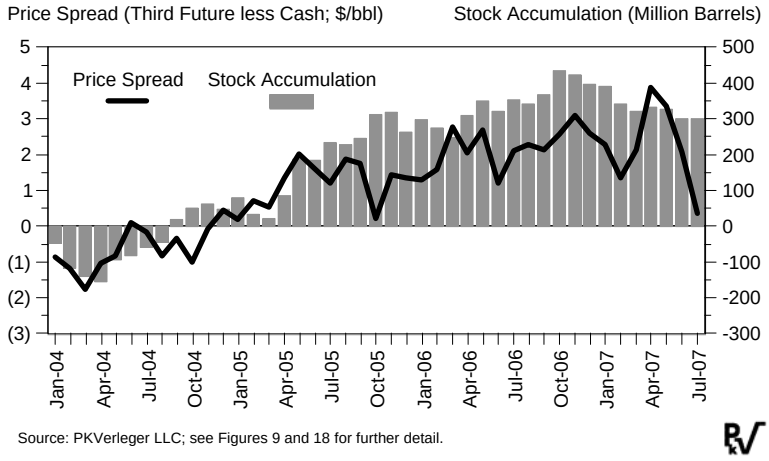
Given the potential profit, it is not surprising that traders responded to the contango in the market by acquiring inventories. The linkage between contango and inventory accumulation is shown in Figure 20 (page 20). This graph covers the limited period from January 2004 through July 2007. Two series are displayed. The first shows the accumulation of global inventories from January 2004 through July 2007. This data is displayed as bars and graphed against the right vertical axis. The 43-month sample is taken from Figure 10 above, which presented data on monthly inventory accumulation from 1990.

The second series presented in Figure 20 is a solid line depicting the WTI price spread at the beginning of the month. Here the spread is measured as the third future less cash. The data shown in Figure 20 were taken from Figure 18. Price spreads are graphed against the left axis.

[9] See, for example, the testimony of Michael W. Masters before the Committee on Homeland Security and Governmental Affairs, U.S. Senate, May 20, 2008 [http://hsgac.senate.gov/public/_files/052008Masters.pdf].
[10] R. S. Eckaus, "The Oil Price Really Is a Speculative Bubble," Center for Energy and Environmental Policy Research Working Paper 08-007, June 2008 [http://tisiphone.mit.edu/RePEc/mee/wpaper/2008-007.pdf].

Examining Figure 20 reveals that cumulatively inventories rose more than 500 million barrels over the period covered. The data also reveal that the accumulation began when the price spreads became positive, making it possible to accumulate stocks profitably. The accumulation continued and stocks remained high through the period. Data for August 2007 to the end of 2008 reveal that inventories were then liquidated during the last half of 2008 because it became unprofitable to hold stocks.

Figure 20
Monthly Global Crude Inventory Accumulation vs. Crude Price Spread, January 2004-July 2007



Source: PKVerleger LLC; see Figures 9 and 18 for further detail.

It must be noted that these data do not confirm the assertion that investors in commodity prices caused prices to rise. Confirmation of the hypothesis requires that one show that the current supply of the commodity to the market was reduced. Such an action must cause prices to rise, other things being equal. Such a showing is easy in a market with fixed supplies and unchanging demand.[11] The global oil market does not, however, satisfy these conditions. As noted above, Saudi Arabia and other producers vary the production of heavy crude oil to reflect market conditions. One must address their actions during the same period before reaching any conclusion regarding the oil price impact of investors in commodity funds.

It goes without saying that consumer prices will not be influenced by the actions of those buying futures contracts if the supply-and-demand balance is unaffected. From January 2004 to August 2007, there is no indication that the activities of passive investors had an impact on physical supply and demand—and thus no confirmation regarding the price movement.

The data from August 2007 to July 2008 reveal that open interest and global inventories declined, as did the number of futures contracts held by investors. These later data suggest investors actually helped depress prices.

[11] See Jeffrey C. Williams and Brian D. Wright, *Storage and Commodity Markets* (Cambridge, England: Cambridge University Press, 1991).

One can suggest, though, that commodity investors may have a hand in setting a floor for oil prices. Earlier we noted that managers must buy additional futures contracts as prices fall in order to maintain the right balance across commodities. As prices plunged in late 2008 and early 2009, such purchases caused contango to increase and promoted profitable inventory acquisition. The purchases, combined with OPEC's output cuts in late 2008, undoubtedly slowed the price decline.

In conclusion, the analysis shows that cash from investors has changed the oil market's behavior. However, investors seem, if anything, to play a countercyclical role that moderates price rises and declines.

Environmental regulators and regulations, in contrast to investors, have not played a countercyclical role. To the contrary, they seem to have exacerbated price cycles, aided and abetted by incompetent actions taken by the U.S. Department of Energy under President George W. Bush.

The critical environmental regulations relate to diesel fuel. In January 2000, the Environmental Protection Agency issued new rules requiring most diesel fuel sold for over-the-road use to contain less than 15 parts per million sulfur beginning in June 2006. Three years later, the EU set very similar standards for diesel fuel sold for over-the-road use in Europe to take effect in January 2009. Some EU member nations implemented these rules even earlier.

