How should the SPR be used, and what benefits does it provide?

A Superfluous Petroleum Reserve?

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Controversy surrounding the existence and management of the United States Strategic Petroleum Reserve (SPR) is not new. Since its creation, there have been legitimate concerns about whether the costs of acquisition and management are justified by the uncertain benefits provided by the SPR in the event of an emergency. Once established, additional questions have arisen about when and to what extent the SPR should be used in an emergency and even what constitutes a true emergency. More recently, some analysts have argued that the Bush administration's decision to fill the reserve to its capacity of 700 million barrels has significantly contributed to higher oil prices.

Clearly, the big news for oil is the dramatic increase in world oil prices since 2001—including the past few months' price spike. What is causing that increase? The simple answer is that the global demand for oil is reaching world production capacity. The Bush administration's addition of 125 million barrels to the SPR from November 2001 to December 2004 is miniscule compared to world consumption growth over the same period, which amounted to more than 2.5 billion barrels. Moreover, SPR stock additions either ceased when market prices spiked during supply shocks such as the Iraq War in early 2003, or occurred during periods of plentiful inventory. The analysis below strongly suggests that the Bush stock-build had no measurable impact on market prices.

While filling the reserve may make us feel secure, the true test is how it can be used in an emergency. Under current law, the president of the United States has the authority to decide whether an energy emergency exists and, if so, when and how to use the SPR. Our limited track record in dealing with those situations is not encouraging. Part of the problem stems from the legislation governing the use of the SPR in an emergency. A more fundamental problem arises from vesting a political entity with the inherently complex task of allocating oil across time and space—a task that is probably best left to market forces.

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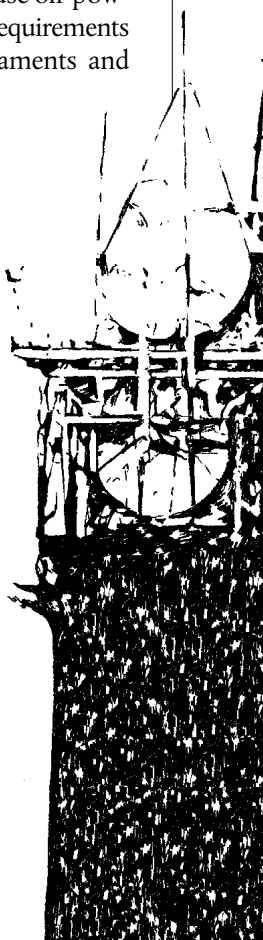
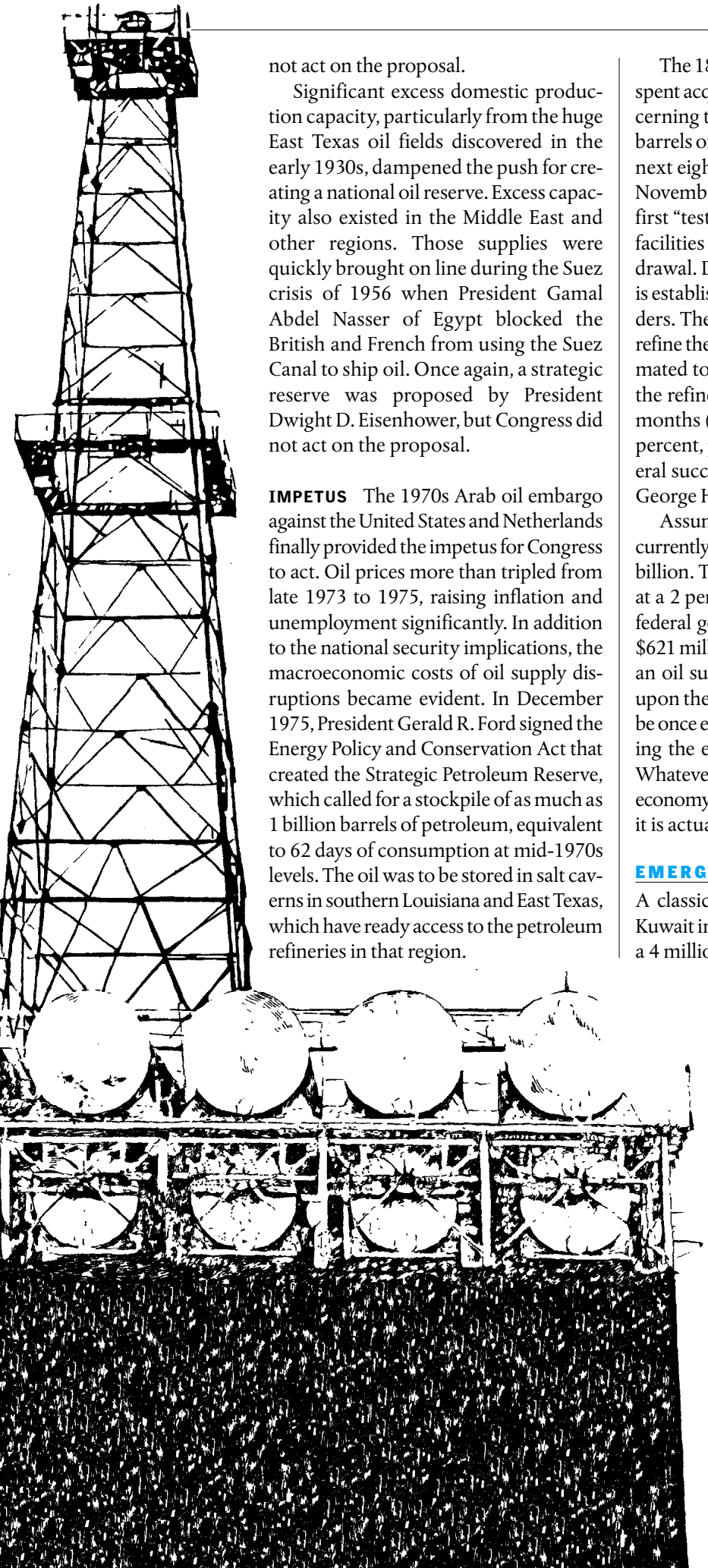
WHY DO WE HAVE THE SPR?

