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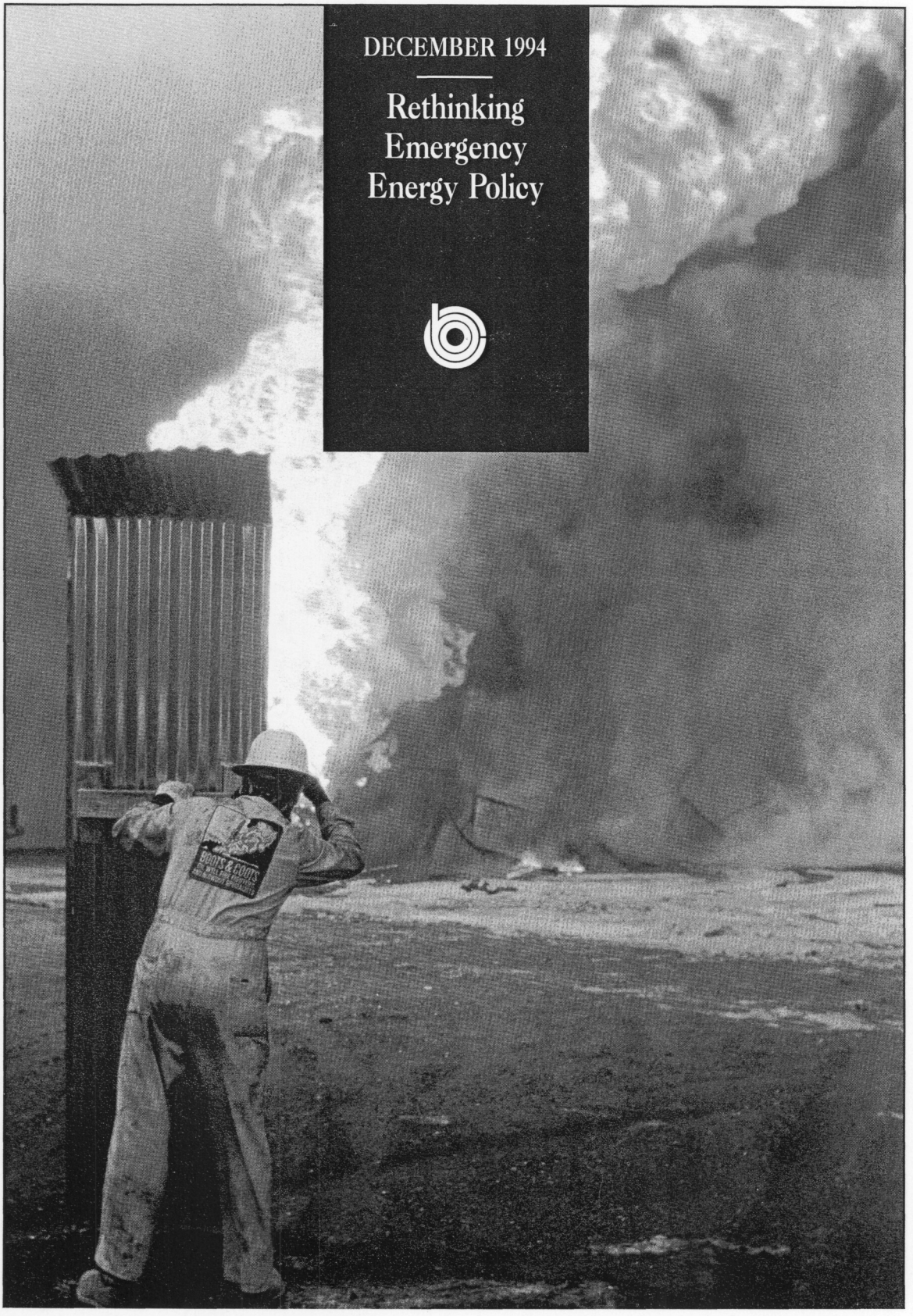

DECEMBER 1994

Rethinking Emergency Energy Policy

RETHINKING EMERGENCY ENERGY POLICY

The Congress of the United States
Congressional Budget Office

NOTES

Unless stated otherwise, all years referred to in this report are calendar years.

Numbers in the text and tables may not add up to totals because of rounding.

Cover photo shows a U.S. firefighter using a sheet of metal to approach a burning oil well at Al Ahmadi fields in Kuwait in March 1991. (Reuters/Bettmann)

Preface

Given major structural changes in the U.S. and world economies since the Arab oil embargo of 1973 and the experience of the Persian Gulf crisis in 1990, current policies for responding to oil supply disruptions may no longer be as effective as the Congress originally envisioned. Chief among these policies is the nation's Strategic Petroleum Reserve (SPR), an emergency stockpile of crude oil. This study, prepared by the Congressional Budget Office (CBO) in response to a request from the Senate Committee on the Budget, analyzes changes in the effectiveness of the SPR and presents options on when and how the government can best use the SPR to protect the economy from losses in the event of supply disruptions.

Richard Farmer of CBO's Natural Resources and Commerce Division prepared the study under the supervision of Roger Hitchner and Jan Paul Acton. Pete Fontaine of CBO's Budget Analysis Division contributed to the section on the budgetary history of the SPR, and Adrienne Kearney of CBO's Macroeconomic Analysis Division provided a valuable review of the overall document. The author thanks Douglas R. Bohi and Lawrence J. Goldstein for their review of an early draft of the study and their many useful comments.

Paul L. Houts edited the manuscript. Christian Spoor provided editorial and production assistance. Donna Wood typed the many drafts. Kathryn Quattrone prepared the study for publication.

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Director

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Summary

Emergency policies to reduce or avoid economic losses from severe disruptions of world oil supplies may no longer be as effective as the Congress originally envisioned. Since the Arab oil embargo of 1973, the United States has based most of its emergency energy policy on the Strategic Petroleum Reserve (SPR), a government-owned stockpile of crude oil.