The introduction of the new sulfur regulations for diesel was a key cause behind the doubling of crude prices to $147 per barrel. The shift to ULSD placed intense pressure on light sweet crude markets. At the margin, most refiners need light sweet crude to produce ULSD. Perhaps by coincidence, most light sweet crudes yield a high percentage of distillate fuel oil (diesel) that contains essentially no sulfur. Heavier crude oils with higher sulfur content—such as Arab Light and Arab Heavy—produce only limited volumes of high-sulfur distillate and only in refineries that have massive desulfurization capacity. Thus the requirement to reduce sulfur in diesel boosted demand for light sweet crude.

The need for sweet crude oil is explained by blending economics. Refiners blend various "feedstocks" or liquids to produce marketable petroleum products. The primary input into diesel fuel is gasoil. Every crude oil contains gasoil. For example, the gasoil yield of each barrel of Nigerian Bonny crude is 36 percent, while the gasoil yield from Saudi Arabia's Arab Light is 24.1 percent, according to the 2008 edition of the Energy Intelligence Group's *Crude Oil Handbook*. The sulfur content of the gasoils also differs. The gasoil from Nigerian crude contains 0.12 percent sulfur by weight, while the sulfur content of gasoil from the Saudi crude is 1.49 percent, 12 times higher.

These are the sulfur contents of diesel fuel produced from "straight-run" gasoil (gasoil produced outright from crude distillation). The sulfur content from "cracked" distillate feedstocks (distillate produced from catalytic crackers) tends to be much higher, making those feedstocks unusable for manufacturing ULSD.

To produce diesel fuel meeting environmental standards, refiners must lower sulfur content in gasoil and then blend in treated feedstocks. It is obviously much easier to meet the requirements using gasoil produced from sweet crudes that contain far less sulfur. A 2000 study by the National Petroleum Council warned that production of diesel fuel with very low sulfur content would be extraordinarily difficult except from straight-run gasoil. The NPC report also warned that the available volumes might not meet demand. The forecast proved correct.[12]

The loss in supply anticipated by the NPC occurred when global demand for diesel was pushed much higher. Lawrence Eagles of JPMorgan presented detailed data in January 2009 that documented the rise in diesel demand. Eagles characterized the period as a "perfect storm in the diesel market." He described that storm in his report:

> Strong global growth, supply disruptions, coupled with a market failure caused a surge in diesel imports in a number of countries. At peak, to meet that demand in its entirety would have required up to an additional 5 million barrels a day of crude oil to satisfy. That was not available so prices had to rise to moderate demand.[13]

Eagles identified China as the source of the market failure and the chief stimulus. The 2008 Summer Olympics in Beijing increased diesel demand. At the same time, price controls in China made it unprofitable for small refiners there (referred to as teapots) to operate and caused them to shut down. He adds that as a result of the shutdowns, China had to import higher-quality diesel supplies from the international market. This squeezed diesel supply. Eagles also noted the strong economic growth in the Middle East and Africa. Diesel demand in these areas was boosted by the high crude prices.

Another boost to demand that Eagles did not note was documented by the French oil company Total. This increase came from economic policies in Europe that encouraged consumers to purchase diesel-powered vehicles rather than gasoline-fueled cars.

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[12] *U.S. Petroleum Refining* (Washington, D.C.: National Petroleum Council, June 2000).
[13] Lawrence Eagles, "With Better Data, Better Understanding," *JPMorgan Global Energy Strategy*, January 27, 2009.

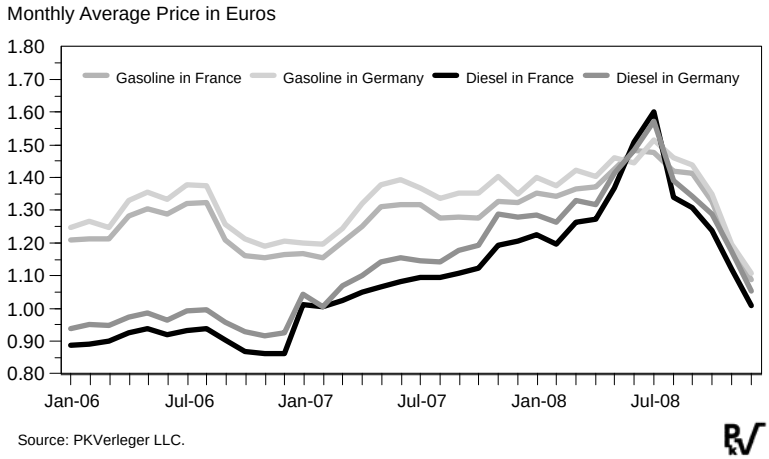
The third stimulus came from the EU's expansion. Twelve new members, all from Eastern Europe, joined in 2006. This added to diesel demand as companies moved manufacturing plants to lower-cost nations—to Poland from Germany, for example. Truck traffic surged, as did demand for ULSD.