Since before World War I, oil has been viewed as a strategic commodity. Winston Churchill successfully argued that the British Navy should switch from coal to oil because oil-powered vessels dramatically reduced labor and space requirements and increased lethality by allowing more armaments and ammunition to be stowed on board. On the other hand, reliance on oil required the strategic placement of resupply points around the world. While the United Kingdom had abundant coal reserves, it did not have domestic oil reserves at the time, which was the principal argument against the transition from coal.



During World War I when the French mobilized the Paris taxi fleet to move troops to the front and stop the German advance, the strategic importance of gasoline became more obvious as a critical element in modern warfare. The strategic importance of oil was again affirmed during World War II after the collapse of the Japanese and German forces—a collapse that was in part attributed to their loss of access to oil fields and to the destruction of their synthetic oil-producing plants. Those lessons motivated Interior Secretary Harold Ickes in 1944 to propose the stockpiling of crude oil for emergencies. A few years later, President Harry S. Truman's Minerals Policy Commission proposed the creation of a strategic oil supply in 1952, but Congress did



not act on the proposal.

Significant excess domestic production capacity, particularly from the huge East Texas oil fields discovered in the early 1930s, dampened the push for creating a national oil reserve. Excess capacity also existed in the Middle East and other regions. Those supplies were quickly brought on line during the Suez crisis of 1956 when President Gamal Abdel Nasser of Egypt blocked the British and French from using the Suez Canal to ship oil. Once again, a strategic reserve was proposed by President Dwight D. Eisenhower, but Congress did not act on the proposal.

IMPETUS The 1970s Arab oil embargo against the United States and Netherlands finally provided the impetus for Congress to act. Oil prices more than tripled from late 1973 to 1975, raising inflation and unemployment significantly. In addition to the national security implications, the macroeconomic costs of oil supply disruptions became evident. In December 1975, President Gerald R. Ford signed the Energy Policy and Conservation Act that created the Strategic Petroleum Reserve, which called for a stockpile of as much as 1 billion barrels of petroleum, equivalent to 62 days of consumption at mid-1970s levels. The oil was to be stored in salt caverns in southern Louisiana and East Texas, which have ready access to the petroleum refineries in that region.

