7

Energy: A Gathering Storm?

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The rise in energy prices after the successful invasion of Iraq focused attention again on energy markets. Crude oil prices were 56 percent higher 15 months after hostilities "ended," while three weeks before the November 2004 presidential election prices were 109 percent higher. The market's response in 2004 contrasted starkly with the events that followed the end of the first Gulf War (table 7.1).

The steady and unexpected rise in crude prices led to many meetings between global energy officials and numerous appeals to representatives of the Organization of Petroleum Exporting Countries (OPEC), especially Saudi Arabia, to boost production. OPEC members responded but to no avail.

Overlooked in the intense focus on immediate day-to-day price changes was a more troubling shift in prices quoted for oil to be delivered toward the end of the decade. These prices, which historically had fluctuated in a very narrow range around $22 per barrel, began a steady, inexorable increase following the conclusion of formal hostilities in Iraq. Between May 19, 2003—the day President George W. Bush declared "mission accomplished" from the deck of the *USS Abraham Lincoln*—and early October 2004, the price quoted for oil to be delivered in December 2009 rose from $23.92 per barrel to $39, a 70 percent increase. During this 17-month period, the increase was unrelenting (figure 7.1).

This increase in forward prices was matched by increases in prices bid for high-quality equity units, offering investors a return directly linked to

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Table 7.1 Changes in world crude prices following the end of the Gulf War and the Iraq War

	Gulf War	Iraq War
Price at beginning of hostilities (dollars per barrel)	30.17	24.49
Price at end of hostilities (dollars per barrel)	20.11	26.27
Percent change following end of hostilities:		
3 months after	–7.2	11.4
6 months after	2.9	7.9
9 months after	–5.8	28.3
12 months after	–13.2	36.1
15 months after	3.8	56.0

Note: Prices are for Dated Brent Crude.

Source: Platts.

oil prices. Share prices offered for the BP Prudhoe Bay Royalty Trust, a trust issued by British Petroleum for production from Prudhoe Bay in Alaska, rose from $14 per share in May 2004 to almost $55 per share. The increase in the BP share price corresponds to a change in investor expectations regarding the rate of increase in future oil prices. In May 2003, investors thought prices would rise at a modest 2 percent, reaching $33 per barrel by 2010. Fifteen months later, the expected rate of increase had risen to 5.5 percent, and investors now expect that prices will reach $55 per barrel by 2010 (table 7.2).[1]

This shift in expectations warns of a gathering energy storm, an economic event that threatens greater damage than the worst hurricane. This summer's price increases were but the first tropical squalls from the approaching system. Increasingly severe harm will be inflicted on the global economy in the absence of action. In the worst case, limited energy supplies could result in a bidding war that thrusts the world economy into a serious and possibly prolonged recession.

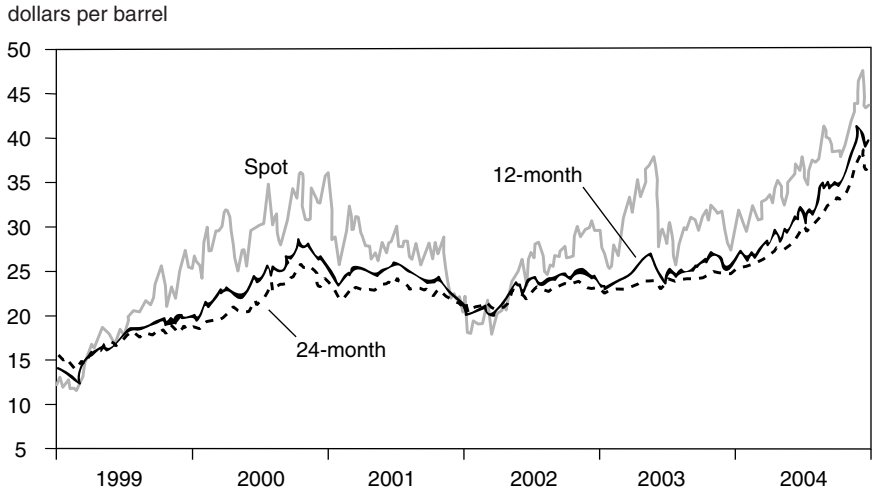
In this chapter, I examine seven factors that have thrust energy to the forefront of global economic concerns. I then investigate several possible policy alternatives. I conclude by suggesting that the world situation can only be resolved by adopting a global cooperative agreement or imposing draconian and politically unpalatable taxes on petroleum use.

Sources of Strain in Global Energy Markets

In this section I offer seven explanations for the coming crisis. First, China and India have emerged on the global energy scene as major market par-

1. The derivation of table 7.2 from the BP Prudhoe Bay Royalty Trust is explained in appendix 7A.

Figure 7.1 Settlement price of spot, 12-month forward, and 24-month forward WTI futures, 1999–2004



WTI = West Texas intermediate crude oil prices

Sources: Platts; NYMEX.

ticipants. Increased industrial output in these countries and a more affluent citizenry have boosted energy demand, particularly for petroleum, at record rates in both. Second, the key players in the global energy industry—OPEC nationals and the large multinational companies—failed to anticipate the demand growth and did not expand capacity to meet it. Investment slowed or stopped following the price collapse at the end of the 1990s, and companies have been reluctant to accelerate programs since. Third, precarious political circumstances in key oil-exporting countries make supplies from these nations uncertain. Internally or externally caused disruptions in Iran, Venezuela, Saudi Arabia, or Iraq could result in a significant loss of world oil supplies, sending prices even higher. Fourth, energy processing and transportation capacity—particularly at refineries—has lagged growth in demand. World refiners today cannot produce the types of products demanded by consumers in the required volumes. Fifth, environmental regulations adopted in the United States and Europe have adversely affected refiner capacity to manufacture key transportation fuels such as gasoline, diesel fuel, and jet fuel. Supply limitations have led to large product price increases, which have pulled up crude prices. Sixth, consumers have heard a mixed and confusing message from governments and industry. Energy companies warned of shortages, while the auto industry signaled no supply problems. These conflicting signs have discouraged conservation, laid the foundation for large

Table 7.2 Expected future oil prices derived from BP Royalty Trust (dollars per barrel)

Year	May 2003	August 2004
2005	27.17	41.92
2006	28.26	44.23
2007	29.39	46.66
2008	30.57	49.23
2009	31.79	51.94
2010	33.06	54.79
2011	34.38	57.81
2012	35.76	60.98
2013	37.19	64.34
2014	38.68	67.88
2015	40.22	71.61
2016	41.83	75.55
2017	43.51	79.70
2018	45.25	84.09
2019	47.06	88.71
2020	48.94	93.59

Source: Author's calculations.

increases in use, and created conditions that could cause very large price increases. Finally, Saudi Arabia and the other OPEC members engaged in a coercive effort to squeeze global supplies. This effort, which would be illegal in any developed nation, denied consuming nations the opportunity to prepare for the impending storm.

The new presidential administration must begin a program to address the tightening situation in world energy markets. The effort will require cooperation with other nations to achieve three goals: reducing uncontrolled growth in consumption, stimulating increased production, and stabilizing markets. However, the attempt will fail without large and painful measures at home. The cost of failure will be high. Inaction will no doubt lead to sharply lower rates of global growth and possibly a severe recession.

Influence of China and India

The emergence of China and India as principal players on the global energy scene represents the most important change in the global energy economy in 30 years. In 1990, consumption in these two countries amounted to no more than 3.5 million barrels per day, approximately 5 percent of global petroleum use. In 2003, 13 years later, use in the two countries has more than doubled and now accounts for more than 10 percent of global oil consumption.

Table 7.3 Sources of growth in world oil consumption, 1990–2003 (millions of barrels per day)

Source	1990	2003	Annual growth rate (percent)
China and India	3.6	8.7	7.0
Total world	66.2	78.1	1.3
World, less China and India	62.6	69.4	0.8

Source: BP *Statistical Review of World Energy Markets*, 2004.

The impact of the two countries on world markets can be seen in table 7.3. The top row of this table shows total use by these two countries in 1990 and 2003, as well as the annual rate of growth, which is 7 percent. The second row shows total global use, which grew at the far more sedate rate of 1.3 percent per year. Row three of table 7.3 shows the growth rate for global consumption excluding India and China. Global consumption exclusive of India and China increased at a rate of only 0.8 percent per year.

The slower growth in use in the non-China/India world is explained by lower rates of economic growth in these areas and lower intensities of oil use. China and India, without question, recorded more rapid rates of economic expansion from 1990 to 2003 than the rest of the world. Furthermore, the income elasticities of oil demand growth in India and China appear to be roughly 50 percent greater than those estimated for the rest of the world.[2]

This finding should not come as a surprise. A number of studies of petroleum and energy demand have found that elasticities are very high for developing countries emerging as newly industrialized nations (see, for example, Dunkerley 1990).

Inadequate Investment in Developing Oil Reserves

The rapidly changing global oil environment can also be traced to underinvestment. Between 1990 and 2003, the productive capacity of the global oil industry increased at a rate of 1.1 percent annually (compared with growth in global consumption of 1.3 percent per year). For a number of years, the slower expansion of productive capacity was not important be-

2. Very rough econometric estimates suggest the elasticity of demand for petroleum for the world as a whole is around 0.5, while the elasticities of demand for China and India are closer to 0.75.

cause OPEC nations collectively held substantial surplus capacity. However, this surplus was exhausted in 2004.[3]

Caution on the part of producers as well as political disruptions explain the lack of investment. The 1998 oil price collapse profoundly affected private firms and government companies in OPEC nations. In addition, private investors—particularly major oil companies—have not put large sums into significant projects outside major industrialized countries because they fear their investments would never be recovered.

The absence of investment has been noted by international energy officials, who have repeatedly called on oil-exporting nations and major oil companies to boost expansion. These pleas have largely been rejected. *The Wall Street Journal* reported in August that officials from OPEC countries and multinational companies rebuffed a direct appeal to heighten investment from Claude Mandil, executive director of the International Energy Agency (IEA).