Finally, EU members are required by law to hold stocks of petroleum products in strategic reserves, and the EU boosted this requirement in 2008 even as prices surged.[14]

The strong demand for diesel in Europe combined with the global supply squeeze altered the traditional relationship between the retail price of distillate fuel oil and the retail price of gasoline within Europe. Traditionally retail diesel prices were lower than gasoline prices, in large part because tax rates on diesel were lower than tax rates on gasoline. For example, the tax on diesel in France in August 2008 was 0.649 euros, while the tax on gasoline was 0.839 euros. Absent higher spot prices for diesel fuel, gasoline would have sold at a premium of approximately 20 percent to diesel. However, supplies were squeezed.

Figure 21 traces the impact on retail diesel prices. This graph shows the retail price for gasoline and diesel fuel in France and Germany from January 2006 through the end of 2008. Retail diesel prices begin at a discount of 25 percent to gasoline. The discount closes, though, by June 2008 as diesel prices rise. During the period, retail diesel prices rose by 27 percent in euros.

Figure 21
Retail Gasoline and Diesel Prices in Germany and France, 2006-2008

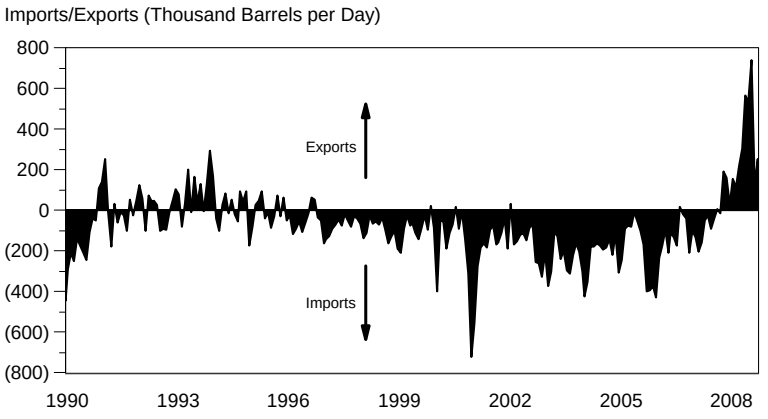


During 2007 and 2008, Europe became the incremental global market for diesel. For the first time in decades, the United States became a diesel exporter, as can be seen from Figure 22 (page 24). Consequently, the European consumer set the price for diesel fuel and the price was set in euros, not dollars. From August 2007 through July 2008, the euro rose 16 percent against the dollar, as can also be

[14] Total, "Diesel or Petrol, A debate which often fails to allow for the fact that the price is dependent on supply and demand," September 3, 2008 [www.total.com/en/press/energy-dossiers/diesel-or-petrol/debate-diesel-petrol-prices_16838.htm].

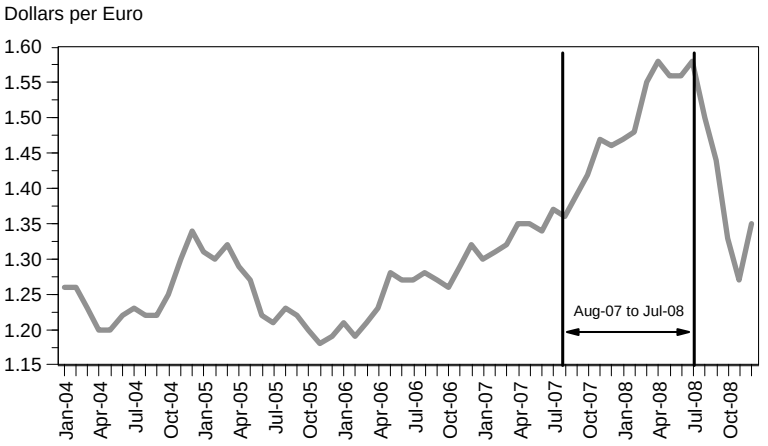
seen from Figure 23. Two vertical lines in the graph mark the period of tightening in the light crude market. The euro's rise required a 16-percent rise in dollar-denominated diesel prices because Europe was the incremental buyer.

Figure 22
Monthly Net Distillate Imports/Exports to/from the U.S., January 1990-October 2008



Source: U.S. DOE.

Figure 23
Euro/Dollar Exchange Rate, 2004-2008



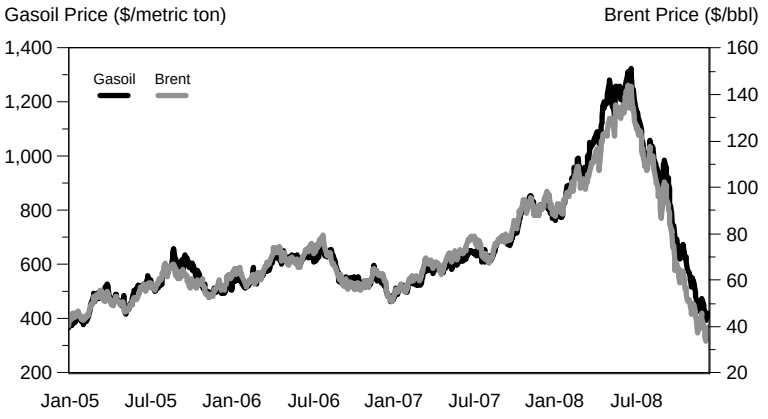
Source: Platts.