The 18 months following the establishment of the SPR were spent acquiring the salt mines and specifying the logistics concerning the facilities. Finally, in July of 1977, the first 412,000 barrels of light crude oil were deposited in the reserve. For the next eight years, the stockpile grew with regular deposits. In November of 1985, the Department of Energy engaged in its first "test sale" of the reserve to determine if procedures and facilities were suitable in the event of an emergency withdrawal. During an extraction of oil from the SPR, an auction is established, with the stockpiled oil going to the highest bidders. The bidders are oil companies or private refineries that refine the oil for U.S. market consumption—a cycle that is estimated to take approximately 13 days. Under the agreement, the refiners pledge to refill the reserve with private oil in 12 months (along with interest that usually amounts to about 5 percent, paid in oil). The 1985 test sale was considered a general success. The reserve was again tested in 1990 under the George H.W. Bush administration.

Assuming a price of $45 per barrel, the 660 million barrels currently in the SPR represent a public investment of nearly $30 billion. The annual foregone interest is $600 million per year at a 2 percent interest rate. Maintaining the reserve costs the federal government $21 million a year. So the nation pays a $621 million annual insurance premium for "protection" from an oil supply disruption. The benefits of this policy depend upon the frequency of oil supply disruptions, which seems to be once every five years, and the reserve's effectiveness in avoiding the economic damages resulting from oil price shocks. Whatever one believes about the effects of oil prices on the economy, the effectiveness of the SPR depends critically on how it is actually utilized during a crisis.

EMERGENCY USE OF THE SPR

A classic SPR scenario unfolded with the Iraqi invasion of Kuwait in August 1990. The immediate impact was more than a 4 million barrel reduction in the roughly 62 million barrels per day of world oil production at the time. Prices went from $15 per barrel in July of 1990 to over $30 per barrel in October. Despite the sharp price increase, President George H.W. Bush did not declare an emergency and release oil from the SPR. Instead, the supply reduction was offset by additional production from other members of the Organization of Petroleum Exporting Countries. By December 1990, OPEC production returned to pre-war levels, with more than three-quarters of the replacement coming from Saudi Arabia. In essence, the additional production capacity served the same function as a strategic reserve, very similar to America's excess oil production capacity during World War II.

In January of 1991, President George H.W. Bush announced the attack on Iraq and the first emergency withdrawal from the SPR. He ordered the Energy Department to sell off 33,750,000 barrels. The next day, oil prices opened at $32 and by the close of trading were $21 per barrel. But not a single drop of SPR oil entered the market. Prices

MORGAN BALLARD

TABLE 1

Commercial Crude Oil Stocks

(In millions of barrels)

Year	Commercial Oil		Government Oil*			Total
End	Land	Sea	U.S.	E.U.	Japan	Stocks
1995	752	814	592	302	299	2,759
1996	728	780	566	325	303	2,702
1997	765	841	563	315	315	2,799
1998	778	856	571	343	315	2,863
1999	723	839	567	327	315	2,771
2000	742	930	541	330	313	2,856
2001	772	840	550	327	316	2,805
2002	708	842	599	328	318	2,795
2003	732	905	638	344	321	2,940
2004	772	942	672	334	321	3,041

* Government stocks in the European Union and Japan include petroleum products.
Source: *Energy Intelligence, Inc.*

remained around the $20 level through the end of the conflict in late March 1991. Only half of the initially allotted 33.75 million barrels was released. As a result, skeptics of the SPR wondered about the timing of the decision to sell—was it "too little too late?"

This experience highlights the important role of expectations and the difficult choices they pose in deciding when to sell oil from the reserve. During the military buildup in the fall of 1990, there were considerable fears that Iraq would invade the oil fields of eastern Saudi Arabia, a short distance from Kuwait. If that had happened, world oil production would have dropped at least another 3–4 million barrels per day and a protracted conflict would have been likely. There was clearly a value to holding off on tapping the SPR until the political and military pictures became clearer. Moreover, releasing oil from the reserve in September and October of 1990 could have delayed the introduction of additional production from other OPEC and non-OPEC producers. No doubt, policymakers at the time were aware of the capability of the Saudis and others to offset the lost production from Kuwait and Iraq. On the other hand, the slow response of those producers contributed to higher prices, which suggests an early and prompt release from the SPR could have been warranted.