> After a heated debate over the outlook for demand, the oil officials—including officials from the Organization of Petroleum Exporting Countries and major international oil companies—stood firm, according to four participants. Fearful that prices would collapse again as they did in 1998, no one was willing to raise spending sharply. "The OPEC countries said they would wait and see if there was a structural shift up in demand," said one participant. "But that could take years."[4]

In September 2004, Thierry Desmarest, chief executive of Total, the world's fifth largest multinational oil company, told *Financial Times* that private companies could not meet the world's increasing demand by investing outside of OPEC. Instead, he warned that the world's rising need for oil could be satisfied only if OPEC countries allow the multinationals to invest and develop added production within their borders.[5]

Missing from Desmarest's remarks was a caution that both private and national companies in OPEC nations were once concerned that increased production from Iraq could quickly drive prices down. Prior to the war in March 2003, there was widespread speculation that a swift Iraqi victory would lead to a flood of oil on world markets. Just as the invasion was about to start, a *Washington Post* reporter wrote,

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3. Measuring capacity in the petroleum industry is very subjective. In the case of non-OPEC countries today, capacity is almost always fully utilized. What surplus capacity exists is found in OPEC. The calculations of OPEC's surplus capacity have always been biased. For years *Petroleum Intelligence Weekly* (*PIW*) has published estimates of OPEC productive capacity and production. The *PIW* figures are usually cited in press and expert reports. They indicate that OPEC had a surplus of 8 million barrels per day in late 1989 (12 to 14 percent of global capacity) before Iraq invaded Kuwait. This surplus dwindled to 0.5 million barrels per day (less than 1 percent of global capacity) by September 2004.

4. Bhushan Bahree and Patrick Bartak, "Awash in a Gusher of Cash, Oil Firms are Reluctant Investors," *The Wall Street Journal*, August 26, 2004, 1.

5. Interview with Thierry Desmarest, *Financial Times*, September 13, 2004.

> Would a postwar Iraq, an original member of the Organization of Petroleum Exporting Countries that has been on OPEC's sidelines since its defeat in the 1991 Gulf War, support Saudi goals of keeping world oil prices within a stable range, about $25 a barrel? Or would Iraq rush to refill its treasury by boosting production, and driving down oil prices, at the expense of the Saudis, Iran, Kuwait, and other producers? In that scenario, could OPEC survive?[6]

The concern of world investors regarding Iraq's intentions seemed warranted. The country is acknowledged to possess reserves in excess of 100 billion barrels and might be able to more than double production. Another prewar *Post* article explained,

> Iraq, which has the world's second-largest oil reserves after Saudi Arabia, has produced at most 2.5 million barrels a day in recent years and is exporting nothing now. It is likely to raise production to 3.5 million barrels a day within two years, when, by opening fields that have gone untapped because of the sanctions, it could increase production to as much as 6 million barrels a day in five to seven years.[7]

With this background, the conservative approach to investing by oil companies and oil-exporting countries seems reasonable. Unfortunately, the inability to boost production from Iraq immediately contributes to the problem where world supply is likely to increase at a rate slower than global demand would rise if the oil were available.

Political Instability in Oil-Exporting Countries

Market expectations have also been altered by anxiety associated with the future tenure of governments in a number of oil-exporting countries, as well as worries that internal conditions may adversely affect oil production. Iraq is clearly the most prominent concern. Oil exports have been repeatedly upset by attacks on production and transportation facilities.

However, Iraq is not unique. Many other producing nations have problems. Exports from Nigeria have been threatened repeatedly by a low-level civil war between those living in oil-producing areas and those ruling the country. Venezuelan output was disrupted in early 2003 and continues to be vulnerable to a dispute between radical president Cesar Chavez and the large middle class that ran the oil industry for decades. Prospects for output increases from Russia, the world's largest non-OPEC producer, are now at risk because of the dispute between Yukos, the country's largest oil company, and President Vladimir Putin.

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6. Peter Behr, "Iraq May Regain Status as an Oil Industry Power," *The Washington Post*, March 23, 2003, A08.

7. Robert J. McCartney, "OPEC May Feel Pressure with Return of Iraqi Oil," *The Washington Post*, April 27, 2003, A26.

Another concern is Iran. The country is under pressure not from internal disputes but from the United States and the European Union demanding dismantlement of its nuclear enrichment program. Foreign policy scholars have warned that Iran's acquisition of nuclear weapons would quickly destabilize the Middle East.[8] Others warn that Israel may take preemptive military action against Iranian nuclear facilities just as it did years earlier against Iraq.[9] An Israeli attack or UN sanctions on Iran could destabilize production from the Middle East. Iranian output could be disrupted. More likely, though, Iran will attempt to influence exports from other countries. World oil supplies were affected periodically during the 10-year Iran-Iraq war in the 1980s. Battles then had only modest impacts on world oil prices because the capacity of producing countries drastically exceeded the needs of consuming nations. Today, as already noted, no such surplus exists. Conflict with Iran would likely lead to a large price increase.

Finally, the political situation in Saudi Arabia, the world's largest oil-exporting country, must concern the new US administration. Terrorists have increased their attacks on the most visible targets in the kingdom following the US invasion of Iraq, and foreign workers (particularly British and American citizens) have become targets. There is a small but nontrivial probability that exports from the country will be disrupted by some political or terrorist act in the next four years. Such an incident would cause serious global economic dislocations.

In short, a variety of threats to oil production exist in countries that supply much of the world's oil needs. Some of these risks have been listed in this chapter. Over the next four years, one must expect to see supplies interrupted to an extent that averages at least 1 percent of world capacity each year.

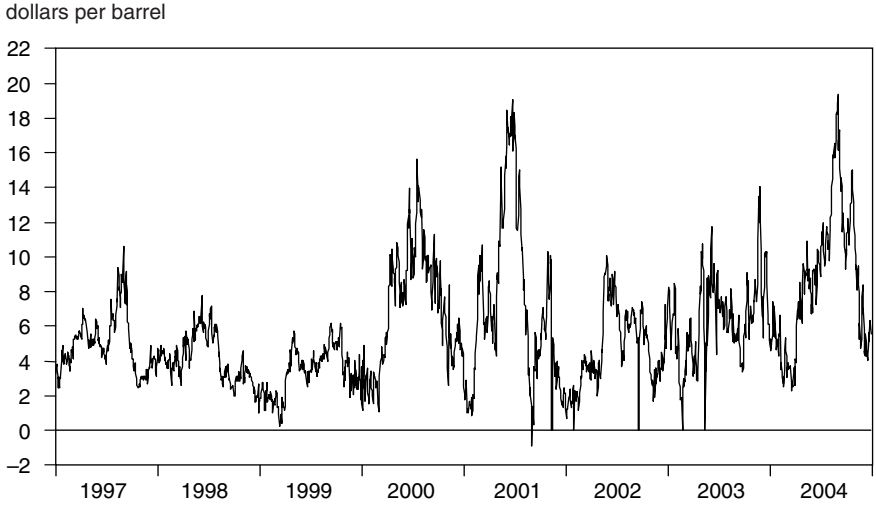
Inadequate Investment in Refining Capacity

The lack of investment in the refining capacity required to produce—from the crude oils being pumped today—the quantity of fuels demanded by consumers in Europe, Japan, and the United States, fuels that must comply with increasingly stringent environmental standards, is complicating the developing energy crisis. In particular, world refiners will apparently not be able to manufacture sufficient gasoline, diesel fuel, and jet fuel that meet current environmental standards at price levels close to those that prevailed in 2003.

8. See Fareed Zakaria, "Iran: the Next Crisis," *The Washington Post*, August 10, 2004, A19, and Walter Russell Mead, "Iran: A Darker Shadow than Iraq," *The Los Angeles Times*, July 25, 2004.

9. Tyler Marshall, "Iran Threat Grows among Rising US Divisions," *The Los Angeles Times*, September 12, 2004.

Figure 7.2 Refining margin on unleaded gasoline, US Gulf Coast, 1997–2004



Source: Author's calculations.

The shortage of refining capacity has developed for three reasons. First, the world's largest oil companies refrained from expanding refining during the last decade because returns on investment were low.[10] Second, China did not forecast the growth in its demand for products and build sufficient capacity. Third, competition regulators in Europe and the United States demanded that the large companies divest themselves of refining assets. In the United States, the Federal Trade Commission (FTC 2004) is proud of its actions, believing the divestitures enhanced competition. Unfortunately, the smaller firms that acquired refineries cannot raise capital as easily as the multinationals. Capacity expansion has slowed. The costs of the shortsighted FTC policy became all too visible in the spring of 2004 when the industry could not boost production to meet surging demand. Spot gasoline prices rose by 50 percent from March to June, refining margins surged to record levels (as can be seen in figure 7.2), and the higher gasoline prices pulled up spot crude prices.

(There is a widespread belief that petroleum product prices follow crude oil prices. Federal Reserve Board Chairman Alan Greenspan often expresses this view.[11] This economic theory is sometimes correct. How-

10. See the forthcoming National Petroleum Council study on refining (draft on file with author).

11. See remarks by Chairman Alan Greenspan, "Central Bank Panel Discussion: Economic Developments," at the International Monetary Conference, London, England, June 8, 2004, www.federalreserve.gov.

ever, when refining capacity constrains supply, product prices will lead crude prices; see box 7.1.)

The 50 percent rise in gasoline prices recorded in the spring of 2004 might have been partially avoided had competition regulators adopted a different strategy toward mergers. At the time, the rule makers reviewed existing refining capacity without regard to potential increases in global product demand or the synergies achievable if merging companies had been able to link refineries together. In one case, the opportunity to boost US refining capacity by as much as 300,000 barrels per day (1.7 percent of US capacity) was lost.[12] The potential supply of products in the United States and Europe today would be as much as 10 percent greater had the FTC and its counterpart in Europe conditioned merger approvals on commitments by refiners to expand capacity.

China's failure to invest in refining capacity also contributed to (and will continue to contribute to) the rise in crude prices, particularly in the fall of 2004. China did not construct adequate refining capacity to meet its growing demand. China also did not build the type of capacity required to process high-sulfur Middle Eastern crudes. Thus to meet growing distillate demands in the fall of 2004, China was forced to bid for the world's limited supplies of light, low-sulfur crude. China's action may have added as much as $10 per barrel to crude prices.[13]

New, More Stringent Environmental Requirements

New environmental rules that require sulfur removal from gasoline and diesel fuel make the situation more precarious. These regulations began to take effect for US gasoline in 2004 and will apply to European diesel in 2005. When US regulations were finalized in 1999, the US Environmental Protection Agency (EPA) predicted that refiners would have no difficulty meeting the requirements because they would invest in the capacity needed to reduce sulfur (EPA 1999a).