Prices for light sweet crude also rose with the European diesel price. The linkage was particularly tight from August 2007 through mid-2008. The diesel price increase plus the euro's exchange rate rise dictated that sweet crude prices had to climb at least 50 percent, or from $75 per barrel to at least $112. Figure 24 (page 25) compares the rise in gasoil price (the European term for diesel) with the price rise for Brent, a sweet North Sea crude used to produce diesel. The Brent price is graphed against the right vertical axis, while the gasoil price (quoted in dollars per metric ton) is graphed against the left axis. The parallel movement is obvious. During much of 2007 and 2008, gasoil led Brent and other crude prices higher and then contributed to the collapse.

In addition to the increased diesel demand described above, petroleum markets in 2007 and 2008 experienced supply shocks. The increase in light sweet crude prices was exacerbated by output disruptions and by a U.S. government action that removed sweet crude from the market.

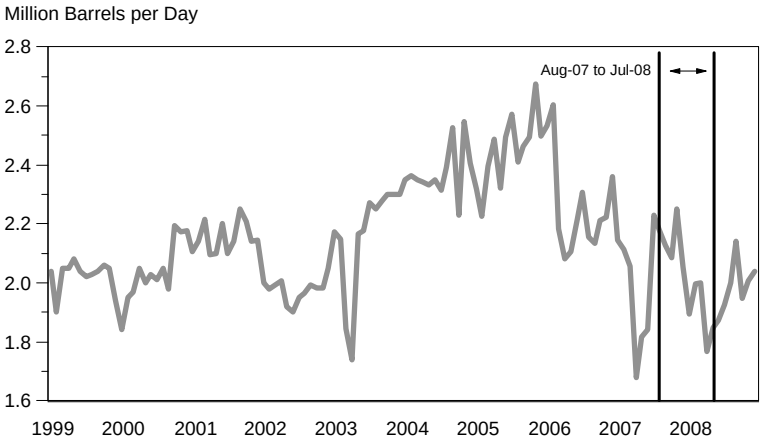
The disruption involved Nigeria, a country that produces up to 40 percent of total world supply (just 15 million barrels per day at maximum) of light sweet crude. A low-level civil war there has blocked as much as 400,000 barrels per day of the country's output. The impact of the Nigerian civil war on its production is shown in Figure 25. This graph shows Nigerian crude output by month from 1999 through the end of 2008. The August 2007 to July 2008 period is identified by vertical lines. During the critical period, Nigeria's output fell from 2.2 million barrels per day to 1.8 million barrels per day, a loss of light sweet crude that could not be replaced from other sources. For the 12-month period beginning in August 2007, production was down an average of 80,000 barrels per day.

Figure 24
Brent and Gasoil Spot Prices, January 2005-January 2009



Source: Platts.

Figure 25
Monthly Nigerian Crude Production, 1999-2008



Source: Energy Intelligence Group

Theoretically, consuming nations could have replaced the lost Nigerian production by drawing down strategic stocks of sweet crude. Industrialized countries have emergency reserves that now total more than 1.5 billion barrels of crude and product. Probably one-third of this total is sweet crude. However, these nations did not draw stocks because Nigeria's problems did not meet the threshold for a disruption as defined by the International Energy Agreement. So markets were left to cope with the supply loss.

The U.S. Department of Energy made the situation worse when it decided to add crude to the Strategic Petroleum Reserve. DOE began filling the SPR in August 2007 and continued to put oil into it until July 2008, when Congress ordered it to stop. The oil price rise from $70 to $147 per barrel occurred simultaneously. As part of the fill program, DOE removed approximately 30,000 barrels per day of light sweet crude from the market. This means that over 11 months, DOE took about half as much light sweet crude out of play as the Nigerian problems did.

The incompetent DOE officials appointed by President Bush argued that the SPR additions accounted for a very small portion of world crude demand. These officials neglected to note—or more likely never understood—that refiners would have to process as much as 600,000 barrels per day of Arab Heavy (compared to 30,000 barrels per day of light sweet crude) to replace the diesel fuel volume lost when DOE removed sweet crude from the market. They also failed to note that DOE could have moderated the price increase by selling sweet crude from the SPR.

According to Platts, Katharine Fredriksen, one of the incompetent DOE officials, testified to Congress that "the SPR's 'modest' fill rate of 70,000 b/d does not put 'undue pressure on the world oil market.'" The report added,

> In testimony to the committee, Fredriksen said 70,000 b/d equated to only about one-tenth of 1% of global demand, and as such would have no real effect on oil prices. "It is our intent to increase the level of import protection stored in the SPR as expeditiously as practicable," she said. "The modest goal does not put undue pressure on markets."[15]

The oil price collapse began after DOE stopped filling the SPR and new volumes of light sweet crude production came into the market. Since July 2008, crude prices have plunged precipitously, at one point dropping to just over $31 per barrel. The rapid turnaround can be attributed to several factors, including Congress forcing DOE to stop filling the SPR. The decrease began when the euro started weakening against the dollar and accelerated after Russia invaded Georgia. At the time, some suggested that the Russian incursion would boost oil prices. Precisely the opposite occurred, though, because the military action highlighted the EU's political weakness. The euro fell quickly by around ten percent. The dollar price for diesel dropped with the euro, as did crude prices.