QUEST FOR MARKET STABILIZATION

The SPR began to show its age in early 1995 when as many as 73 million barrels had to be reallocated from the Weeks Island site because of structural weaknesses. Some $100 million in taxpayer funds were needed to avert an environmental catastrophe and, as a result, the reserve came under political fire. To prevent similar situations, SPR facilities underwent a $328 million renovation, which gave the stockpile another 25 years of useful life.

In the spring of 1996, Congress authorized the selling of $227.6 million worth of oil in order to reduce the federal deficit. This marked a dramatic shift in the purpose of the SPR—instead of a strategic asset, the reserve was used as a piggy bank that could be tapped during fiscal hard times.

The SPR would soon also become a tool to manipulate markets. Some analysts had long touted the reserve as a savior for so-called market emergencies that often occur during the summer driving and winter heating seasons. Given limited U.S. petroleum refining capacity, gasoline prices often spike during the onset of the summer driving season. Distillate fuel oil prices also often increase sharply during the beginning of the winter heating season. In response to public pressure, elected officials often grasp for policies. Long-term policies such as building more refining capacity, drilling for oil in Alaska, or raising automotive fuel economy standards involve tough choices. Selling oil from the reserve to lower market prices is a popular quick-fix.

In September of 2000, President Bill Clinton ordered the release of 30 million barrels of oil from the SPR to offset a spike in heating oil prices in the northeast. The decision came one day after an appeal from Vice-President Al Gore, who was locked in a tight (and ultimately unsuccessful) presidential campaign. The political motivations for Clinton's decision are worrisome, as is the minimal effect. At the time, refineries were operating at full capacity, so the excess crude did little to lower heating oil prices. There was simply a shortage of heating oil on the market, not crude. Even the White House admitted that only about 40 percent of the released oil would eventually be converted to heating oil.

The episode illustrates the wide latitude that the president enjoys in declaring an energy emergency. Under the law, an "energy emergency" is defined as a reduction in oil supply of significant scope and duration, with a resulting severe increase in the price of petroleum products and major adverse impacts on the economy. That test seems fairly straightforward, but in practice this authority allows considerable room for interpretation. For example, world oil production declined roughly 3 million barrels per day (about 5 percent) and prices more than doubled after Iraq invaded Kuwait in August 1990. In response, President George H.W. Bush belatedly ordered the sale of 30 million barrels of oil from the SPR nearly five months later in January of 1991. In contrast, President Bill Clinton also declared an oil emergency—not in response to a drop in world crude oil production, but to high heating oil prices. Obviously, the two administrations had very different views of what constitutes an energy emergency. More fundamentally, the two episodes raise the issue of whether the SPR should be used to manage short-term fluctuations in petroleum prices or whether it should be tapped only for severe energy supply disruptions.

The buffer stock management genie, however, has been let out of the bottle. In July of 2000, President Clinton directed the Energy Department to establish a heating oil reserve in the Northeast. There also have been proposals in California to create a gasoline reserve.

One of the key arguments for creation of those reserves is that refiners and distributors of petroleum products do not hold sufficient inventories. Departures of stocks from normal levels are often used to support those arguments. But the arguments fail to appreciate that inventories respond to market forces, often dropping sharply when prices for immediate delivery are higher than those for future delivery. Why hold on

to oil when you can sell it today for a higher price than tomorrow? Also, if the government is holding inventories, why should private firms?

The idea of using buffer stocks to smooth commodity prices is not new and indeed was quite popular among international commodity cartels during the 1970s and 1980s. Most were unsuccessful and some collapsed in rather spectacular financial disasters. (The collapse of the mid-1980s tin cartel is a classic example.) This experience does not bode well for the effectiveness of using petroleum reserves for market stabilization. While the combined strategic reserves of the United States, Japan, and Western Europe now exceed 1.3 billion barrels, that amounts to only 20 days of world consumption. Moreover, markets anticipate change so that even a substantial release from the reserves for a declared emergency may work temporarily but may backfire as markets adjust.

WHAT DETERMINES OIL INVENTORIES?