The EPA predictions were proven wrong. The agency failed to account for the separate FTC policy that ordered major integrated oil companies to divest refining capacity. The acquiring firms lacked the financial resources to proceed with investments at the rate predicted by the EPA. In theory, imports might have offset the absence of US supply. However, many foreign refiners that had previously provided gasoline to the United

12. The opportunity occurred when Shell and Texaco merged refining operations. The two companies owned adjacent refineries in the state of Washington with combined capacity of less than 200,000 barrels per day. The merger produced a chance to create one giant refinery of 500,000 barrels per day or more, which might have met much of the West Coast's demands.

13. See "Refiners at the Limit on Sulfur," *Argus Global Markets*, September 27, 2004, 3, and "China Leads Race to Secure Sweet Supply," *Argus Global Markets*, September 13, 2004, 2.

Box 7.1 Arbitrage between crude and product

There is a widespread view that prices of petroleum products follow world crude prices. Federal Reserve Chairman Alan Greenspan often cites this thinking in his testimony before Congress.

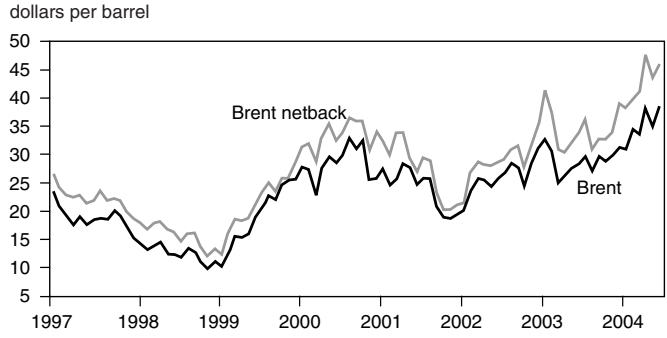
The empirical evidence refutes the position that product prices always follow crude, as does economic theory. Traders at oil companies have understood the role of arbitrage for decades. Every day they calculate the gross product worth (GPW)[1] of a number of different crudes and then compare them with crude spot prices. After deducting transportation and processing costs, they rank the crudes according to profitability and bid for the most profitable. The bidding process drives the crude spot price toward the GPW. Financial economists describe this process as arbitrage.

Arbitrage has been explained regularly by all major petroleum market publications. The most complete presentation dates back to 1979 in *Petroleum Intelligence Weekly (PIW)*. The 1982 version of the explanation begins with this advice: "Oil price developments are now attracting the attention of many non-specialists without a background in the understanding of the marketplace and the analytical tools used in assessing trends."[2] EIG, the publisher of *PIW*, has reissued the explanation periodically, most recently in the organization's *International Crude Oil Market Handbook*.

The financial importance of netbacks to the oil industry is evidenced by how frequently they are estimated and published. These numbers provide traders and managers with stylized rankings of various crude values. *Argus Global Markets* prints weekly netback estimates for a variety of crudes at three markets: northern Europe, US Gulf Coast, and Singapore. The netbacks are based on Argus' valuation of markets. *Platts Global Alert* publishes daily estimates of netbacks in a number of markets based on Platts' estimates of spot prices in markets.

The arbitrage theory can be demonstrated analytically by statistically comparing the GPW of a crude with the crude's reported spot price. The results of such a test, shown in figure 7B.1, demonstrate the relationship between crude prices and spot product

Figure 7B.1 Brent spot price versus gross product worth at Houston, 1997–2004



Source: Author's calculations, from *Weekly Petroleum Argus* data.

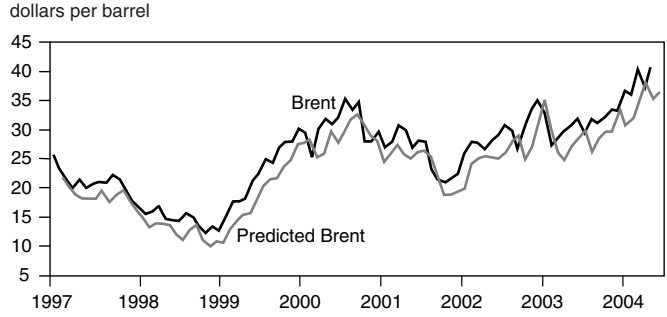
1. The gross product worth of a crude is nothing more than the weighted average value of all the refined product components of a barrel of crude at the refinery gate. The value is determined by multiplying the spot price of the products produced from the crude by the percentage volume of product yielded from a barrel.

2. "The ABCs of Measuring Oil Market Price Trends," *Petroleum Intelligence Weekly*, March 8, 1982, special supplement, 2.

(box continues next page)

Box 7.1 Arbitrage between crude and product *(continued)*

Figure 7B.2 Brent spot price versus spot price predicted from gross product worth at Houston, 1997–2004



Source: Author's calculations.

prices. Figure 7B.1 shows the spot price of Brent crude (Dated Brent) as reported by *Weekly Petroleum Argus*. Also shown is the GPW of Brent computed at the US Gulf Coast (Houston).[3] One can note that the spot price of Brent closely follows the GPW.

There is a strong linkage between the spot price of Brent and the GPW. A regression of the change in the Brent spot price on the change in the GPW yields an R-squared of 0.71 and a highly significant coefficient on the change in GPW (the *t*-statistic is 12.6).[4] Figure 7B.2 compares the actual spot price with the predicted spot price. The arbitrage during periods of high crude inventories (1998–99) and low crude inventories (late 2000, 2003–04) is obvious.

3. The GPW of Brent was computed using refining yields published in *The International Crude Oil Market Handbook 1999–2000* published by EIG.

4. The regression is estimated in first difference form to correct for the covariance with time in the data. A test of the relationship estimated in level form (regression of spot prices on GPW) reveals the presence of a unit root.

States found they could not comply with the new regulations. The EPA, in effect, had erected a nontariff trade barrier.

Absence of Conservation by Key Consumers

The absence of conservation has increased the intensity of the looming crisis. The American motorists' love of sport-utility vehicles (SUVs) and trucks provides the most obvious manifestation of the problem. The Department of Energy (*DOE Monthly Energy Review*, May 2004, 17) reports that average fuel economy of all vehicles increased from 11.9 miles per gallon in 1973 to 17 miles per gallon in 2002. This trend has now been reversed. Increased demand from less efficient SUVs probably imposes an

additional 200,000 to 500,000 barrels per day of incremental demand on a refinery industry that is, as noted earlier, short of capacity. The incremental demand causes an unnecessary rise in gasoline prices—and the higher gasoline prices translate into higher crude prices.

OPEC's Aggressive Effort to Keep Inventories Tight

Oil-exporting countries have clearly contributed to the precarious balance in global energy markets by pursuing a production strategy aimed at keeping inventories extremely lean. Saudi Arabia introduced this tactic in 1999 when crude prices hovered around $10 per barrel. The policy's proponents asserted that oil exporters would enjoy much higher revenues if they actively discouraged private parties and governments of consuming nations from holding excess stocks. Their plan succeeded.

The higher price levels have been achieved by collusion and intimidation. OPEC members have met regularly to set and adjust production quotas. At the same time, they have coerced other countries—principally Mexico and Norway—into joining agreements to cut output. In March 1999, when crude prices hovered briefly around $10 per barrel, Saudi Arabia pressured OPEC countries and three other nations into pumping less. At the time, the kingdom threatened to boost production and drive prices below $5 per barrel unless the others cut back (*Petroleum Intelligence Weekly*, March 22, 1999, 1).

Oil-exporting countries announced two production cutbacks during late 2003 and early 2004. While not fully implemented, these reductions removed any incentive for refiners or traders to hold inventories, leaving the global economy vulnerable to large price increases when unexpected consumption growth occurred in China and India.

OPEC's continued pursuit of these anticompetitive policies will only make crude oil prices more volatile and much higher over the rest of the decade. The impacts will be particularly pernicious if oil-exporting nations act aggressively to thwart efforts to protect consuming economies against OPEC's domination of the world oil market.

Strains on the Oil Market: Repeating History

The situation regarding energy markets in January 2005 will be very similar to the one that confronted Richard Nixon on the eve of his inauguration in 1973. At that time, James Akins, former US ambassador to Saudi Arabia, published a seminal article in *Foreign Affairs* entitled "The Oil Crisis: This Time the Wolf Is Here" (Akins 1973). Akins focused on efforts by oil-exporting countries to wrest control of their resources from multinational Western oil companies and the attempts by producers to stand to-

gether within OPEC to "manage" the oil market. He noted but then disparaged the prevailing view that producer attempts to restrain output would fail. He also ridiculed forecasts that oil prices would remain below $2 per barrel until at least 1980.

Akins cautioned that then-prevalent competitive bidding by consuming countries for oil sold by an increasingly united cartel could result in an uncontrolled upward rise in oil prices.

> With OPEC production limitations in the future, or even with normal slow growth, with only Saudi Arabia and perhaps Iraq capable of substantial expansions, bidding for supplies could soon get out of hand, and the projected price of $5.00 per barrel in 1980, or even a price of $7.00, could seem conservative. (Akins 1973, 487)

Akins' contribution was to foresee the need for cooperation among consuming countries to avoid bidding against one another for oil supplies. He advocated developing alternative energy sources, a relatively new idea in 1973; cooperation among consuming countries, particularly in developing oil resources outside OPEC; and finally, conservation, noting that such measures "could do much to limit our present profligate use of energy for a host of marginal purposes" (Akins 1973, 489).

Scenarios for World Oil Markets and the World Economy

The situation in the world oil market today bears a remarkable similarity to the one Akins observed. The foundations of the earlier crisis were laid between 1960 and 1970, just as the foundation of the current crisis was formed between 1990 and 2002. In the earlier episode, economic growth in Europe and Japan stimulated increased oil consumption, while the world's multinational companies simultaneously limited investment. In Europe, small automobiles replaced bicycles and motor scooters, and then larger cars replaced smaller cars. In Japan, economic growth stimulated increased oil use across the economy. Simultaneously, a surplus developed in world oil markets. The United States responded by imposing quotas on oil imports, creating significant downward pressure on oil prices. Multinational oil companies, then the stewards of OPEC oil, forced producers to accept price cuts. Investment lagged.