Many analysts feel that the economic threat posed by severe disruptions of oil supplies has decreased and that as a result, the benefits from releasing SPR oil in a crisis are smaller today than in the past. Moreover, the experience of the Persian Gulf crisis in 1990 and 1991 demonstrated disturbing problems with current policy guiding the use of the SPR in a crisis. Indeed, during the Gulf crisis, both the process of deciding to use the SPR and the mechanism for selling the oil may have actually contributed to market uncertainty at the time. This study examines the rationale for U.S. emergency energy policy in light of this recent experience and considers options for altering the policy guiding when and how the SPR is used.

Policies guiding the government's response to energy emergencies have changed remarkably little over the past 20 years, despite major changes in the structure of oil markets and in the broader economy. Those changes have both weakened and altered the link between oil price shocks and economic activity. Moreover, other government policies have changed over this period in ways that have further weakened the impact of price shocks on the economy. Those changes include phasing out price controls on petroleum and windfall profit taxes on domestic oil producers, introducing fuel-efficiency standards for motor vehicles, changing the federal regulatory structure affecting natural gas and electricity, and providing federal support for the development and use of alternative fuels.

The recent experience of the Persian Gulf crisis underscored the importance of those changes in policy and market structure, demonstrating the economy's ability to reduce oil imports in the face of rising prices without incurring shortages of gasoline or other petroleum products. That experience also highlighted problems with current programs for responding to energy emergencies.

Evaluating the Strategic Petroleum Reserve and International Programs

Two cornerstones of U.S. policy for responding to energy emergencies are the Strategic Petroleum Reserve and the United States' participation in the multilateral programs of the International Energy Agency. Those programs are closely linked because the President has legislative authority to release SPR oil in support of IEA actions and because the SPR constitutes the bulk of the IEA's capability for emergency response. The official policy of the United States regarding severe oil supply disruptions is to rely on market forces to allocate the remaining sup-

ply and to supplement that supply by an early drawdown of the SPR in large volumes and in coordination with the IEA.

What Is the Strategic Petroleum Reserve?

The Strategic Petroleum Reserve is a government-owned stock of crude oil that is available for release at the President's discretion in the event of a severe energy supply interruption or under the obligations of international agreements. The original legislation authorizing the creation of the SPR and U.S. membership in the International Energy Agency was the Energy Policy and Conservation Act of 1975. As amended in 1990, the act authorizes the Department of Energy (DOE) to store up to 1 billion barrels of crude oil in the SPR. Storage capacity today is 750 million barrels, located in five underground storage facilities along the gulf coasts of Texas and Louisiana. The maximum drawdown capability for the reserve is 4 million barrels per day (bbl/day).

Over the past 20 years, the United States has spent about $4 billion constructing five underground storage sites and related transportation facilities for moving and holding SPR oil. It has spent an additional $17 billion to fill partially the Strategic Petroleum Reserve with 592 million barrels of crude oil. Current annual costs to operate and maintain the SPR are about $200 million.

What Is the International Energy Agency?

The International Energy Agency was created to carry out the goals of the Agreement on an International Energy Program, signed by 21 industrialized nations in November 1974. In the International Energy Program, the IEA members agreed to maintain sufficient reserves to sustain domestic oil consumption for at least 90 days with no net oil imports. (The United States meets its 90-day commitment by combining Strategic Petroleum Reserve and private stocks.) Members of the International Energy Agency also agreed to develop capabilities to respond to a significant disruption of the world oil supply system, including a formula for sharing the available supply of oil.

In addition to drawing down stocks and sharing oil, the capabilities of individual IEA members to respond to emergencies include restricting demand, switching away from oil products on a short-term basis, and increasing oil production by member nations. As evidenced by the IEA's response to the events of the Persian Gulf crisis, however, drawing down stocks is the most significant of these actions in terms of volume, with most of the stocks coming from the U.S. Strategic Petroleum Reserve. (Only two other countries--Germany and Japan--maintain large government-owned stocks of oil.) In other words, the Strategic Petroleum Reserve constitutes the biggest part of the IEA's emergency response program.

Current Guidelines for Releasing Strategic Petroleum Reserve Oil

Current guidelines for identifying conditions that justify a release of SPR oil reflect early thinking about the nature of the economic threat from disruptions. The original government view was that economic losses would result from a disruption of oil supplies to the nation's industries and from any accompanying rise in price inflation. Later government thinking projected economic losses from the costs of adjusting to higher prices. In keeping with the current view on the importance of replacing lost supplies, the government's plan for releasing SPR oil has always been to set the volume of release and let the market determine the price.

How the Original Policy for Emergency Response Has Changed

Over the past two decades, Congressional debate about energy emergency policy has centered primarily on the SPR's optimal capacities for storage and distribution, on annual funding levels for filling the reserve, and, more recently, on alternative funding mechanisms for acquiring oil. Recent Congressional action has, however, expanded the list of market events that could justify a release of SPR oil. For

example, amendments to the Energy Policy and Conservation Act in 1990 and 1992 expanded the authority for release to include minor or regional shortages and directed the President to consider severe price increase as evidence of a supply shortage.

Yet surprisingly little discussion has surrounded the issues of what nature or level of adverse impact on the economy would merit a release of oil and whether other processes for selling that oil might be more effective in protecting the economy from losses.

When and How to Use the Strategic Petroleum Reserve

Any search for policies on when and how to best use the SPR should consider the basic benefits from releasing those stocks in the first place. A release of SPR oil can convey benefits by helping avoid some part of the economic losses that stem from a disruption of oil supplies. Specifically, a release can reduce economic losses if it can contribute to lowering both oil prices and the nation's total imports of oil.

In deciding when to use the SPR, two specific considerations are important. One is how large are the economic benefits from release at any given time. The other is how large are the benefits from an immediate release of stocks in the face of a crisis compared with the expected advantages from a future release when the disruption in supply may be even more extreme. The SPR should be used only if the benefits from immediate release would exceed those from future release.