Stocks of crude oil are held at various points in the petroleum distribution network — at oil fields, in tankers and pipelines, in bulk terminals, at refineries, and of course by governments as strategic reserves. Commercial inventories of crude oil held in primary markets — the United States, European Union, and Japan—averaged slightly less than 750 million barrels from 1995 to 2004, as indicated in Table 1. A considerable amount of crude oil inventory is in transit at sea. These so-called "floating inventories" averaged more than 850 million barrels over the past decade. Additional inventories are held in areas outside the primary markets, such as China, Russia, and India. Information on crude oil stocks held in those areas is unavailable.

While government stocks of crude oil have remained virtually steady in the European Union and Japan since 1995, the U.S. strategic reserve of crude oil increased from 550 million barrels at the end of 2001 to its present level of more than 670 million barrels. Despite the increase, there has not been a corresponding reduction in commercial crude oil inventories. In fact, commercial inventories of crude oil in primary markets at the end of 2004 were 98 million barrels higher than 2001 year-end levels. Commercial crude oil inventories in the United States, however, dropped from 312 million barrels in December of 2001 to 292 million barrels in December 2004—a decline of 6.8 percent.

A wider measure of petroleum inventory combines crude oil with petroleum products held by refineries and bulk terminal operators. This definition allows a global measure of "oil" inventory. Total world oil inventories at the end of 2004 were 6.3 billion barrels. Stocks of oil held in the Organization for Economic Cooperation and Development countries comprised more than 40 percent of this amount, as shown in Figure 1. Another 20 percent is held in the non-OECD areas and 16 percent is floating on the high seas. World strategic reserves constitute roughly 23 percent of world oil inventories, amounting to more than 1.5 billion barrels, but significantly less than the 4.8 billion of commercial oil inventories in December 2004.

CONVENIENCE YIELDS With continuous production, inventories are held to maintain the flow of crude from producing fields to refineries. Likewise, oil companies use finished-goods inventories to smooth production and avoid costly startup and shutdown costs to meet changes in sales. In addition, firms may hold inventories of crude oil and other inputs to smooth costs by accumulating raw material stocks when prices are low and drawing down inventories when input prices escalate.

The production and cost-smoothing benefits may justify holding inventories even when they can be sold at a higher price today than tomorrow. The cost-saving benefits from holding inventories are known as the "convenience yield" or the returns that firms realize from holding inventories.

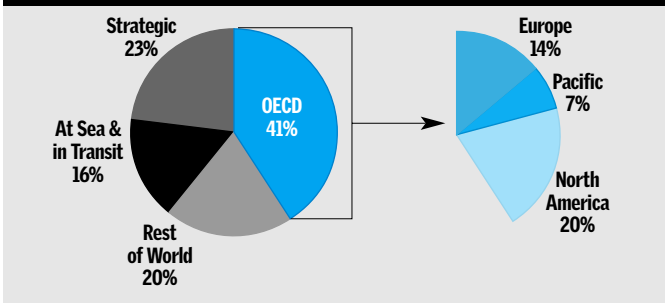
The convenience yield is not directly observed. Instead, it must be inferred from market prices. How do we do this? The intuition is as follows: Inventories provide a physical bridge between market balance today and tomorrow. Currently available supplies depend in part upon inventories carried over from last period. Likewise, stocks carried over from this period to the next will affect commodity availability in the future. Because prices in any specific period reflect the balance between demand and availability, inventories link prices between time periods.

The speculative net benefit of holding title to a commodity in storage is simply equal to the difference between the future

FIGURE 1

Distribution of World Oil Inventories

December 2004



and current price. To justify the cost of holding a commodity in storage, this return should cover the cost of insuring and warehousing the commodity. There is also a financial opportunity cost to holding an inventory asset because the owner could have sold the commodity and invested the proceeds in an asset that pays interest. Those arguments suggest that prices for delivery in the future should be higher than those currently prevailing in spot or cash markets, with the difference equaling the carrying charges. In the parlance of the British, markets with prices that justify the carrying charges are "in contango."

Often, however, spot or cash prices for immediate delivery substantially exceed prices for future delivery. Under those conditions, market prices imply inverse carrying charges and the market is in a state of "backwardation" so that there are no incentives for holding stocks. Firms should rapidly sell off inventories, driving reserve levels to zero. Massive sell-offs, however, are rarely if ever observed in commodity markets, which casts doubt on this extreme view.