The similarity between the first decade of the 21st century and the 1970s can be seen by comparing table 7.3 with table 7.4. Table 7.3 shows the "but-for" growth rate for global oil consumption excluding the rapid development of India and China between 1990 and 2004. Table 7.4 shows similar statistics for the period 1965 to 1971. However, in the case of table 7.4, the sources of higher-than-average growth are Europe and Japan. The data for the earlier time reveal that global consumption grew

Table 7.4 Sources of growth in world oil consumption, 1965–71 (millions of barrels per day)

	1965	1971	Annual growth rate (percent)
World, less USSR	23.2	36.1	7.6
Europe	7.4	12.5	9.1
Japan	1.7	4.6	17.9
World, less Europe and Japan	14.1	18.9	5.0

Source: BP *Statistical Yearbook*.

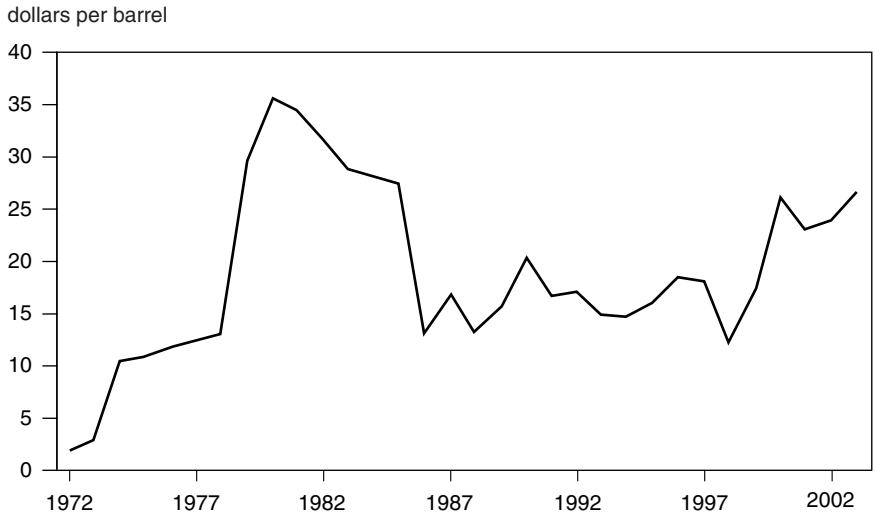
at a rate of 7.6 percent per year over the six-year period. However, growth in the more developed areas (primarily the United States and Canada) was a more "sedate" 5 percent.[14] Free-world consumption in 1971 would have been 14 percent, or 5 million barrels per day, lower in 1971 than actually recorded, had use in all countries expanded at 5 percent rather than the recorded 7.6 percent rate. The difference of 5 million barrels per day was enough to set the stage for the 1973–74 energy crisis.

A few experts writing in the late 1960s and early 1970s recognized that the rapid growth in global demand combined with the lack of investment in exploration in OPEC countries, as well as other energy policies such as price controls imposed on natural gas, created the potential for a future energy crisis. A task force convened by President Nixon under the direction of George Schultz considered the issue in detail. Their study of the effect of US limitations on crude oil imports noted the need for new investment but expressed little concern. Instead, the members concluded that Saudi production would have to double by 1980, filling the gap (US Cabinet Task Force on Oil Import Control 1970). This did not happen. Rather, prices increased by 450 percent in two years and remained high, while oil production remained essentially unchanged over the decade (figure 7.3).

The situation today is no different from the one in 1973. An oil price rise of unpredictable magnitudes will occur if there are further unexpected increases in demand that cannot be met by boosting output—or if global production is disrupted. "Shortage conditions" (defined as periods when global demand cannot be satisfied at current prices) will likely emerge at times of stronger economic growth or at those times of year when global use crests (peak summer months and winter).

14. Energy consumption statistics for the period before 1990 generally exclude use in the former USSR. That convention is followed here.

Figure 7.3 Spot price of Arab light and Dubai crude oil, 1972–2002



Source: BP *Statistical Review of World Energy Markets*, 2004.

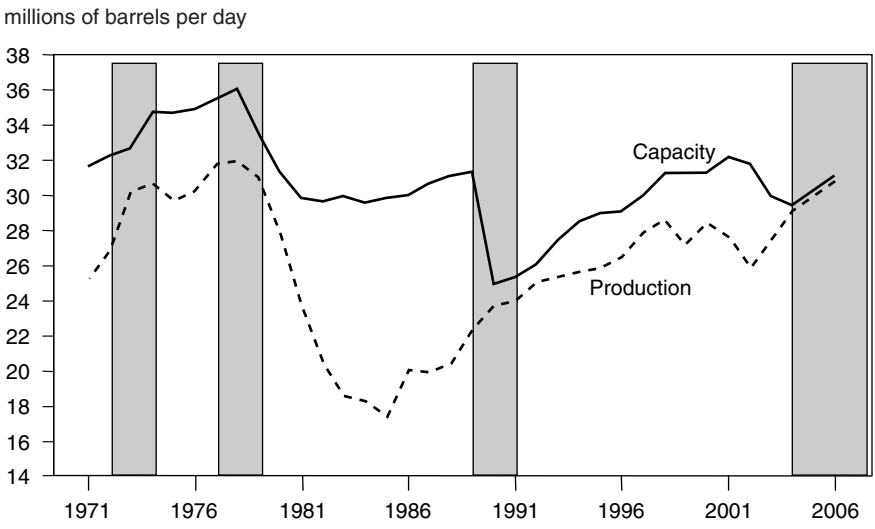
Crude prices could climb from the present average in the $40s to perhaps $55 by mid-2005 and as high as $70 in 2006 should "shortage conditions" occur in those years. Even higher prices might be seen later in the decade. In theory, crude prices might reach $160 per barrel if history follows the 1973 script precisely. As already noted, conditions today are propitious for such an increase. This does not imply, though, that prices will go up in 2005 or 2006. Circumstances are favorable, but that is all that can be said.

Such extraordinary price increases could be moderated today by using the strategic stocks created following the 1973 crisis. Today, governments of the major industrialized nations own or control more than 1.4 billion barrels of oil that might be deployed to address supply disruptions and steady prices. However, current policies preclude such action. Campaigning in 2004, Vice President Dick Cheney explained to voters that the United States would not use public stocks to stabilize prices.

> The reason we set up the [Strategic Petroleum Reserve, SPR] back in the '70s, and maintain it since, is to deal with the emergency that would arise if . . . something were to suddenly happen to one of the major nations supplying petroleum to the US . . . [and] we were dealing with a situation [in which] we lost 5- or 6-mil b/d . . . out of the 20-mil b/d that we currently consume. That would be the kind of national crisis that would drive prices so high and probably bring large parts of our economy to a halt. . . . We keep the [SPR] to deal with exactly that kind of contingency.[15]

15. *Platts Global Alert*, August 24, 2004. Secretary of Energy Spencer Abraham affirmed that this was the US policy a week later (*Platts Global Alert*, August 31, 2004).

Figure 7.4 OPEC crude output versus OPEC estimated productive capacity, 1971–2006



Note: Shaded bars denote periods of price increases.
Source: Author's calculations.

This statement implies that the US government would allow prices to rise to $70, $80, or even $100 per barrel without acting.[16]

The situation's tenuous nature is captured in figure 7.4, which shows OPEC productive capacity and OPEC output from 1971 through 2006. Note that periods of price increases (shaded on the graph) correspond to periods of sharp production boosts.

Economic Impacts of the Next Price Shock

Market events that took crude to $60 or $70 per barrel or higher would affect global and US growth rates. Macroeconomic Advisers (*Economic Outlook*, August 24, 2004, 11) calculates that each $10-per-barrel rise would reduce GDP growth relative to its baseline forecast by 0.3 percentage points in the current and next years. Federal Reserve Governor Edward Gramlich's estimates are approximately the same when the calculations are

16. The vice president's statement implies that strategic reserves are to be used only if the global supply unexpectedly falls 25 percent short of demand. Most models of global oil supply and demand would predict that such a shortfall would cause prices to rise by as much as 2,000 percent in the short run, although increases of such magnitude are unlikely to occur—or persist for long. Today, $100 crude would represent a 200 percent increase from early 2000 price levels.

made using large-scale econometric models, but larger if one uses reduced-form models such as those put forward by Hamilton (1983, 2003b).[17] The estimates offered by Gramlich and Macroeconomic Advisers suggest that a price increase of $40 per barrel that took crude to $70 would cut GDP growth by less than 2 percent, although nonlinearities in their model might cause the impact to be larger.

Today, though, most economists are talking not of $70-per-barrel oil but of $40-per-barrel oil. Furthermore, they begin by contrasting the $40 per barrel with a price level of $30 and conclude that the economic impacts are relatively modest. Such analyses tend to obscure the aggregate effect of oil price impacts on the global economy because the "consensus" is that oil prices would stay in the mid-$30s absent any market disorder. The impacts become significantly larger if one assumes that crude oil prices would be in the mid-$20s in a more stable world.[18] The losses associated with the shift between a $20-per-barrel world and a $40-per-barrel world are roughly double. One could argue that the macroeconomic calculations should start from this lower-price base because most studies show that crude oil prices would fluctuate around $20 per barrel if oil markets were not controlled by a cartel that aggressively cuts production to keep prices higher (Verleger 2004).

I have attempted to calculate the economic impacts of shifting from a low-price environment to a high-price one by employing results published by the IEA and the European Central Bank (ECB). Both organizations recently issued reports evaluating the macroeconomic impacts of higher oil prices (IEA 2004, Jiménez-Rodríguez and Sánchez 2004). The IEA published estimates of the impacts of a $10-per-barrel increase in oil prices on every region of the world.

I first examine the impacts on the US economy and then present summary results for the rest of the world. I created three macroeconomic scenarios for the United States using the multipliers published in these studies and quarterly consensus forecasts of GDP. I started with a base-case projection of GDP through 2006 founded on an assumed oil price in the low $30s. I then recalculated economic growth under two alternative assumptions. In the first, I assumed the West Texas intermediate (WTI) crude oil prices dropped to $23 per barrel on January 1, 2004, and stayed at that level through 2006.[19] In the second, I assumed WTI rose from $38 per barrel in 2004 to $48 in 2005 and $55 in 2006.

17. Speech by Edward M. Gramlich, "Oil Shocks and Monetary Policy," September 16, 2004, www.federal-reserve.gov/boarddocs/speeches/2004/20040916/default.htm.

18. I selected a price of $20 as the one that would prevail in a stable world because most oil firms today use that price to evaluate investment opportunities. Projects that can be profitable with prices in the low $20s are approved. Projects that cannot meet this test are not.