Identifying the benefits from release at any time--present or future--is not straightforward, however, because the drop in the nation's total oil imports can be greater or smaller than the direct amount of SPR oil released. For example, if the SPR release succeeds in lowering oil prices, higher domestic use of oil and lower domestic oil production in response to those lower oil prices can add to the demand for imports. That change would offset some of the direct effect of the SPR sale on lowering imports and, hence, reduce the benefits from release. In addition, changes in private oil stocks in response to changes in expected oil prices and price uncertainty can lead to higher or lower demand for imports. For example, if the release of SPR oil helped to lower market uncertainty and encouraged a higher rate of withdrawal from private stocks of oil, a bigger drop in total imports and greater economic benefit would result.

Given the importance of changes in the rate of withdrawal of private stocks, decisions concerning how to use the SPR should consider how the sales mechanism affects market uncertainty.

Appraising Changing Institutions and the Changing Threat to Energy Security

Since the creation of the Strategic Petroleum Reserve and the International Energy Agency, four important changes have occurred that affect the basic need for these programs and the best way to use them.

First, oil markets have changed dramatically--price controls are gone, supplies of oil have diversified, and an active futures market has developed. (Futures markets are federally regulated institutions where traders buy and sell contracts that lock in prices today for crude oil and petroleum products to be delivered in the future.) Those changes make oil prices better indicators of true scarcity than before. With freer markets, disruptions are now more likely to appear as oil price shocks rather than physical shortages. Also, futures markets now allow firms to use financial instruments rather than physical stocks of oil to guard against (or speculate in) price changes, freeing up private stocks of oil during supply disruptions. Nevertheless, SPR and IEA policy has not adapted fully to these new market conditions.

The second major change is the way the economy uses oil. Many analysts believe that the U.S. economy is more flexible in its use of oil and other energy sources than it was in the past, although that claim is subject to some controversy. With more responsive prices and the opportunities to hedge that futures markets offer, oil consumers today have greater incentives and capabilities to reduce their oil purchases

in response to a loss of oil supplies. As a result, a given supply disruption should have a smaller effect on the economy than a similar disruption would have had 20 years ago. Oil imports now can drop more quickly in response to a loss of oil supplies. Moreover, a drop in purchases of imported oil can now come about without a commensurate drop in consumer and business expenditures. Oil markets did not respond in this fashion in the early supply disruptions, which helps explain why the oil price shocks of the 1970s tended to be self-sustaining and were a big contributor to the inflationary cycle.

In addition to those possible real effects, some studies of the effects of oil price changes on the economy over the past 20 years have concluded that the effects never were as great as many analysts believed. Of particular note is a body of research indicating that the severity of economic recessions in the past has been attributable more to price controls, restrictive monetary policy, and the state of business cycles in the United States and the other major industrialized countries than to changes in oil prices.

The third major change is the growing interdependence of world economies--particularly between oil-producing and oil-consuming areas. The Middle East is still a highly risky source of oil, but one should keep in mind that those oil-producing countries have invested large amounts of their oil earnings in the United States and other oil-consuming countries. Because any action on their part that harms the U.S. economy also endangers their investments in the United States, oil producers and consumers now have a shared economic interest in stability. That economic interdependence dampens foreign political and economic incentives for disrupting oil supplies.

The fourth major change affecting emergency policies is that oil prices are much more volatile today. Small changes in the current supply or in the outlook for supply can lead to large movements in oil prices within a short time frame--both up and down. Price volatility is greater today than in the past because of the combined effects of price decontrol, greater sales of oil and oil products on a spot basis (for delivery within one or two months) rather than under long-term contracts, and more competition among businesses producing, processing, and marketing oil. Those changes have had more impact on greater price stability than any increased capability of oil consumers to substitute oil products on short notice for other forms of energy.

Price volatility is a concern because it is closely linked to market uncertainty. Oil prices are generally more volatile and uncertain during major supply disruptions for two other reasons. First, an increased frequency of smaller changes in supply--both actual and threatened--seems to accompany large supply losses. Second, a large disruption of world supplies will cut into the worldwide buffer of excess capacity to produce oil.

In normal times, producers--especially in the large oil-exporting countries--can increase oil production at relatively little extra cost because they maintain some level of excess capacity. But if that capacity is diminished, larger increases in oil prices would be needed to bring forth additional supply than would otherwise be needed. Consequently, a release of SPR oil can help to reduce market uncertainty simply by helping to restore the buffer of excess capacity.

How Effective Were Emergency Policies During the Persian Gulf Crisis?

The experience of the Persian Gulf crisis, instigated when Iraq invaded Kuwait on August 2, 1990, provided the first opportunity to assess the usefulness of current policies guiding the release of SPR oil and the activation of IEA emergency procedures. Those programs had never been used before, except in tests.

The government's response to that actual crisis demonstrated the difficulties of deciding whether any such supply emergency could benefit from early attention. The crisis could have ended very early, in which case the SPR would not have been needed, or it could have dragged on for years, in which case the SPR could not have helped. Moreover, differences in the domestic political and economic situations of the major U.S. trading partners in the International Energy Agency weakened the mutual interest in a co-

ordinated release. Even the original precondition for action--a supply shortfall--made little sense in the current free-market environment.

Problems with Using the Strategic Petroleum Reserve

Despite such economic and political uncertainties of the time, the use of the Strategic Petroleum Reserve during the Persian Gulf crisis can be criticized on two counts. First, the way the government sold the oil did not use the SPR to its greatest advantage, even given the stated objective of increasing world supply and lowering oil prices. Under ordinary circumstances, the Department of Energy accepts bids--subject to a minimum bid price--to deliver oil in the future at a price to be determined on that later date. But in both its test sale in September 1990 and the emergency sale in January 1991, DOE was unable to sell all of the oil it planned to release because it set the minimum bid price too high. Thus, the supply and price effects one would associate with the announced release volume could not be achieved.

Second, the lack of a clear policy for release and early indecision by the government about the use of the SPR added to the uncertainty of supply already plaguing the oil markets. Even if the government had had a clear policy, the sales process the government used (and still uses) could have added to market uncertainty because of inherent delays between the decision to release oil and the final sale of oil. Greater uncertainty caused individuals and businesses to hold onto their stocks of oil and petroleum products, and that additional demand for private stocks raised oil imports and prices--just the opposite of the original intent of the Strategic Petroleum Reserve release.