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The classic theory of storage argues that producers and distributors never completely sell off inventories because they earn a convenience yield from holding stocks. This convenience yield is very nonlinear, remaining relatively low at high inventory levels but then rising sharply once stocks reach very low levels. The convenience yield equates the return from holding inventories to the return from selling stocks of oil and banking the proceeds that a price backwardation would demand. The main testable hypothesis from the classic theory of storage is that price backwardations — or negative forward price spreads — should occur during periods with low inventories.

As Figure 2 indicates, this theory seems to have some support from the oil market. The figure plots the four-week forward price spread for West Texas Intermediate crude (traded on the New York Mercantile Exchange), which is defined as the "futures" price less the spot price, with total days' supply, which is total oil inventories divided by demand.

The figure depicts a well-known fact about oil markets: they are generally in price backwardation. The figure also illustrates that the forward spread and days' supply move together, particularly since 1991. As the forward price spread declines (which means that nearby prices rise relative to forward prices), oil companies have less incentive to hold inventories because there is a capital loss on oil inventory assets. Hence, inventories should decline.

The other interesting feature of Figure 2 is the downward trend in the amount of inventories held in relation to market demand. After reaching a peak of over 98 days in 1990, relative inventory availability steadily declined during the mid-1990s and then fluctuated between 82 and 90 days with no apparent trend since 1995. Much of this decline can be attributed to the adoption of just-in-time inventory management that led to a permanent reduction in the amount of inventory held in the network relative to sales.

FIGURE 2

Oil Inventory/Forward Price Spread

1987 to 2004

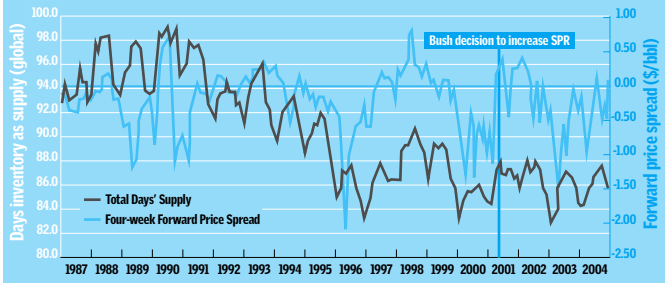
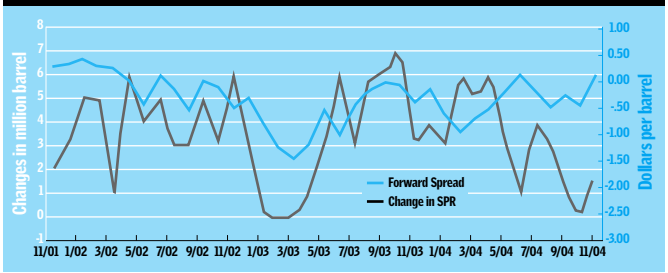


FIGURE 3

Change in SPR, Forward Price Spread

November 2001 to November 2004



DID THE BUSH SPR BUILD AFFECT THE MARKET?

George W. Bush's November 2001 decision to fill the SPR is also indicated in Figure 2. There are no discernable changes in the trends of days of supply and the forward price spread before and after this decision. While a steep price backwardation occurred during the spring of 2003, an equally steep backwardation occurred during the spring of 2000.

A closer look at the market effects of the SPR stock build is shown in Figure 3, which displays a time-series plot of the forward price spread and the change in the SPR. If the stock-build decision had a market impact, one would expect that changes in stocks would be associated with rising spot prices and declining forward price spreads so that the lines in Figure 3 would move in opposite directions. In other words, if there is an increase in the reserve, the price spread should fall. The evidence indicates just the opposite—accumulations in the SPR occurred during periods when nearby prices were low relative to forward prices. This suggests that the SPR managers were following the market and not buying during periods of steep price backwardations. A stark illustration of this occurred during the Iraq War when there were no SPR stock builds during the first quarter of 2003 and yet a steep price backwardation occurred. From this perspective, it seems unlikely that the Bush administration's decision to build the SPR affected the market.

WHY DID OIL PRICES INCREASE?