19. I use $23 per barrel for WTI because WTI tends to trade at a $3-per-barrel premium to globally traded crude.

Table 7.5 Impact on US economic growth under three alternative oil price scenarios, 2004–06

Scenario	2004	2005	2006
Annual rates of change in GDP (percent)			
Base case	4.7	4.1	3.7
Low prices	5.6	4.7	4.3
High prices	4.7	3.2	2.0
Q4-to-Q4 growth in GDP (percent)			
Base case	4.4	3.9	3.6
Low prices	5.3	4.5	4.3
High prices	4.4	3.0	1.9
WTI assumptions (dollars per barrel)			
Base case	36.9	33.2	31.0
Low prices	23.0	23.0	23.0
High prices	38.8	45.3	55.0

Q4 = fourth quarter
WTI = West Texas intermediate crude oil prices

Source: Author's calculations.

I derived the high crude prices assumed in the third case from an analysis of US gasoline price levels that will be required in 2005 and 2006 to cap the growth in use of that fuel. As already noted, a lack of new refining capacity combined with stricter regulations regarding gasoline sulfur content will limit the product's available supply. Annual retail price increases of between 30 and 50 cents per gallon will be required to arrest the expected demand growth. The higher gasoline prices will *pull up* crude oil prices during the spring and summer, leading to the crude price levels used here.

Table 7.5 shows the results of these scenarios for the United States. The findings of these simulations suggest that US GDP growth would be twice as high under the low-price scenario as the high-price one.

The IEA study also provided estimates of the economic impact of higher oil prices on other world regions. Table 7.6 shows these estimates for four price scenarios.

The impacts of higher oil prices calculated here reveal the obvious fact that the world would be better off with lower oil prices. Suggestions that higher oil prices are not as damaging to the world economy today as in the past may be correct. Nevertheless, lower oil prices are still better for the economy than high prices. As Governor Gramlich stated, "All things considered, although the present oil shock may not be as significant as the shocks we remember from the 1970s and 1980s, it will definitely register." [20]

20. Speech by Edward M. Gramlich, "Oil Shocks and Monetary Policy," September 16, 2004, www.federal-reserve.gov/boarddocs/speeches/2004/20040916/default.htm.

Table 7.6 Impact on global economic growth under four oil price scenarios, 2005 and 2006 (percent)

Region	2005		2006	
	Mid price	High price	Mid price	High price
Organization for Economic Cooperation and Development	–0.4	–0.9	–0.3	–1.3
United States	–0.3	–0.7	–0.2	–1.0
Eurozone	–0.5	–1.1	–0.4	–1.6
Japan	–0.4	–0.9	–0.3	–1.3
Oil-importing developing nations				
Asia	–0.8	–1.8	–0.6	–2.6
China	–0.8	–1.8	–0.6	–2.6
India	–1.0	–2.2	–0.8	–3.2
Malaysia	–0.4	–0.9	–0.3	–1.3
Philippines	–1.6	–3.6	–1.3	–5.1
Thailand	–1.8	–4.0	–1.4	–5.8
Latin America[a]	–0.2	–0.4	–0.2	–0.6
Argentina	–0.4	–0.9	–0.3	–1.3
Brazil	–0.4	–0.9	–0.3	–1.3
Chile	–0.4	–0.9	–0.3	–1.3
Highly indebted poor countries	–1.6	–3.6	–1.3	–5.1

a. Includes Mexico.

Source: Author's calculations.

Moreover, these three scenarios by no means offer a best-case/worst-case comparison. One can imagine a far worse case if the situation in the Middle East degenerated into a true crisis. The Middle East today faces the risk of continued chaos in Iraq as well as a potential confrontation with Iran. One can imagine a scenario where supplies from Iran were disrupted for a long time due to an attack on the country's nuclear facilities, while Iraq's efforts to boost production continue to be hampered by internal fighting. In such circumstances, prices could easily rise to levels above $100 per barrel even if the IEA authorized a release from strategic reserves.

Moderating or Avoiding the Impending Energy Crisis

The approaching energy crisis will cause serious economic dislocations despite the optimistic predictions of economists and central bankers.[21]

21. See Chris Giles and Andrew Balls, "Why This Time the World Economy Can Cope with an Oil Price Shock," *Financial Times*, October 20, 2004, 6. A number of central bankers and senior monetary officials quoted in the report commented that rising oil prices did not pose risks to the global economy similar to those created in 1973. The authors quote Federal Re-

The higher oil prices associated with limited available supplies will cause global growth rates to fall short of projected and achievable levels. However, many and perhaps all of these losses can be avoided if the United States and other nations adopt different energy strategies.

The United States must lead this effort because as the largest global economy it is also the world's largest petroleum consumer. In the eyes of many, the United States is also the most profligate oil consumer. Thus, the current course of energy markets, which seem to be taking the world toward economic catastrophe, will not change unless the United States acts.

Upon taking office, the new presidential administration will want to put forward policies to address the domestic and international dimensions of the crisis. These actions must attend to the short- and long-term situations. A number of measures are described in this chapter. Some of these focus solely on domestic energy policies. Such suggestions may seem out of place in a chapter centering on international issues. However, it can be argued that little will be achieved in the global policy arena until the United States institutes policies that correct the most obvious deficiencies of its domestic energy program.

Ultimately, the new administration will want to push other nations to accept an agreement to stabilize global oil prices. Such a program would require converting current strategic stocks to buffer stocks, doubling current storage capacity, and using buffer stock purchases and sales to stabilize prices within an agreed range. Adopting this program in January 2003 likely would have kept crude prices below $40 per barrel in 2004, effectively avoiding the loss of as much as 1 percent of global GDP. Adopting the program in January 2005 could raise global growth rates in 2005 and 2006 by as much as a full percentage point each year.

Creating a global agreement to stabilize prices will not, however, resolve current difficulties. Other polices must be pursued as well, if for no other reason than to convince oil-exporting countries that it is in their best interest to agree to a stabilization agreement.

In the petroleum sector, changes in short-term regulations, promotion of seasonal inventory management practices, development of measures that ensure better inventory management practices, aggressive advocacy of conservation, promotion of greater flexibility in environmental standards, adoption of policies that encourage refinery expansion, and expansion of global inventories can probably moderate most, if not all, of the short-term threat.

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serve Board Governor Ben Bernanke, who explained that the world is more resilient today than in 1973 because investors have greater faith in central banks. This faith will reduce the necessity of raising interest rates in response to further oil price increases. Economic losses associated with the 1973 increase were doubled when central banks raised interest rates in response to the oil price rise (see Schultze and Fried 1975).

The long-run crisis can be avoided by adopting aggressive measures to conserve energy and by working with producing countries to manage the global market. This management requires the expansion and frequent use of public stocks.

Short-Term Measures to Address the Current Problem

The current crisis results from the unexpectedly rapid growth in global consumption. This imbalance is exacerbated by the inability of many refineries to process available crude oils. The disparity can be rectified by adopting measures to limit consumption growth, promoting inventory accumulation whenever consumption declines, and relaxing environmental regulations temporarily.

Releasing Strategic Reserves Through a Swap

Conservative economist Stephen Hanke has asserted that George W. Bush's first administration's management of the US Strategic Petroleum Reserve (SPR) added $10 per barrel to crude prices. In a *Wall Street Journal* op-ed, Hanke argued that adopting a policy to lend reserves to the oil industry[22] as proposed in legislation authored by Senators Carl Levin and Susan Collins would lower oil prices by more than $10 per barrel.[23]

Hanke's proposal, which is similar to arguments other economists and I have made for years, adds conservative support to a discussion that has been very partisan to date. Unfortunately, his support is unlikely to lead to action because many politicians see strategic reserves as strategic, not economic tools. As noted earlier, Vice President Cheney emphasized that strategic stocks were being held solely to protect against very large oil supply disruptions. His view is widely held.

Nevertheless, the new administration, confronted with record high oil prices, will have to reconsider this position. In assessing the issue, it must be recognized that the high prices recorded at the end of 2004 were caused by a shortage of light, low-sulfur crude oil, not a crude oil dearth in general. This fact will provide the new administration with an opportunity to (1) quickly affect global oil prices while (2) actually adding oil to the reserve. This outcome can be achieved by selling inventories of light, low-sulfur crude oil held in the reserve while acquiring more than equal volumes of higher-sulfur, heavy crude. For example, if the market conditions

22. A proposal to "lend" oil from the SPR would involve selling crude to buyers under the condition that they return oil to the government in a specified time. The Clinton administration used such a strategy in October 2000.

23. Stephen Hanke, "Over a Barrel," *The Wall Street Journal*, October 21, 2004, A18.

prevailing at the end of October persist, the new administration could sell 100 million barrels of light, low-sulfur crude while purchasing 120 million barrels of heavier crude.

This swap can be achieved because the US SPR contains both types of crudes. At the end of October 2004, 270 million of the 690 million barrels in the SPR were described as light crude oil.[24]

The swap policy would not increase the exposure of the United States or any other country to the impacts of a severe energy supply disruption because the world refining industry has sufficient capacity to process the limited global crude supply available during such a disruption. As noted earlier, Vice President Cheney has stated that US policy envisions using the SPR only if the United States loses 5 to 6 million barrels per day of current supplies (25 to 30 percent). Under such circumstances, the world refining industry could process the available supply without difficulty. During the disruption, up to 25 percent of the world's refineries could be idled. If a light crude shortage occurred, those refineries requiring light crude could be shut down without causing any additional economic harm.