Problems with the Performance of the International Energy Agency

The Persian Gulf crisis also demonstrated strengths and weaknesses of the existing international agreements to deal with supply disruptions. Indeed, differences in the domestic political and economic situations of the IEA member nations weakened their mutual interest in making a coordinated response to the disruption of supply. In fact, when the IEA finally implemented a contingency plan--a plan that it advertised would increase the world oil supply by 2.5 million barrels per day, or about 4 percent of total world supply--the restraints on demand and reductions in stocks that most countries offered as part of that plan were largely voluntary.

In their contribution to the plan, many member countries counted reductions in demand that had already taken place or, paradoxically, would take place in response to the price increase they were trying to avoid. As a result, the maximum addition to world supply from carrying out the IEA contingency plan was probably only about 1.5 million bbl/day--largely from the release of SPR oil by the United Sates. That volume of flow would not have had any large or sustainable effect on the price of oil or price volatility had the ground war actually disrupted oil supplies further.

Options for Making Emergency Policies Work Better

In view of the many changes in oil markets that have altered the potential effectiveness of SPR policy, and given the difficulties the government experienced in attempting to use the SPR in the Persian Gulf crisis, it may be appropriate to consider ways of better using the reserve. A critical factor determining the effectiveness of any emergency programs is whether those programs recognize the important roles played by free prices and market uncertainty.

With those criteria in mind, consider three optional processes for releasing SPR oil and their effects on oil prices and on the nation's total oil imports. The first is the current sales process, calling for the sale of a set volume of SPR oil at a price to be determined in the marketplace. In the second, the government sets a single price for all the SPR oil it wants to sell. In the third, the government estab-

lishes a multitiered price schedule for the oil it wants to sell, with increasing volumes selling at increasingly higher prices.

The current policy of setting the volume could yield benefits comparable with the two price-setting processes (single and multitier prices) in a supply disruption of known size and duration. Indeed, the government commonly makes that assumption of zero uncertainty when it evaluates the benefits of releasing the SPR. Even with uncertainty about the size and duration of a supply disruption or about the prospects for further disruptions, a volume-setting sale may yield comparable benefits if it can help restore the worldwide buffer of excess supply capacity and thereby help to reduce price volatility and uncertainty.

Beyond any contribution to restoring the supply buffer, however, a release of SPR oil using either of the two price-setting options alone may yield greater economic benefits than the current sales process because those options can more effectively reduce market uncertainty and encourage the drawdown of private oil stocks. Very simply put, with SPR oil freely available to the market at a constant or increasing price, the world supply of oil would become more responsive to price changes. Moreover, price movements in response to subsequent small changes in supply or demand would be smaller--that is, less volatile.

For any sales process, the benefits from gaining a quick and complete drop in current oil prices would be greater if the government made efforts to reduce uncertainty about the sales process itself and the government's intentions, expedited the final transfer of title for SPR oil to purchasers, and hedged its sales by using futures contracts or some related risk-management tool.

Chapter One

National Policies for Energy Emergencies: An Overview

After the Arab oil embargo of 1973 and 1974, the U.S. government concentrated on developing energy policies that would protect the U.S. economy from the adverse effects of future disruptions of world oil supplies. Many of those policies focused on providing incentives for raising domestic oil production and for lowering oil use by consumers and businesses, thereby reducing the nation's vulnerability to disruptions before they happen. A different set of emergency policies evolved for cushioning the impact of supply disruptions once they had occurred.

Since the mid-1970s, energy emergency policy has relied on the Strategic Petroleum Reserve (SPR) --a government-owned stock of crude oil--and the multilateral programs of the International Energy Agency (IEA). The Energy Policy and Conservation Act of 1975 (EPCA) provided authorization for both. The EPCA and policy statements of the U.S. Department of Energy list general emergency circumstances in which the U.S. government could release oil from the SPR and describe how the government would respond to a supply disruption.

The current policy for responding to severe disruptions of oil supplies is to rely on market forces to allocate supply, as well as to supplement that supply (if needed) with an early drawdown of the SPR in large volumes and in coordination with the members of the International Energy Agency. In a sense, the SPR and the IEA are very much products of their times: they represent a particular view of how energy policies could be useful in blunting the worst effects of any disruptions in the oil supply.

However, changes in energy markets and in the broader economy since 1973, plus the recent experience of the Persian Gulf crisis, have underscored a number of problems with current policies. This study specifically addresses those problems. In so doing, it examines issues and options relating to government decisions about when and how to make use of the Strategic Petroleum Reserve to best protect the economy from losses.

Understanding the Strategic Petroleum Reserve and International Programs

The Department of Energy (DOE) describes its strategic stocks of crude oil and its participation in international programs that restrain oil demand and increase indigenous production of oil and alternative fuels as the nation's most important emergency programs for dealing with a major loss of world oil supplies.[1] Despite many changes in other government policies affecting energy and in the basic structure of energy markets, those emergency programs and the policies guiding their use have changed little since their inception in the 1970s.

1. Department of Energy, *Energy Security: A Report to the President* (March 1987), p. 215.

What Is the Strategic Petroleum Reserve?

The Strategic Petroleum Reserve, established by the Energy Policy and Conservation Act of 1975, was a response to the 1973 Arab oil embargo.[2] The Congress intended the SPR primarily to promote economic security. More directly, the creation of the SPR satisfied the nation's commitments under the Agreement on an International Energy Program, signed by the United States and other industrialized countries in November 1974.

However, additional arguments existed for developing the Strategic Petroleum Reserve as a national security asset. For example, the government is a major oil consumer, and the SPR can serve as an inventory for government use. Moreover, to the extent that the United States is in a position to affect the world supply and demand for oil through its military and geopolitical activities, it could have greater freedom to do so if it can use the SPR to help offset those effects on oil markets. Outside the energy arena, the United States contracted to buy additional volumes of crude oil for the SPR from Mexico in the 1980s to help support that country in a financially difficult period.