If the Bush administration is not responsible for the rise in oil prices, then what is? The answer is Adam Smith's invisible hand — the interplay between supply and demand. This view may be hard for many citizens to accept because OPEC attracts so much attention when its oil ministers meet to set production quotas. Nevertheless, oil is like many other industrial commodities, with very price-inelastic demand in the short-run and a supply-side characterized by a large volume of production with low marginal cost punctuated by sharply rising marginal cost as production reaches capacity limits. Of course, OPEC complicates the supply side considerably with recurring attempts to restrict production and raise prices above competitive levels. While conspiracy theorists like to characterize the world oil industry as a cabal of OPEC and large integrated oil companies, market prices respond to supply and demand just as in many other commodity markets. Even cartels are constrained by competitive forces. These features of the world oil market—inelastic demand and supply with capacity constraints—contribute to price volatility.

World oil prices adjusted for inflation are approaching levels last seen in 1985, just after the second great oil supply shock from 1979 to 1981. During that spike, prices peaked at the equivalent of nearly $65 per barrel in today's dollars, as indicated in Figure 4. Except for the downturn in prices following the September 11 attacks and the subsequent reduction in air

FIGURE 4

U.S. Refiners' Acquisition Cost

(Crude Oil in nominal and constant 2004 dollars)

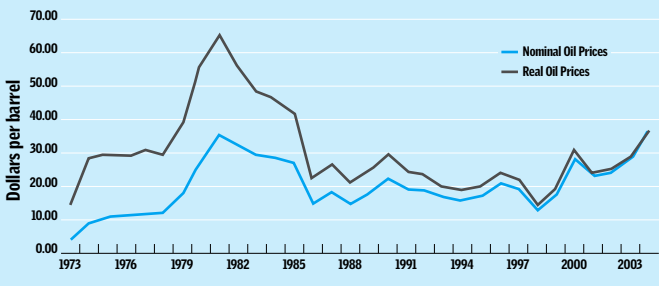


TABLE 2

Petroleum Product Demand

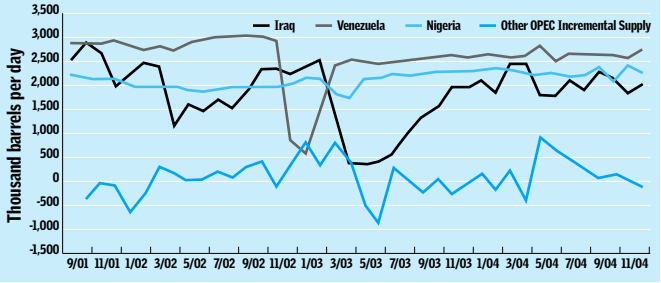
(Incremental; in thousand barrels per day)

Region	2001	2002	2003	2004
North America	-60	104	474	589
Western Europe	154	-11	174	258
Pacific	-73	-38	145	-138
China	69	253	650	899
Former Soviet Union	230	32	430	-164
Eastern Europe	526	207	152	74
OPEC	288	207	127	395
Rest of World	111	153	549	230
Total	1,245	908	2,701	2,144

FIGURE 5

Crude Oil Production

Iraq, Venezuela, Nigeria and other OPEC Countries



travel, oil prices have steadily increased since 1998. Since 2001, real oil prices have increased 40 percent, with more than half the increase occurring during 2004. This sustained recovery in prices has not been seen since the 1970s.

Unlike the earlier price spikes that resulted from supply cuts, this time it is growing demand that is boosting oil costs. Stronger economic growth, particularly in China and the United States, is substantially increasing the demand for crude oil. Table 2 below provides a summary of incremental demand for the past four years. Since 2002, world demand for petroleum products increased more than 4.8 million barrels per day. More than half of the increase occurred in North America and China. The incremental additions to world petroleum consumption during 2003–2004 are larger than any previous increases since 1986. Chinese petroleum consumption increased 8.9 percent per annum between 2001 and 2004. The emergence of China as a major consumer and now importer of petroleum is a seminal event.

This demand growth is occurring in the midst of a perfect storm of supply problems, from political instability in Venezuela to sabotage of Iraqi oil exporting facilities. (See Figure 5.) For example, the general strike in Venezuela virtually shut down its oil industry. To further exacerbate the situation, the Iraq War started the following month, causing a precipitous drop in Iraqi oil production. Nigerian production also declined as a result of an oil worker strike.