The immediate economic benefits of this swap strategy in 2005 would be tremendous. Hanke suggests that it could reduce crude oil prices by $10 per barrel. This estimate is probably conservative. A decision to put 100 million barrels of light crude oil on the market to be sold over 90 days could easily bring light crude oil prices down by $20 per barrel. WTI and Brent could trade for $35 per barrel by January 2005 if the strategy were implemented on November 1, 2004.[25]

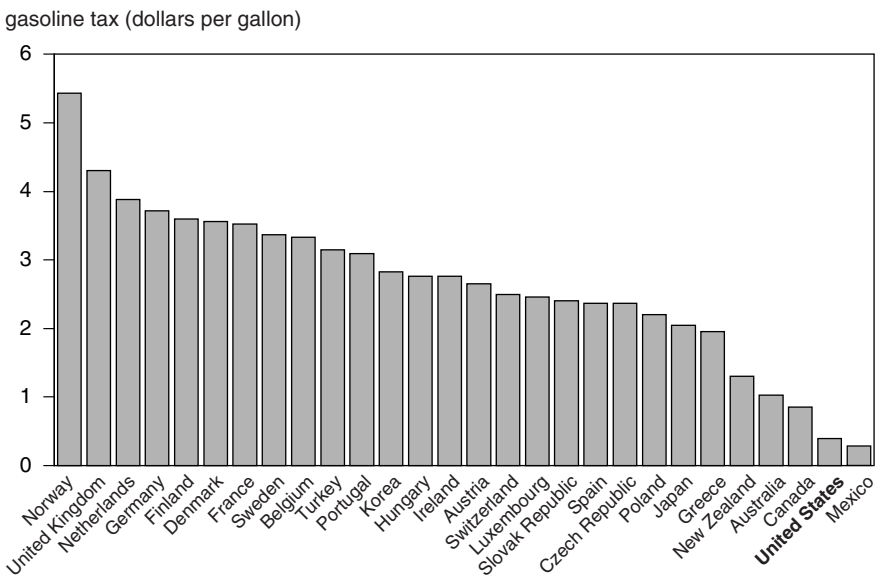
Raising the Gasoline Tax

A gasoline tax matched by a reduction in other taxes should be the critical component in a policy adopted to deal with the current imbalance in global markets. Today, taxes in the United States are well below those imposed in other countries, as can be seen in figure 7.5. Putting in place a tax of $1 per gallon would go a long way toward relieving the current pressure on world oil prices. A $1 tax would cut US gasoline consumption by roughly 8 percent (or 800,000 barrels per day) within a year. The reduced demand would ease pressure on world refineries and significantly moderate global crude prices.

24. See Strategic Petroleum Reserve Inventory for October 26, 2004, www2.spr.doe.gov/DIR/SilverStream/Pages/pgDailyInventoryReportViewDOE_new.html.

25. The prediction of a $20-per-barrel decline is calculated as follows. First, at the end of October the normal differential between light and heavy crude oils had increased by as much as $10 per barrel. Release of 100 million barrels of light crude oil would easily eliminate this premium. Second, the decline in the WTI cash price would start a liquidation of contracts for delivery in two to seven years if past trends hold. This liquidation could lower the entire forward price curve by as much as $20 per barrel but is more likely to cause a decrease of around $10.

Figure 7.5 Gasoline taxes by country, second quarter 2004



Source: IEA Energy Prices and Taxes, second quarter 2004.

A gasoline tax would also impose a serious fiscal drag on the US economy. At $1 per gallon, the tax would raise approximately $140 billion in revenues. This burden would need to be offset by lowering other taxes. A standard proposal offered by many economists involves compensating for the higher tax by eliminating or reducing the employee portion of the Social Security tax. Such an act would ameliorate the macro effects of the gasoline tax while preserving the conservation impact. Economic simulations repeatedly reveal that a revenue-neutral tax will not cause serious macro losses, although the effect on specific regions could be serious.

Unfortunately, a gasoline tax is always seen as politically impractical and regressive, even if coupled with a rebate such as waiving the worker portion of OASDI tax payments. Proposals such as a prospective gasoline tax joined with an SUV buyback program are also considered totally impractical.[26]

There are, though, two very strong arguments for adopting a gasoline tax. First, the low level of US gasoline taxes represents a serious imped-

26. This proposal would involve enacting a tax to take effect in two years. The time delay would allow consumers to readjust lifestyles, including moving closer to work. It would also allow cities and towns time to expand and improve mass transit. Associated with it would be a government commitment to buy back fuel-inefficient SUVs at market prices so owners would not suffer large financial losses. The SUVs would be scrapped.

iment to economic relations between the United States, the European Union, and Japan. Second, a large gasoline tax could frustrate efforts by oil-exporting nations to artificially elevate world oil prices.

A gas tax would contribute to improved global economic relations, possibly making it easier to achieve other important economic goals. Officials of many US allies confront enormous difficulties when they ask their citizens to accept further energy policy measures to cut usage. If the United States enacted a higher tax, it would make it easier for officials from these countries to cooperate on energy policy and other economic policy issues.

Instituting a large gasoline tax would also directly confront efforts by oil-exporting countries to raise prices artificially. Econometric studies show each $0.25-per-gallon increase in gasoline taxes would cut US motor fuels consumption by 200,000 barrels per day in the short run (defined as six months) and 700,000 barrels per day in the long run (two to three years).[27] Within two years, a $1 tax would reduce global demand by more than 2 percent, easing pressures on global oil markets. The reduced demand could ease upward pressure on oil prices, shifting as much as two-thirds of the tax burden from consumers to world oil producers.[28]

Revising the EPA Program for Reducing Sulfur in Gasoline

Recently implemented rules requiring gasoline sulfur reduction may also need to be rolled back. The plan was promulgated in 1999 and mandated a lowering of the refinery average of gasoline sulfur content to 30 parts per million (ppm) with a maximum per-gallon cap of 80 ppm by 2006 (EPA 1999b, 2004).

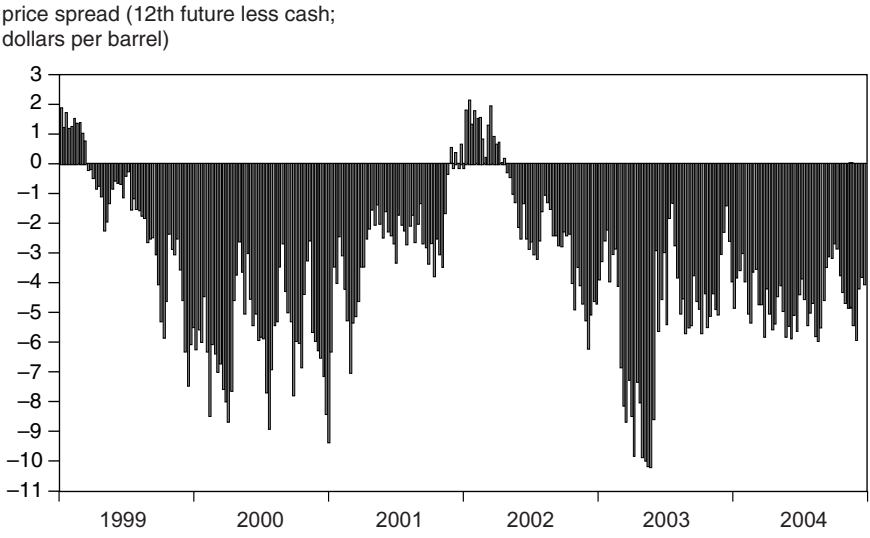
The program imposes a nontariff barrier to trade because refiners that export gasoline to the United States face tighter regulations than domestic refiners. As such, it has reduced the volume of exports that can be shipped to the United States in 2004 and may further lower the amount that qualifies for sale in the United States in 2005 and 2006 (Energy Information Agency 2004).

These rules contributed to the 50 percent increase in spot gasoline prices in the spring of 2004, which led to the crude price rise from the low $30s to $40. The EPA requirements will contribute to further large jumps in gasoline prices in the spring of 2005 absent regulatory relief.

27. Short-run price elasticities of demand range from –.2 to –4, while long-run elasticities are twice as large. See Dahl and Sterner (1991) or Houthakker, Verleger, and Sheehan (1976).

28. Imposing a tax on US motor fuels would raise the average price of all petroleum consumed in the United States by approximately $0.55 per gallon or $23 per barrel. The price increase would lower consumption by more than 1 million barrels per day. A decline of this magnitude under current market conditions could easily drop oil prices from the mid-$50s back to the mid-$30s, effectively shifting the burden of the tax to oil producers.

Figure 7.6 Incentive to hold stocks: Crude oil price spreads, 1999–2004



Source: Author's calculations.

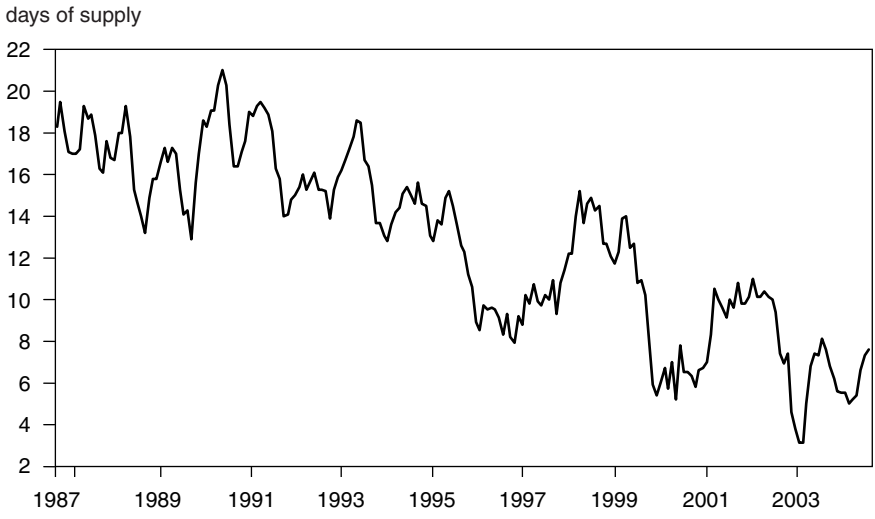
The current upward pressure on prices can be relieved by modifying the program. However, relief should be granted in a form that preserves returns on investments made in desulfurization equipment. Specifically, imported or domestic gasoline that does not meet the standards should be subject to a fee of $2.50 to $5 per barrel (5 to 10 cents per gallon). Such a fee would guarantee the returns of refiners but would potentially cap the increase in crude costs.

Adopting Policies to Promote Inventory Accumulation

Oil markets have been in "backwardation"[29] for more than five years, with the exception of a brief period following 9/11. In this situation, the price for crude oil or product to be delivered in a few months' time or a year is *less* than the product's cash price. For example, at the end of September 2004 the WTI spot price was $49.58 per barrel. On the same day, crude for delivery in a year settled for $43.73, a discount of $5.85 per barrel. Over the last year, backwardation has ranged from minus $2.70 to

29. Governor Gramlich defines the term as follows: "A stock exchange term for a percentage paid by a seller of stock for the privilege of delaying its delivery until some agreed on future date. In effect, the futures price is less than the spot price."