SPR Size and Drawdown Capability. As amended in 1990, the Energy Policy and Conservation Act authorizes the Department of Energy to store up to 1 billion barrels of crude oil for emergency use in a Strategic Petroleum Reserve. DOE has constructed storage capacity for up to 750 million barrels and plans to develop a drawdown capability of 4.5 million barrels per day (bbl/day). However, the reserve only holds about 590 million barrels today, and current maximum capability for drawdown is 4 million bbl/day. That oil is located in five underground storage facilities along the gulf coasts of Texas and Louisiana. If the Strategic Petroleum Reserve was ever filled to the 750-million-barrel mark, a drawdown capability of 4.5 million bbl/day would be sufficient to replace about 55 percent of the current level of net petroleum imports for nearly six months.

The SPR's effective capability for distribution today is only about 2 million bbl/day--about 25 percent of net petroleum imports--and is sustainable for merely 90 days. That level is far below the maximum drawdown capability because of problems with excessive heat and with natural gas seepage into some of the storage caverns.[3] Excessive gas content makes the crude oil too volatile for transportation. And excessive heat raises the vapor pressure of the crude oil and increases air emissions during drawdown. Problems with excessive heat and gas content mean that about 200 million barrels of SPR oil cannot be safely removed. A third problem that may reduce the availability of SPR oil even further involves water leakage at the Weeks Island storage site, which holds a total of 73 million barrels of oil.[4] Nevertheless, current plans to correct the natural gas and heat problems would not restore the SPR to its designed drawdown capacity until 1998.

Budgetary History: Government Expenditures on SPR Facilities and Oil. To date, the United States has spent about $21 billion on the Strategic Petroleum Reserve (see Table 1). That figure includes about $4 billion to construct and maintain storage and transportation facilities and about $17 billion for crude oil, which has a current market value of about $10 billion. In addition, the government is spending more than $200 million annually to operate and maintain the reserve. In the next couple years, about half of those funds will go to correct the heat, gas, and water problems just mentioned.

In the 1995 Department of Interior Appropriations Act (H.R. 4602), the Congress appropriated $244 million to continue operating and maintaining existing SPR storage facilities. No new funds were appropriated to acquire crude oil or to transport, in-

2. The Congressional Research Service has summarized the legislative history of the Strategic Petroleum Reserve and the debates on financing and drawdown capability in Robert Bamberger, *The Strategic Petroleum Reserve*, CRS Issue Brief IB87050 (September 10, 1993).

3. See testimony by Jack S. Siegel, Assistant Secretary for Fossil Energy, before the Subcommittee on Interior and Related Agencies of the House Committee on Appropriations, March 23, 1994. The General Accounting Office analyzed the impact of these problems on SPR drawdown capacity in the report *Energy Policy: Ranking Options to Improve the Readiness of and Expand the Strategic Petroleum Reserve*, GAO/RCED-94-259 (August 1994).

4. "DOE Is Likely to Reach a Decision Within Next Two Weeks," *Inside Energy* (September 5, 1994), p. 5.

ject, draw down, and distribute oil. Indeed, the Administration has not asked for new funds to acquire crude oil since 1990 (for spending in fiscal year 1991), and the Congress last provided new funds to acquire oil in the Department of Interior Appropriations Act for fiscal year 1992. In the 1995 appropriation, the Congress even transferred $91 million (included in the $244 million figure) from unspent acquisitions funds to pay for facilities and for operating costs.

Table 1.
Strategic Petroleum Reserve Appropriations, 1976-1995 (In billions of dollars)

Fiscal Year	Petroleum Acquisition and Transportation	Storage Facilities Development and Operations	Management	Total
1976	0	0.30	0.01	0.31
1977	0.44	0	0.01	0.45
1978	2.70	0.46	0.02	3.01
1979[a]	2.36	0.63	0.02	3.01
1980[a]	-2.02	0	0.02	-2.00
1981[a]	3.21	0.11	0.02	3.33
1982[a]	3.68	0.18	0.02	3.88
1983	2.07	0.22	0.02	2.32
1984	0.65	0.14	0.02	0.81
1985	2.05	0.44	0.02	2.51
1986[a]	-0.01	0.11	0.01	0.11
1987	0	0.13	0.01	0.15
1988	0.44	0.15	0.01	0.60
1989	0.24	0.16	0.01	0.42
1990[b]	0.37	0.18	0.01	0.56
1991[c]	0.57	0.19	0.01	0.77
1992	0.09	0.17	0.01	0.27
1993[d]	-0.01	0.16	0.01	0.18
1994	0	0.19	0.02	0.21
1995[a]	-0.09	0.23	0.02	0.15
Total	16.59	4.16	0.31	21.06

SOURCE: Congressional Budget Office based on Department of Energy data.

a. Figures reflect reprogramming from petroleum acquisition to other Strategic Petroleum Reserve activities (mainly development of storage facilities).

b. Includes $122.7 million from the test sale in the fall of 1990.

c. Includes $315.4 million from the Strategic Petroleum Reserve sale in the winter of 1991.

d. Includes a $126 million Department of Defense appropriation for acquiring oil for the Strategic Petroleum Reserve.

Using unspent past funds and revenues from SPR sales, the Department of Energy acquired oil for the SPR at an average rate of about 40,000 bbl/day in fiscal year 1993 (see Table 2). The fill rate fell to about 16,000 bbl/day in fiscal year 1994 and will be near zero in 1995.

Despite the lack of new appropriations, by the end of 1994, the Department of Energy will still have about $200 million in unspent funds for purchasing oil for the SPR. Those funds would support an acquisition rate of about 10,000 bbl/day for about three years. However, Congressional reports filed in association with the 1995 Department of Interior Appropriations Act anticipate that SPR oil acquisition funds will continue to be transferred to help pay for annual maintenance and upgrading costs of the SPR facilities. Hence, the Strategic Petroleum Reserve is unlikely to reach a level of even 600 million barrels without new appropriations for oil acquisition.