[15] "SPR Nears High Volume Mark as Senate Ponders Impact," *Platts Global Alert*, February 26, 2008.

The end of the 2008 Olympics added further downward pressure to diesel prices. China had accumulated stocks to assure adequate supplies. These stocks were released, reducing demand. Use in Europe also started to decline as the recession took hold there.

The precipitous fall accelerated in late 2008 following the collapse of Lehman Brothers. The recession/depression removed all upward pressure on the market.

At the same time, light sweet crude supply increased when a new field in the Gulf of Mexico came online. Diesel supply rose at roughly the same time as refiners changed catalysts to increase production.

Conclusion

No single cause can be identified for the rise and fall in oil prices from 1999 through 2009. The increase from $10 to $147 per barrel came about first because of OPEC actions and then because of the consuming governments' squeeze on light sweet crude. The combination of falling diesel demand, a boost in light sweet crude supply, and increased productive capacity for diesel fuel brought about the subsequent price decline. These factors fully explain the 1999 to 2009 price cycle.

Speculation played no part in the price increase and decrease. During 2008, several individuals published papers suggesting that speculative activity heavily influenced the cycle. One academic, respected for his work in the area of development economics, concluded that speculation had to be behind the price cycle because no other factor could be found. His paper was nonsense, however, because the price cycle, as shown above, was caused by factors other than speculation. It is significant that no other academic signed on to the speculation explanation.

Those asserting that speculators caused the price increase noted the cash flow into new commodity-linked instruments such as the S&P Goldman Sachs Commodity Index and the Dow Jones-AIG Commodity Index. The amounts invested in these indices rose from $68 billion at the beginning of 2006 to perhaps $250 billion in the spring of 2008. Observing this rise, many concluded that the money must be driving the crude price rise.

However, those blaming commodity indices have failed to show the necessary physical linkage between commodity prices and the investment flow. Decades of economic research have shown that commodity price manipulators must buy and hold physical inventories of a commodity to create an artificial price. For example, the Hunt Brothers gained control over a large portion

of the physical silver supply. Firms that had sold short had to pay very large sums to close their positions. No such linkage has yet been demonstrated for oil.

The conclusion then is that the price rise is linked to shifts in supply and demand in the physical market. The increase began initially when OPEC members worked aggressively to limit inventories in consuming countries. Then new environmental regulations combined with inept energy policy took prices from $70 to $147 per barrel.

Looking Forward

Oil prices will likely follow a different trajectory over the next five years. For the reasons outlined below, they will probably fluctuate between $30 and $50 per barrel rather than rising arithmetically or falling geometrically. While there may be occasional surges toward $70 and plunges to $10, the general context will be dull. This will be in sharp contrast to the breathless excitement that has dominated the market and moved market commentary to the front pages of major newspapers. For firms in the oil sector, adopting aggressive cost management programs will be the key to success.

Of course, events could change the forecast. A serious global political disruption related to war could temporarily raise prices. Prices could also be lifted if governments of producing and consuming countries worked together to stabilize them at higher levels. Such action is desirable but unlikely.

The low price environment will result from the interaction of four factors: 1) the global economic slowdown, 2) the return of aggressive economic regulation, 3) the U.S. auto industry's impending bankruptcy, and 4) Barack Obama's inauguration as the 44th president of the United States. The interplay of these elements will significantly reduce global energy and oil use over the next four years from levels projected only a few months ago. Global oil consumption in 2012 may fall well short of 2008 levels. The fall in demand will prevent prices from rising.

The global recession that has gained strength since the fall will keep prices depressed. The origins of the current economic crisis are different from earlier episodes and the length will likely be much, much longer. In the simplest terms, earlier recessions—such as those occurring in 1973, 1980, and 1991—can be traced to a fall in demand. The current recession/depression, in contrast, has been caused by the collapse of financial institutions. Academic research reveals that recessions originating in the banking sector tend to be more severe and last longer.

The most thorough analysis and probably the best studies of the situation have been done by Carmen Reinhart and Kenneth Rogoff. Their most recent paper, "Banking Crises: an Equal Opportunity Menace,"[16] suggests a very sobering outlook for the future.

Reinhart and Rogoff examined banking crises in 66 developing and industrialized countries dating back to 1800. They found that crises are "equal opportunity" events, that is, they cause similar problems in developing and developed nations. Their results suggest that banking crises last more than three years. They also noted that these crises lead to large increases in government spending: "On average, government debt rises by 86 percent during the three years following the banking crisis. The fiscal consequences are thus an order of magnitude larger than the usual bank bailout costs that are the centerpiece of most previous studies."[17]

(If Reinhart and Rogoff are right, the cost of resolving the current problems will range from five to nine trillion dollars. Either figure is substantially larger than the economic stimulus numbers being discussed by the Obama administration.)