Figure 7.7 Usable commercial stocks in OECD countries, 1987–2004



Source: Energy Intelligence Group.

minus $6 per barrel (figure 7.6). This market condition discourages refiners and traders from holding inventories (Williams and Wright 1982).

The incentive to hold stocks is further reduced by the very high cost of crude oil and limited financial resources of several of the independent refiners created by FTC divestiture actions. These firms often cannot obtain credit to add stocks. As a result, privately held crude volumes have continually declined. One indication of this is the downward trend in commercially available inventories as reported by the Energy Intelligence Group as shown in figure 7.7. These stocks are measured in days of supply held in OECD countries that companies can draw to meet unexpected demand. One can observe that inventories have dropped from 17 days in 1990 to seven days in 2004.

The situation has become so extreme that three refineries—all owned by an independent firm—were forced to shut down following Hurricane Ivan because they exhausted their crude inventories. These plants were not affected by the storm, and the logistical facilities that supplied crude were disrupted for less than a week. The refineries ceased operations because they held less than a week's supply of crude. Such events did not occur in the past because refiners had larger inventories.

At the same time, peak global demand for key economic products such as gasoline, distillate fuel oil, and jet fuel has increased relative to refiner capacity. In other industries—and historically in the oil industry—such a

situation has been addressed in the short term by building inventories during periods of low seasonal demand. This has not occurred in 2004, though, because access to short-term capital has been limited and markets have been in backwardation.

Creating market conditions (contango) that encourage stock building would promote inventory accumulation. Contango could be promoted by releasing strategic stocks to private buyers. Converting strategic stocks to a buffer stock system designed to stabilize prices could achieve this goal. The stabilization program is discussed in more detail later.

Long-Term Strategies for Addressing the Energy Problem

President Bush proposed a detailed energy program in May 2001. His plan contained measures that would have boosted oil and gas production, expanded coal use, streamlined US regulation of the electricity industry, and removed many regulatory barriers that impeded energy investment projects. Missing from the Bush program were any serious steps to reduce energy consumption. Several versions of the Bush energy program were passed by the House of Representatives, and one version passed the Senate, but none ever passed both legislative bodies. The new administration will need to revisit the issue, putting forward legislation that can muster support from both houses.

Among other elements, long-term legislation must contain programs to reduce petroleum use, promote refinery capacity upgrades, and create a multinational system to stabilize oil price fluctuations. Some elements of a program are outlined here.

Adopting Programs to Reduce Oil Conservation

The new administration must take steps to limit growth in oil use. Historically, the primary tool for reducing use has been the corporate average fuel economy (CAFE) standards. CAFE rules require automakers to achieve certain specific fuel efficiency standards for each model year. These requirements, originally imposed in 1976, were effective until the mid-1990s. However, in recent years the auto industry has circumvented them by convincing consumers to substitute trucks (which were not subject to CAFE standards) for automobiles or to purchase SUVs, which under the law are treated as trucks. Going forward, this regulatory loophole needs to be closed and steps taken to improve vehicle fleet efficiency substantially by 2010.

A study by the National Academy of Sciences (NAS) published in 2002 concluded that a further increase in CAFE standards would reduce gasoline consumption by 2015 from levels that otherwise would be expected

to occur. However, the committee also noted that a number of alternative policies would be superior to mandated standards, including tradable credits for fuel economy standards, "feebates" (a combination of taxes on vehicles with low gas mileage and rebates for very efficient vehicles), higher fuel taxes, or standards based on vehicle attributes (NAS 2002). The NAS committee recommended that any changes in CAFE standards should include a broad program that allowed trading of fuel economy credits.

The NAS study forms the basis by which the new administration can frame a policy to reduce gasoline and diesel consumption substantially over the next 10 years. The opportunity should not be missed.

Implementing tighter fuel economy standards, particularly through market incentives, could save substantial volumes of petroleum by 2015 and 2020. Today, US consumers burn 10 million barrels per day of petroleum on US roads and highways, one out of every eight barrels of crude produced in the world. If current trends continue, US motor fuel consumption could rise to 12.3 million barrels per day by 2020 and account for one of every nine barrels consumed in the world. This projected figure might be reduced by as much as a third if fuel economy standards were tightened. As the NAS panel suggested, progress could probably be achieved most rapidly if these standards were imposed using market-based incentives. For example, a program of "feebates" could provide the necessary financial incentives for automakers to substitute lighter materials, composites, and more efficient drive trains for existing technologies.[30]

Adopting domestic policies that focus on reducing petroleum consumption will pay large dividends in international negotiations in the energy area by reversing present perceptions of US energy policy. A more favorable view of US policies will also facilitate talks in other economic policy areas.

Accelerating Introduction of Alternative Fuels such as Cellulosic Ethanol

The United States should also speed up programs to find environmentally acceptable fuel feed stocks that can be substituted for petroleum. Introducing significant volumes of such fuels would serve at least two purposes. First, OPEC's control over the oil market would be reduced. Second, total emissions of global warming gases would be cut. Such fuels exist. One of these fuels is cellulosic ethanol. Lugar and Woolsey (1999) list the advantages of the fuel:

30. A recent report by the Rocky Mountain Institute (2004) highlights the potential savings achievable through automobile redesign.

- "Cellulosic ethanol is a first-class transportation fuel, able to power cars of today as well as tomorrow, use the vast infrastructure already built for gasoline, and enter quickly and easily into the transportation system."
- "It can be shipped in standard rail cars and tank trucks and is easily mixed with gasoline."
- "Although somewhat lower in energy content, it has a substantially higher octane rating than gasoline, allowing for more efficient combustion."
- "It can radically reduce the emission of global warming gases, help reduce the choking smog of our cities, and improve air quality."
- "It is far less toxic than petroleum, far less likely to explode and burn accidentally, and far simpler physically and chemically, making possible simpler refining procedures."

The impediment to the use of cellulosic ethanol has always been cost. A study published by DOE in 2000 (Dipardo 2000) put the price of producing ethanol in this manner at between $1.15 and $1.43 per gallon (in 1998 prices). At the time, spot gasoline was trading at much lower prices. However, at the end of April 2004, spot gasoline prices were at a level that would make the ethanol process competitive.

Revising US and EU Merger Rules Regarding the Oil Industry

For the last decade, the US FTC has aggressively enforced US antitrust law to preserve competition in refining. The agency trumpets the fact that it has accomplished this goal (FTC 2004). Preserving competition has meant that consumer prices are lower than they would otherwise be, given the level of refining capacity.

The agency neglects to note, though, that its policies have effectively destroyed refining capacity. Investments that might have been made to expand facilities have not been made. For example, in the 1997 merger of Shell and Texaco refining assets, the companies could have converted two adjacent facilities into one giant refinery. That one very large, extremely sophisticated unit might have had 400,000 to 500,000 barrels per day of capacity (3 percent of total US capacity). However, the opportunity was lost because the FTC forced Shell to sell one of the units to an independent.

The rise of independent refiners is analogous to the rise of low-cost airlines. These firms receive assistance from the government in the form of waivers from environmental rules and other actions, just as the low-cost airlines have received special benefits from the Department of Trans-

portation.[31] However, the multinational companies have adopted a different strategy than the network airlines. Whereas network carriers such as United Airlines have sought to compete with the low-cost carriers, the major oil companies have gradually withdrawn from the market, selling other refineries and cutting investment.

The FTC policy to preserve competition, then, has slowed growth in refining capacity. Consumers are paying much higher, but competitive, prices for these actions. A new policy that promotes investment and quite possibly acquisition of independent refiners by multinational companies is urgently required to encourage the creation of more capacity.

Negotiating an Agreement Between Consuming and Producing Countries to Stabilize Prices

The last element of the new administration's energy program must be negotiating an agreement between oil-consuming and producing countries to stabilize oil prices. The program should be based on stabilization programs implemented with varying success for other commodities. In such programs, inventories are managed to moderate the price movements of a storable commodity by selling the commodity when its price threatens to exceed a target price and buying the commodity when the price falls below the target level.

Bosworth and Lawrence (1982, 152) note that such programs are a tool that can rapidly reach its goal. However, they also caution that buffer stock programs are difficult to establish. First, they require sufficient investment capital. Second, they require the participation of most if not all countries to avoid free riding. Third, buffer stock programs can discourage private stockpiling. Finally, buffer stock programs require producers and consumers to agree on a price stabilization range.[32]

The first three conditions have already been satisfied for oil. Government stockpiles have been created. The United States, Japan, and EU members today hold 1.4 billion barrels of strategic stocks. These could form the basis of the buffer stock program. The countries holding these inventories need only agree to permit their use for price stabilization pur-

31. For example, Frontier Airlines has been allowed to fly nonstop from Denver to Washington National while United Airlines has not, despite the fact that United Airlines has its major hub in Denver.

32. Bosworth and Lawrence also explain that it is not possible to create buffer stocks for all commodities. To be a candidate for stabilization, a commodity must be relatively homogeneous, an organized international market must exist for the commodity, and the market must be global so that commodity stabilization in one geographic location will affect prices across the globe. Petroleum clearly qualifies. See Verleger (1994).