Legal Restrictions on the Use of the SPR: Responding to Physical Shortages, Supporting the IEA. The Energy Policy and Conservation Act authorizes and restricts the use of the Strategic Petroleum Reserve. Specifically, a distribution of SPR oil would require a Presidential finding of a shortfall in supply or could be authorized by the President to

Table 2.
Levels of Strategic Petroleum Reserve Oil Fills, 1976-1994

	Fiscal Year		Calendar Year	
	Year-End Inventory (Millions of barrels)	Average Fill Rate (Thousands of barrels per day)	Year-End Inventory (Millions of barrels)	Average Fill Rate (Thousands of barrels per day)
1976	0	0	0	0
1977	1.1	3	7.2	20
1978	49.1	131	68.5	168
1979	91.2	115	91.7	64
1980	92.8	4	107.8	44
1981	199.2	292	230.3	336
1982	277.9	215	293.8	174
1983	361.0	228	379.1	234
1984	431.1	191	450.5	195
1985[a]	489.3	159	493.3	119
1986[a]	506.4	47	511.6	51
1987	533.9	75	540.6	80
1988	554.7	57	559.5	52
1989	577.1	62	579.9	56
1990[a]	589.6	34	585.7	27
1991[b]	568.5	0	568.5	0
1992	571.4	8	574.7	17
1993	585.7	39	587.1	34
1994	591.7	16	591.7	13

SOURCE: Congressional Budget Office based on Department of Energy data.

a. Reflects drawdown of some SPR oil during test sales.

b. Reflects moratorium on acquisitions during the Persian Gulf crisis.

meet U.S. obligations under the International Energy Program. The EPCA provides no guidance on the size of the loss needed to trigger a SPR release. Nor does the EPCA indicate the degree of adverse economic impact or the size of a price increase that would justify a release. Indeed, the government has in the past rejected the idea of releasing SPR oil based on any specific trigger formula.[5]

No major changes in the purposes to which the SPR is put or in the way the SPR is financed or sold can take place without some change to the Energy Policy and Conservation Act. However, some changes have occurred. For example, the concept of the supply shortfall needed for SPR drawdown has changed in the past couple years. The original definition promulgated in 1975 was a loss in the national supply caused by interruptions in the supply of imported petroleum that could adversely affect the national economy. The 1990 amendments to the EPCA broadened that concept to include shortages brought about by interruptions in the supply of domestic petroleum products. Regional interests had pressured the Congress for many years to expand use of the SPR to help with local supply imbalances. The Exxon Valdez oil spill in 1989 (and subsequent increases in West Coast gasoline prices) and the severe cold that winter in the Northeast (and subsequent increases in Northeast heating oil prices) probably contributed to passage of the 1990 amendments.

Moreover, in the 1992 amendments to the Energy Policy and Conservation Act, the Congress made the requirements for drawdown more specific by directing the President to consider severe increases in petroleum prices as an indicator of shortfalls in supplies. That revision recognized that government regulation of oil markets had eased greatly since the 1970s and that physical shortfalls, as evidenced by gasoline lines, would not be likely as long as prices could rise to clear the market.

Within the restrictions of the EPCA, the stated policy of the United States on the use of the Strategic Petroleum Reserve is to draw down the stocks early and in large volumes in response to a supply disruption.[6] Under the auspices of the International Energy Agency, the United States participates in a cooperative process to draw down those stocks in a coordinated manner. The intent of this coordination is to maximize the value of the stocks and avoid counterproductive measures (such as decisions by other countries to increase their own stocks).

The Current Sales Process: Competitive Bidding for a Set Volume. To release oil from the Strategic Petroleum Reserve, the Department of Energy decides on and announces the level of supply it would like to sell; the actual release of oil takes place a month or two in the future.[7] The department also decides on a minimum price it will accept for that oil. Private companies then submit sealed, competitive bids for particular crude oils at particular SPR sites, including a price they would pay for prompt delivery of that volume and a range of dates when they would like delivery. (Delay in delivery is a necessary consequence of logistical problems, such as the need for private companies to arrange for transportation of the oil and the limited rate at which oil can flow from the SPR.)

The Department of Energy ranks all the bids it receives by price, starting with the highest price and working down until the total volume of oil offered is accounted for. DOE rejects bids out of hand that are below 90 percent of the minimum price. For the successful bids, the price ultimately paid on delivery will not be the initial bid price but rather the bid price plus an adjustment for any changes in market prices between the bid date and the delivery date. That process of setting volumes and minimum prices and accepting bids is conducted separately for SPR crude oils of different qualities and from different storage locations.

The Economic Rationale for Releasing a Set Volume of SPR Oil. The current objective of setting the volume to be released may reflect the Department of Energy's early concern with lost oil supplies being the principal cause of economic losses during a dis-

5. Department of Energy, *SPR Drawdown Plan* (1982).

6. Department of Energy, *United States Policy for Responding to Oil Supply Disruptions* (February 1994).

7. Department of Energy, *Strategic Petroleum Reserve Distribution Plan* (December 1982), Amendment Number 4.

ruption. That approach may also have been a tailored response to the major threat of the day: politically motivated disruptions in oil supply that would be of a known volume for a known period of time.

In DOE's original view, a release of SPR oil could achieve economic benefits by replacing lost oil imports and causing the world oil price to fall. Specifically, DOE assumed that U.S. oil imports and world demand for newly produced oil would fall by the full amount of the SPR release. Obtaining that result required a further assumption that domestic oil production, oil consumption, and private oil stocks would not change in response to the release or to the subsequent change in the oil price.

Analyses by the Department of Energy of the benefits of releasing the Strategic Petroleum Reserve continue to focus on the economic costs of this type of disruption--with full information about the size and duration of supply loss. Moreover, DOE makes those analyses without assuming any significant response in demand or domestic production to changing oil prices; nor does it assume any response in private stocks to changes in expected price levels or to uncertainty over the course of the disruption. As a result, private demand and oil stocks are assumed to have no incentive to change in response to an SPR release, and a simple release of any given amount of SPR oil would always have the same magnitude of effect on total imports and prices. That is, total oil imports change only by the amount of the SPR release. In this view, the only government decision relevant for lowering oil imports and oil prices appears to be how much SPR oil to sell.