Interestingly, other OPEC producers did not offset the production shortfalls. Instead, once Iraqi oil production showed signs of bottoming out and recovering, other OPEC members cut production nearly a million barrels per day during the second quarter of 2003 as prices fell.

Additional production problems occurred during the last hurricane season in the Gulf of Mexico, which produces more than 1.7 million barrels of crude per day. Hurricane Ivan was very unusual because it caused underwater mudslides. The slides caused significant damage to underwater pipelines connecting production platforms to shore. Repairs took a considerable length of time, which stretched a typical one-week production shortfall to well over a month, with production dropping 300–400 thousand barrels per day. While this shortfall is small, it came at a time of roaring demand and OPEC production restraint.

While crude oil supply shocks are nothing new, the general pervasiveness of the current difficulties is troubling. Even more alarming is diminishing excess production capacity in places like Saudi Arabia, declining production in mature fields such as the North Sea, and relatively small incremental production from new fields. Apart from West Africa, there are no new major producing areas ramping up production. With no new major production fields and steadily increasing demand, utilization of OPEC production capacity has increased sharply in recent years. Like many other industries nearing capacity constraints, prices must rise. As Figure 6 vividly illustrates, the oil industry is no different. Also like other industries, higher prices will induce additional production capacity, but this could take a number of years to develop.

CONCLUSION

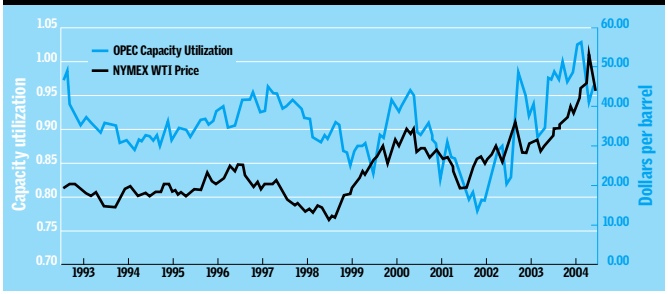
No amount of SPR stock manipulations will offset the price pressures created by demand growth of more than 2 million barrels per day. Even offsetting half this growth would require more than 350 million barrels from the SPR. Moreover, the reserve was established to alleviate the effects of "a severe energy interruption," not to regulate higher-than-average oil prices.

Even if market stabilization were a legitimate policy goal, it is a quixotic dream. Crude oil prices are inherently volatile because the demand for crude oil is extremely price inelastic in the short run and supply is also very price inelastic if the industry is operating at or near capacity. The existence of the

FIGURE 6

Crude Prices

and OPEC Capacity Utilization



SPR does not release us from dependence on foreign sources of oil. Rather, the reserve may give us some slight breathing room if foreign production were to be disrupted.

While the benefits of holding the SPR are uncertain and difficult to quantify, they critically depend upon how the reserve is used in a crisis. The responsiveness of the SPR sales during a crisis is crucial. If, by the time the necessary actions are implemented and oil has found its way onto the market, the crisis is over, then it is seemingly fruitless to tie up the billions of dollars required to hold the reserve. If the SPR's desired effects take place too slowly and the market corrects in the meantime, then its entire reason for being is suspect.

Currently, the authority to decide what constitutes an oil crisis, how much SPR should be released in the event of a crisis, and the timing of the release rests with the president of the United States. At first glance, granting the authority to the president seems appropriate given the importance of oil to our economy. But our limited experience with emergency releases of the SPR is checkered at best. The "too-little, too-late" release during the 1990–1991 Gulf Was illustrates the difficulty of deciding what constitutes a crisis and the timing of the release. In addition, Al Gore's flagging poll numbers hardly constituted a national crisis.

The Bush administration's decision to increase the SPR over a period of more than three years did very little to affect world oil prices. Rising world demand and years of low investment in new production capacity are the principal factors contributing to higher recent prices. Withdrawing oil from the SPR will do nothing to alleviate those fundamental challenges and indeed could be counterproductive by encouraging consumption and diminishing incentives for new supply.

While a larger SPR may make some people feel better, it has done nothing to eliminate the Achilles heal of the program—how to decide when to use it. Political institutions, even august ones like the presidency, have not inspired a great deal of confidence in their ability to handle such difficult tasks. Market-based solutions to privatize this function, such as selling options on the SPR, provide an intriguing possibility that warrant additional study. R