One of Reinhart and Rogoff's key findings was that real estate cycles around banking crises are "similar in duration and amplitude across the two groups of countries" (emerging and developed nations). They found this result surprising "given that almost all other macroeconomic and financial time series (income, consumption, government spending, interest rates, etc.) exhibit higher volatility in emerging markets."[18]

The Reinhart and Rogoff analysis suggests that U.S. housing prices may have much further to fall. The most common index for domestic housing prices, that of Professors Case and Shiller, has already dropped 30 percent. The Reinhart and Rogoff research indicates that prices must decline another 10 to 30 percent if the historical cycle repeats.

Reinhart and Rogoff also noted key features regarding real estate that stand out in their data. First, they found that the persistence of real housing price cycles in advanced economies and emerging markets is typically four to six years.[19] In addition (as noted above), they found that the magnitude of the housing cycle is not typically different for advanced and emerging economies.

[16] Carmen M. Reinhart and Kenneth S. Rogoff, "Banking Crises: an Equal Opportunity Menace," NBER Working Paper No. 14587, December 18, 2008.
[17] Reinhart and Rogoff, p. 3.
[18] Reinhart and Rogoff, p. 3.
[19] Reinhart and Rogoff, p. 30.

Reinhart and Rogoff also suggested that banking-related recessions last approximately three years, with GDP dropping in all three. According to these authors, real growth declines around one percent in the first year, a little more than one percent in the second year, and then roughly half a percent in the third year. Growth rates do not return to pre-crisis levels until the fourth year.[20]

Reinhart and Rogoff applied their analysis to the current crisis in a paper published in *The Wall Street Journal* on February 3, 2009.[21] They reported that the contraction should stop toward the end of 2009 **if the recession started in January 2008**. However, the contraction could last well into 2010 if one dates the recession from September 2008 when Lehman Brothers fell.

The February paper also suggests housing prices will decline at least ten percent from current levels. The decrease will not end until early 2011. Lastly, they add that the U.S. deficit will rise by eight to nine trillion dollars by the time the recession ends, boosted by declines in tax revenues and increased expenditures.

The collapse of the financial system will also delay recovery, in part because financial institutions cannot resell loans. Another factor is that much of the credit supplied over the last decade came from outside the banking system. Hedge funds, pension funds, and other new intermediaries offered credit on favorable terms. At the same time, banks often made syndicated loans. As a result, three out of four dollars lent by banks were quickly converted to securities and taken off their books.

Today these new forms of credit have vanished. Banks are once again the source of credit for most borrowers. While central banks have stepped in to buy low-quality loans from banks and backstop the financial system, most of the innovations popular a year or two ago have vanished. Thus, credit is being squeezed.

The recession will not be isolated to the United States. The slowdown will be as bad or worse in many countries. As a result, global oil use will likely decline in 2010 and 2011. Falling use linked to the recession will hold prices down.

Growth in global demand will also be depressed by the return of regulation. Writing in *The New York Times*, conservative columnist William Kristol remarked on the importance of Barack Obama's election when he made this observation: "All good things must come to an end.

[20] Reinhart and Rogoff, p. 38.
[21] Reinhart and Rogoff, "What Other Financial Crises Tell Us: the Lesson of History is Grim. Expect a Long Slump," *The Wall Street Journal*, February 2, 2009.

January 20, 2009 marked the end of a conservative era."[22] A key component of the "conservative era" was the removal of economic regulation. With Ronald Reagan's inauguration, the United States and much of the world embarked on a period of economic liberation that may be unparalleled in history. The United Kingdom, led by Margaret Thatcher, matched deregulatory efforts in the U.S.

For the last 28 years, the United States, and to a lesser extent Great Britain, have continued on the deregulatory path pioneered by Reagan and Thatcher. In the UK, Prime Ministers John Major and Tony Blair promoted unregulated markets, as did the administrations of George H.W. Bush, Bill Clinton, and George W. Bush. The latter Bush has been particularly forceful in his efforts to lift market controls.

The last 28 years will likely become known as the golden era of deregulation. The period officially ended on January 20, 2009, with Obama's inauguration, but the end really began on March 17, 2008, when the U.S. government bailed out Bear Stearns. As president, Barack Obama will undoubtedly direct much greater government involvement in the financial and manufacturing sectors. Salaries and bonuses paid to financial officials will likely be regulated by Washington. Federal overseers will watch over and perhaps dictate production plans to U.S. automakers. The Federal Reserve Board or the Secretary of Housing and Urban Development will probably prescribe the types and terms of mortgages offered to new home buyers. The days of buccaneer capitalism will be over.

The return of regulation could drastically alter the growth pattern and rate of energy use in the United States, other industrial countries, and quite possibly developing nations such as China. Going forward, growth rates in use will be lower than projected in 2008.