What Is the International Energy Agency?

The International Energy Agency was created to carry out the goals of the Agreement on an International Energy Program, signed by 21 industrialized nations in November 1974 (24 countries are now members).[8] In the International Energy Program, the IEA members agreed to maintain sufficient reserves to sustain domestic oil consumption for at least 90 days with no net oil imports. Crude oil and petroleum products in private storage, alternative fuel supplies available for substituting for oil, and standby capability for oil production all count toward the nation's emergency reserve commitment under the International Energy Program. Under the auspices of the IEA, the United States and other members confer on drawing down emergency stocks and activating other emergency measures in a coordinated manner.

Emergency Programs of the IEA. The members also agreed to develop capabilities to respond to an emergency if a significant disruption of the world oil supply system occurred, including a formula for sharing the available supply of oil. In addition to stock drawdown and oil sharing, capabilities for responding to emergencies are to include restraints on demand, switching away from oil products for the short term, and increasing oil production by members. As evidenced by the response to the Persian Gulf crisis, the International Energy Agency relies on emergency stocks to replace most of the lost supplies, with most of those stocks coming from the Strategic Petroleum Reserve.

Legal Restrictions on IEA Actions: Responding to Supply Shortfalls. The charter of the International Energy Agency is more specific than is the Energy Policy and Conservation Act concerning the size of the supply shortfall needed to activate the IEA's emergency programs. It makes no mention at all, however, concerning the ultimate economic goals of those programs--for example, how much economic loss would warrant action. The IEA Secretariat makes the finding of disruption, subject to review by the agency's Governing Board, and directs the member nations to activate programs for restraining demand, drawing down reserves, and sharing oil among members--most likely in that order. As originally envisioned, some use of emergency reserves could be considered a restraint on demand, but a total commitment of emergency reserves would be viewed as a last resort. The agency now appears to view sharing

8. The 24 member countries of the IEA today are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

among member nations as the last line of defense after a drawdown of stocks.

The International Energy Agency follows either one of two processes for carrying out its emergency programs, depending on the size of the disruption. Both mechanisms take the volume of lost oil as the criterion for activation. That loss is a net figure, however, calculated after world supply has had a chance to respond to higher prices.

For disruptions of less than 7 percent, individual members of the IEA would participate in a cooperative process, outlined by the IEA Governing Board in 1984, that may result in the release of emergency reserves to increase available supply.[9] Each country would follow domestic conservation policies that it believes are appropriate. Policies may include letting the free-market system work, urging voluntary conservation, or switching from oil to other fuels. To help identify disruptions that merit an emergency response, the Governing Board only identifies circumstances it considers relevant--with price change notably absent.[10] That procedure provided the framework for the U.S. decision to release oil from the SPR in January 1991.

For disruptions that are greater than 7 percent, the International Energy Agency would supposedly activate its Emergency Sharing System and calculate a restraint on demand or an emergency reserve drawdown for each member. The conditions for invoking these emergency programs have not changed since the International Energy Program was first signed. The International Energy Program defines a disruption that would activate the agency's programs as a reduction in supply from predisruption levels for the IEA group as a whole or for any single member. The program also defines a complex set of data requirements and procedures for sharing the remaining oil supplies among IEA members.

The Emergency Sharing System formula establishes an allotment for each country's total oil use during the disruption. Countries currently consuming an amount that is above their permissible level are obligated to share that oil with those currently consuming below their permissible level.[11] The formula establishes those rights to oil in two parts. The first part is the restraint on demand, a percentage adjustment from each member's oil consumption in a base period (the past year). The size of this restraint on demand would itself depend on the size of the disruption. If the supply loss was between 7 percent and 12 percent, that part of a country's permissible level of oil use would be 7 percent below its consumption in the base period. If the loss was more than 12 percent, that part of the permissible level would be 10 percent below its consumption during the base period.

The second part of the formula is the obligation to draw down emergency reserves. If the restraints on demand do not fully allocate the loss of supply, that part of the formula specifies further reductions in permissible oil use proportionate with each member's net imports of oil in the base period (again, the past year). A country with emergency reserves of oil, however, such as the United States with its Strategic Petroleum Reserve, would meet that requirement by drawing down those reserves. Countries with larger net imports, calculated after a drawdown of emergency reserves, would incur a larger reduction in permissible supplies. Largely because of the Strategic Petroleum Reserve, the United States would probably have received oil during the Persian Gulf crisis under the International Energy Program formula.[12] Any country that was experiencing low oil use relative to its base year--because of poor economic performance, weather, or other circumstances--would have been more likely to receive oil than otherwise under the oil-sharing formula.

9. International Energy Agency, *I.E.A. Governing Board Decision on Stocks and Supply Disruptions* (Paris: IEA, July 1984).

10. Ibid., Appendix I.

11. For a discussion of the sharing formula and potential gains to the United States, see David R. Henderson, "The IEA Oil-Sharing Plan: Who Shares with Whom?" *The Energy Journal*, vol. 8, no. 4 (October 1987).

12. For example, the General Accounting Office concluded the United States would have received 1.5 million barrels per day during the Persian Gulf crisis had the oil sharing taken place. See General Accounting Office, *International Energy Agency: Response to the Oil Disruption Caused by the Persian Gulf Crisis*, GAO/NSIAD-92-93 (1992).

How the Government Currently Views the Benefits of Intervening in Oil Markets

The Energy Policy and Conservation Act identifies the objective of releasing the Strategic Petroleum Reserve as avoiding economic losses from supply shortfalls and severe price increases. However, neither the Department of Energy nor the International Energy Agency maintains any specific formula for evaluating the likely effects of government intervention in oil markets on the economy. The clearest insight into the thinking of those agencies comes from investigating the methodology that DOE uses to evaluate the economic benefits from building up the SPR in the first place.