Table 7.7 Estimates of OECD petroleum inventories and world petroleum consumption for selected years

Year	Public stocks (billions of barrels)	Private stocks (billions of barrels)	Total stocks (billions of barrels)	Worldwide consumption (millions of barrels per day)	OECD days of coverage from private stocks
1982	.6	2.8	3.4	61.7	72.4
1990	1.1	2.6	3.7	66.0	61.3
2000	1.2	2.5	3.7	76.2	51.8
2003	1.4	2.5	3.9	79.7	50.0

Sources: BP *Statistical Yearbook* and International Energy Agency.

poses. In addition, India and China, the two countries accounting for the current growth in oil use, are both planning to create their own stockpiles. These nations account for 80 to 90 percent of global consumption by oil-importing countries. Thus, there is little danger that other consuming countries will free ride.[33]

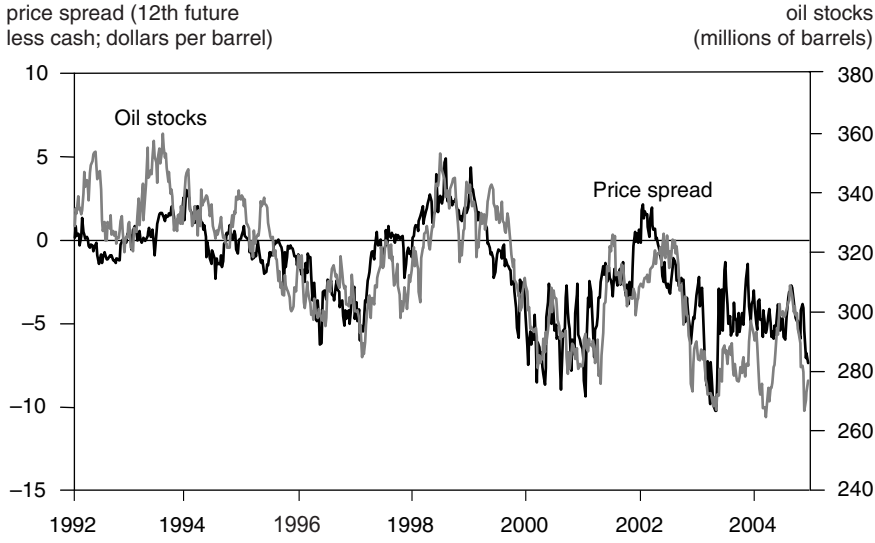
The development of strategic stocks has also already resolved the issue of substituting public stocks for private ones. Bosworth and Lawrence note that public stabilization programs can discourage firms from holding private stocks. Williams and Wright (1982, 341–53) predicted that private oil companies would reduce oil inventories if strategic stocks were created. Their hypothesis has been confirmed. At the end of 2003, public stocks totaled 1.4 billion barrels of oil (table 7.7). These inventories represent 30 percent of world stocks. Public stocks increased from 600 million barrels in 1982. During the same period, private stocks held in the OECD declined by 200 million barrels, despite a 30 percent increase in consumption. As a result, the days of coverage of private stocks fell from 72 days in 1982 to 50 days in 2003 (table 7.7).

Following practices established for buffer stocks, G-7 governments could use their inventories to moderate high oil prices by selling stocks when prices are above the target range and buying when prices fall below a lower level. Alternatively, governments could lend or swap stocks to buyers when prices are high, calling in the loans when prices fall.[34]

33. Free riding is a clear problem with buffer stock programs. Ideally, one wants all consumers to participate in the program. In the case of oil, one wants all oil-importing countries to join in a buffer arrangement. Between 80 and 90 percent of oil-importing countries have or are planning to build strategic stocks.

34. Central banks often lend their gold reserves to private firms to earn a return on otherwise stale assets. A jeweler, for example, will borrow 100 ounces of gold today for a cash payment, agreeing to return a like amount of gold in a year.

Figure 7.8 US private oil stocks versus weekly forward price spread, 1992–2004



Sources: API, NYMEX, and Platts.

A swap transaction would promote contango in the market, thereby boosting the incentive of private firms to hold inventories. Buyers would enter such transactions when oil for forward delivery sold for less than oil offered for delivery today. For example, on October 21, 2004, the price quoted for immediate delivery of Brent crude oil was $50.46 per barrel. However, on that date a buyer could acquire Brent for delivery in December 2006 for $44.36, a $6-per-barrel discount compared with prompt supplies. Under an exchange program, buyers could have taken oil from government stocks on October 21, while purchasing oil to be returned to the government in December 2006. Such sales of oil for delivery in 2006 would increase inventories and lower spot prices, while simultaneously raising prices of oil to be delivered a year later.

The use of swap transactions as a means of encouraging private stock building would address the difficulty described by Bosworth and Lawrence. Policymakers would promote forward buying. Swaps of strategic stocks would reduce backwardation or might even convert backwardation to contango. The shift toward contango would cause private inventories to increase.

The potential effectiveness of the strategy can be seen from figure 7.8. This graph compares levels of private crude oil inventories in the United

States, measured in millions of barrels, with the spread between the 12th future and cash WTI. The spread is graphed against the left vertical axis. Inventories are graphed against the right vertical axis. The period of coverage is 1992 to 2004. A very clear relationship can be observed from figure 7.8. The graph confirms the conclusion that a buffer stock policy relying on swaps would promote private inventory accumulation. Had such a policy been in effect in 2004, it is very probable that oil prices never would have surpassed $40 per barrel.

To be fully successful, the next administration should negotiate a program to expand governmentally controlled stocks that would form the base of the buffer stock. The additional storage capacity would be filled whenever world oil production exceeded world demand. Governments would acquire inventories at times when prices fell below an agreed purchase threshold. For example, stocks would have been augmented in 1998 when crude prices dipped below $20 per barrel.

The creation of a guaranteed market for crude reduces the risk of investing in high-cost projects that promise to deliver large volumes of oil in three, four, or five years. Most forecasts of world energy supply-and-demand balances indicate that these supplies will be required within five to ten years. Yet, as already noted, many firms refuse to invest because they fear a repetition of the 1998 oil price collapse. Price stabilization at a level that brought out such investment would remove the destructive economic cycle of underinvestment that is inevitably followed by a period of very high prices and macroeconomic losses.

The negotiators of a stabilization agreement will confront two strong objections. First, authorities in oil-consuming countries have argued repeatedly that strategic stocks have been built to meet a disruption in global oil supplies. Second, representatives of oil-exporting countries will complain that the imposition of a price stabilization authority deprives them of control over the market.

The first objection can be met by expanding the scope of the stocks allocated to the stabilization of oil markets and meeting future disruptions. Public support for such stocks—and willingness to support them—will no doubt increase if consumers observe that these stocks mitigate oil price increases such as occurred in 2004. Ultimately, a swap policy that promoted private stock building may result in a higher level of global inventories than the current policy based on the creation of large, "sterilized" public stocks combined with essentially no private stocks.

The second objection must be met by a declaratory statement from oil consumers that oil producers will no longer be allowed to artificially raise the price of oil above competitive levels as they have from 2000 to 2004. In the end, oil-consuming nations have the capacity—through taxation of petroleum—to frustrate the cartel's effort to raise oil prices above the marginal costs of production. Further, oil-consuming nations can neutralize

the coercive actions of some cartel members through the use of sanctions and fees on the imports of these countries.[35]

However, there should be no need for confrontation. One would hope that exporting and importing countries could quickly agree if consuming countries approach oil-exporting nations with a constructive proposal to stabilize prices in the price band advocated by OPEC for the last four years of $22 to $28 per barrel for a representative average of OPEC crudes. (The equivalent range for WTI would be $19 to $25 per barrel.) Agreement by the nations sponsoring the buffer stock to buy when world prices fall below $22 for the mix of OPEC crudes (the "OPEC basket") ought to convince exporting countries to cooperate with the effort.

Conclusion: Time Is Short and Action Is Required

Crude oil prices rose to record levels in 2004. In the next three years, they will climb even higher if action is not taken. Economic recession or worse will surely follow. It is not an exaggeration to say an economic storm of immense proportions lies just over the horizon.

In May 2001, President Bush called on Congress to pass a new energy policy. His request for action was correct; however the policies he put forward, even if adopted immediately, would do little to avoid the coming tumult. Today, the United States, the European Union, Japan, Russia, China, and OPEC members, particularly Saudi Arabia, must act as one to address this problem. Each country can take many steps by itself. However, the crisis can be avoided only if they all work together.

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35. In 1999 some OPEC members threatened non-OPEC oil-producing countries with dire economic consequences if they did not cut production. Several countries complied. Such coercion, if practiced by a private company, would be illegal in every OECD country. Any company caught engaging in such practices would be the subject of serious sanctions. Oil-consuming nations can impose similar sanctions on oil-exporting countries through the WTO if the exporter is a member, or through direct action if the country is not a member.

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Appendix 7A
The BP Prudhoe Bay Trust's Link to WTI

The BP Prudhoe Bay Royalty Trust is a financial instrument created by BP in 1989. BP sold the trust approximately 16 percent of the first 90,000 barrels per day of production from the Prudhoe Bay unit. BP undertook to buy the production back from the trust as the oil was produced at a price that was tied to the spot price of West Texas intermediate (WTI) at Cushing as reported by *Platts*. More than 21 million shares were sold to the public, and the units trade on the New York Stock Exchange under the symbol BPT.

The trust is passive. BP manages the Prudhoe Bay unit, produces the oil, and credits the trust with revenue less certain costs specified at the time the shares were issued. The trustee cannot spend the trust's revenue on further development of the field. Instead, all revenue must be passed back to shareholders.

The amount of revenue received by the trust is equal to the WTI price less certain deductions that were specified in 1989. These costs include production, taxes, and fixed costs. The prospectus for the shares indicated that costs of $4.50 per barrel would be deducted from the revenues received when the unit was first issued. The prospectus also stated that the cost charge would be adjusted upward over time to reflect the rising cost of operation and inflation. The most recent 10Q filed by the trust indicates that charges of $15.71 per barrel were deducted in the fourth quarter of 2002. These charges will rise gradually over the next 10 years.

The trust will end after 2010 if shareholders vote to terminate it or if revenues after cost deductions are negative for two consecutive years after 2010. There will be no residual payment for shareholders when the unit terminates.

The absence of a residual payment combined with the structure of the quarterly dividend mean that investors buying shares in BPT buy one and only one thing: a stream of payments tied to the price of oil. The payments will rise if crude oil prices increase and fall if crude oil prices decrease.

The linkage of payments to the price of oil means that the discounted value of expected payments ought to be linked to the expected trend of future oil prices. Indeed, if the share price of BPT is uncorrelated with the overall stock market (i.e., the beta is zero), then the stream of expected dividends discounted by the risk-free interest rate should equal the share price.

The beta of BPT happens to be statistically insignificant, i.e., zero. This means that the projected revenues discounted by the risk-free interest rate can be used to determine investor expectations of oil prices. Expectations of price increases are calculated by trial and error as follows:

- A rate of price increase of WTI is assumed (say, 2 percent per year).
- The rate is translated into quarterly estimates of WTI prices.

- The dividend flow from today to 2020 is calculated given the projected WTI trajectory.
- Dividends are discounted by the price of zero-coupon US Treasury instruments of identical maturity. (For example, the price of treasuries expiring in 2006 is used to discount 2006 projected revenues.)
- Discounted dividends are summed and compared with the quoted share price of the BPT. If the sum exceeds the share price, the process is repeated with a lower rate of price increase. If the sum is less than the share price, a higher rate of increase is tried.

The calculation stops when the sum of discounted revenues equals the quoted share price. As noted in the January 2003 *Petroleum Economics Monthly*, share prices of BPT have been a good predictor of the trend in oil prices over a long period.