Impact on Global Energy Consumption

The most widely circulated longer-term forecasts of global energy and oil demand through 2012 or 2015 anticipate modest but steady growth. Consumption is projected to rise by around one percent per year in the recently released IEA long-term forecast and by half that in the advance issue of the U.S. EIA's *Annual Energy Review*. These projections will be wrong, as are all forecasts. However, the magnitude of the errors in forecasts issued at the end of 2008 and beginning of 2009 will be greater than normal.

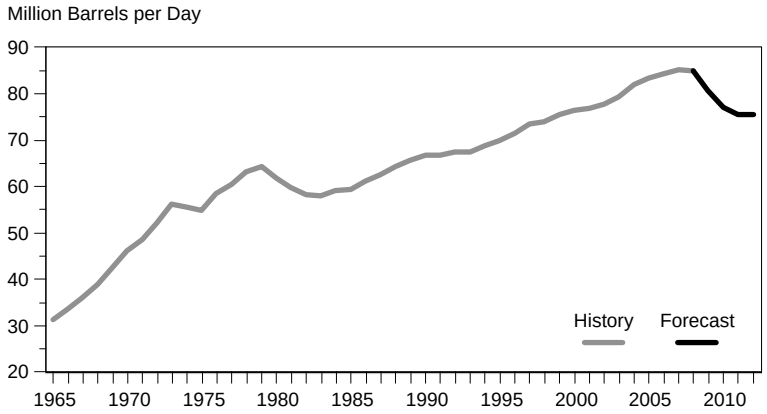
Looking forward to 2010 and 2011, one must expect declines in oil use rather than the increases predicted by the IEA and DOE, given the grim outlook for the economy and the pros-

[22] William Kristol, "Will Obama Save Liberalism," *The New York Times*, January 26, 2009, p. A21.

pects for heightened regulation. Historical relationships suggest that declines in global use between two and four percent should be expected in 2009. Use should drop another two percent in 2010 from 2009 and one percent in 2011 from 2010. This suggests that by 2012 global oil consumption will likely be around 80 million barrels per day, not the 87 million barrels per day forecast by DOE.

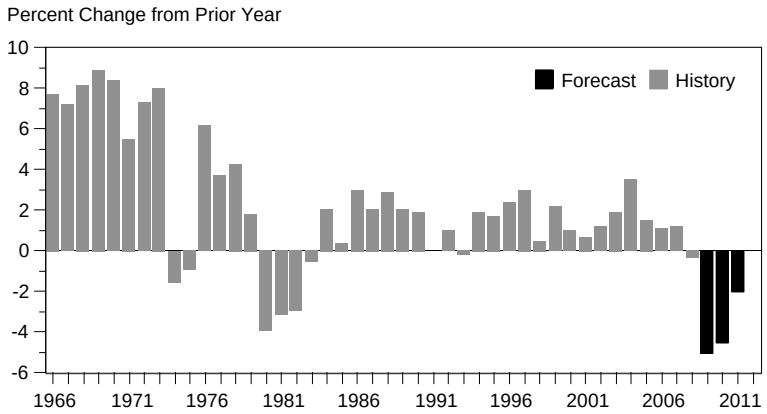
Figures 26 and 27 put the decline in context. Figure 26 shows the trend in global consumption from 1965 to 2008 and extended to 2012. Over the period studied, the data reveal one major consumption decrease from 1980 to 1984. The forecast shown in Figure 26 for 2009 to 2012 assumes the decline in this recession will be of the same magnitude. If the projection is correct, global use will decline by ten million barrels per day to around 75 million barrels per day by 2012. The similarity between the two cycles stands out clearly in Figure 27, which shows the year-to-year percentage change in use.

Figure 26
History and Likely Trend in Global Oil Consumption, 1965 to 2008 and Forecast to 2012



Source: BP Statistical Yearbook; PKVerleger LLC.

Figure 27
Year-to-Year Percentage Change in Global Oil Use, 1966 to 2008 and Forecast to 2012



Source: PKVerleger LLC.

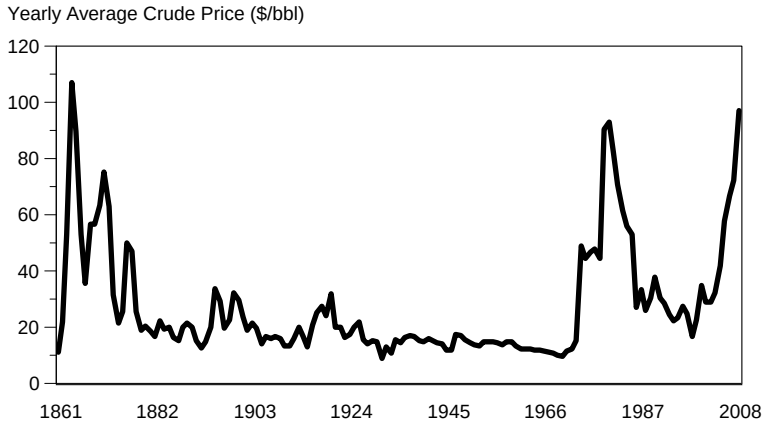
However, the assumption that use from 2009 to 2012 will only decline by the amounts observed between 1980 and 1984 seems strangely optimistic. Reinhart, Rogoff, and many others have emphasized that this recession is far worse than the 1980-84 one. Indeed, as the February 9 *Wall Street Journal* reported, the IMF's managing director referred to the current slowdown as a

"depression." Oil use should fall by far more than 10 million barrels per day if the most pessimistic projections prove correct.

The decline in global energy requirements will challenge the ability of the world's oil-exporting countries to manage the market. Surplus crude productive capacity will increase over the next four years. OPEC will likely have difficulty controlling the market from time to time. Oil prices can be expected to remain below $50 per barrel for some time to come. As noted above, oil prices tend to remain relatively low for years and then rise briefly to very high levels. Figure 28 (which repeats Figure 3 above) shows the 150-year pattern. The world may repeat such a cycle.

The Next Cycle: Sooner than Might Be Expected

Figure 28
Inflation-Adjusted Real Crude Oil Prices, 1861-2008



Note: Prices in 2007 U.S. dollars.
Source: BP; PKVerleger LLC.

This period of low prices will not last indefinitely, however. Just as day follows night, night will follow the day. Oil prices will rise again. At this time, the next major hike will likely accompany the introduction of new regulations limiting sulfur content in fuels used by ships, otherwise known as bunker fuels. Today, these fuels represent the dregs of refining. They are heavy and contain large amounts of sulfur. One source puts the sulfur content of such fuel sold at the U.S. Gulf at 27,000 parts per million (ppm). ULSD, in contrast, contains 10 ppm.

The International Maritime Organization (IMO), a nongovernmental group located in Geneva that governs global shipping operations, has agreed to reduce the cap on sulfur oxide emissions from ships from the current level of 4.5 percent to 3.5 percent in 2012 and then to 0.5 percent by 2020 if the standard is feasible. Separately, a ceiling on fuel sulfur content is set at 1.5 percent and would be lowered to 0.1 percent in 2015. Senator Barbara Boxer of California has proposed moving the 0.1 percent rule forward for the United States to the end of 2010.

These rules could impose significant constraints on the world's refining industry. Many refiners might have to shut down if the rules are enforced widely and carelessly because they lack capacity to remove sulfur from bunker fuels. In addition, one IEA report warned that the world's refining construction industry cannot build the necessary desulfurization capacity in the time horizon specified in the rules, assuming world refiners had the money to pay for the upgrades. There is, then, a risk that the rules will force a substantial reduction in the volume of crude refined. Such an outcome would, of course, be accompanied by an offsetting price increase of enormous magnitude.

Ordinarily one would dismiss such warnings as "scare tactics" advanced by interested parties. This, however, is not the case. As noted above, from 2006 to 2008 the absence of coordination between the world's environmental regulators, energy departments, and the refining industry regarding the introduction of ULSD doubled oil prices from $70 to $140 per barrel. One can be confident that environmental regulators and energy policy officials can stage a repeat performance.

Other new regulations could accelerate and exacerbate the next cycle, particularly one enacted by the State of California. The California regulation is included in a program designed to reduce the state's greenhouse gas emissions. Legislation passed by the California legislature (AB 32 by Nùñez and Pavley) requires producers to track the global carbon intensity of fuels they produce and reduce the intensity by ten percent by 2020.[23] According to Farrell and Sperling, "The term 'life cycle' refers to all of the activities included in the production, transport, storage, and use of the fuel."[24] The Bush administration blocked the initial regulations implementing the law. However, the Obama administration has begun reviewing the program and will likely reinstate it. At least 12 other states are ready to adopt the same rules.

Implementation of the California standards would no doubt further boost the light sweet crude market. Refiners can quickly and easily achieve life-cycle reductions in the fuel cycle by substituting sweet for sour crude. The problem, though, is that supplies of sweet crude are limited. Thus implementing the program will possibly set in motion an energy "beggar-thy-neighbor" trade war where firms seeking to supply California will push sweet crude prices to record heights. In addition, oil-exporting nations such as Saudi Arabia may continue their policy of linking sour crude prices to sweet crude prices, as they have since the early 1990s.

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[23] Carbon intensity, according to Farrell and Sperling (see footnote below) refers to "the total life cycle GWI [global warming intensity] per unit of fuel energy delivered to do useful work at the wheel of a vehicle."

[24] Alexander Farrell and Daniel Sperling, "A Low-Carbon Fuel Standard for California," August 1, 2007, University of California policy analysis paper, August 1, 2007 [http://www.energy.ca.gov/low_carbon_fuel_standard/UC_LCFS_study_Part_2-FINAL.pdf].

In this scenario, all crude prices will rise briefly to very high levels. The high prices will lead to a large wealth transfer from consuming nations to producers and producing nations. (The 2007/2008 transfer to producers amounted to two percent of global GDP.) The high prices will then be followed by yet another global recession and a reversion in oil prices to much lower levels, probably around $30 per barrel in today's prices. It is very possible that the next price cycle, induced by environmental regulations, will begin just as the world emerges from the current recession. If that is the case, the global economy may face a decade of no growth.