Given the prevailing government views of the 1970s and 1980s, releasing SPR oil during a temporary disruption of world oil supplies would have yielded several benefits by avoiding economic costs. For example, DOE studies have identified two components of the costs of disruption: lower gross domestic product (GDP) attributable directly to higher oil prices, and lower GDP attributable to the costs of adjusting to higher prices (including the consequences of slow adjustment in labor markets and of less favorable terms of trade). The Department of Energy measures those adjustment costs as the loss of consumer surplus by oil users, an economic concept representing the change in the difference between the amount those consumers would be willing to pay for oil imports and the amount they actually pay.[13] Higher oil prices lead to lower oil imports and lower consumer surplus (and higher adjustment costs). But the smaller the response of oil imports to higher prices, the greater the loss of surplus and the smaller the costs of adjustment.

Thus, the benefits of releasing SPR oil come from the contribution of that release to lowering oil prices and to lowering imports of oil. Accordingly, the government's first step in measuring the benefits of releasing SPR oil is to calculate the drop in oil prices from the associated addition to world supply and the addition to GDP from that price drop. The second step is to calculate the reduction in adjustment costs as a result of the price drop, measured as the net rebound in oil consumer surplus. (DOE also includes consumer payments to the government for SPR oil among the benefits of release, even though that payment actually represents a transfer among sectors of the economy.)

Presumably, the government should release SPR oil whenever DOE's calculations indicate positive economic benefits. The problem is that such a formula would be likely to yield positive benefits at almost any time and, as such, is of little value for decisionmaking.

Deciding When and How to Use Strategic Stocks

Setting aside the current views of the Department of Energy and the International Energy Agency on emergency policy, which may no longer be completely relevant, some basic economic considerations should underlie decisions about when and how best to use the nation's strategic reserves of crude oil. For example, in deciding when to release SPR oil, it is important to compare the benefits from releasing stocks in the face of a crisis with the expected benefits from maintaining the reserve instead for future use.[14] Moreover, in calculating the benefits from release--whether current or expected--it is important to acknowledge the impact of that release on domestic oil consumption and production (as a result of lower oil prices) and on private oil stocks (as a result of changes in the expected price paths of oil and subsequent market uncertainty).

13. Department of Energy, *Strategic Petroleum Reserve: Analysis of Size Options*, DOE/IE-0016 (February 1990). The Interagency Working Group on SPR Size, chaired by the Department of Energy with representation by 12 other agencies, assumes domestic supply of oil does not rise with higher oil prices, so oil producer surplus (the difference between the market price and the cost of supplying goods) does not increase to offset any decrease in oil consumer surplus.

14. Alternative views on simple rules to guide decisions to release the Strategic Petroleum Reserve are reviewed in a report by Robert L. Bamberger and Lawrence C. Kumins, *The Strategic Petroleum Reserve and the Drawdown Dilemma*, Report 90-492 ENR (Congressional Research Service, October 12, 1990).

How the government goes about releasing SPR oil can also determine the benefits of release if the sales process itself affects the expected price path and market uncertainty. Hence, the decision about when to release oil may depend closely on how the government sells that oil.

When to Use the Strategic Petroleum Reserve: Now Versus Later

Releasing crude oil from the Strategic Petroleum Reserve may help to protect the nation from economic losses attributable to a temporary disruption of world oil supplies. But the government could achieve some level of economic stimulus from selling SPR oil at almost any time--regardless of any turmoil in oil markets. A key consideration in deciding if a current release is indeed appropriate should be whether the current economic benefits from the release in question are greater than the expected benefits from releasing oil later. That strategy would ensure the greatest total benefits from release over any period of time.

The current economic benefits of an SPR sale would stem from its ability to lower world oil prices and the nation's total oil imports. The expected benefits from holding onto SPR oil for later release would also reflect the expected size of the supply disruption at that later date and the likelihood of that future disruption occurring. In short, the benefits of release at any particular time would closely mirror the economic costs of an oil supply disruption at that time.

Oil Supply Disruptions and Economic Losses. A disruption of world oil supplies and the ensuing shock to oil prices could have several adverse effects on the economy. In particular, a sudden rise in prices might contribute to losses in economic output by lowering real incomes and consumer demand, causing businesses to lay off workers and to idle machinery in oil-intensive activities. It could also cause the economy to expend resources as it adjusts to changing relative prices. Total real consumer expenditures for all goods and services--a broad measure of economic welfare--would decline along with economic output. Consumer expenditures could also slip as more of the nation's output is directed to exports to satisfy an increased demand for U.S. goods and services by oil-exporting nations.

Some of those losses attributable to higher prices would be offset if the nation was able to reduce its use of oil and its total oil imports in response to higher oil prices without having to reduce total consumer expenditures. However, the net impact of a supply disruption on the overall economy would be negative. In some circumstances, the net impact of a disruption might also reflect the state of the economy. For example, a supply disruption would pose more of a threat to an economy at the turning point between recession and recovery--with weak consumer confidence and no strong investment.

Economic Benefits from SPR Release. The economy can benefit from a release of SPR oil in two ways. First, a release could help the economy avoid some of the initial adverse effects of a supply disruption by lowering oil prices. Second, a release could enable the economy to reduce its total oil imports further without the necessity of reducing oil use or incurring the costs of switching to other fuels or increasing domestic oil production.

Estimating current and expected benefits from releasing SPR oil, however, is more difficult than just identifying the volume of release and its impact on current oil prices. For example, the benefits of release would presumably be greater in the face of larger price shocks--whether now or later. Otherwise, a release would yield no greater benefits than in noncrisis times. And just as a price shock may pose a greater threat to the economy at certain points in the business cycle, the benefits from government action to reduce oil prices may be greater at different times.

Similarly, the effect of SPR release on total oil imports may be greater or less than the direct amount of the release. Indeed, the effect of releasing SPR oil on total oil imports would be threefold.

The first is the volume of SPR release itself. A greater release means a greater reduction in total imports--all else being constant.

The second is any subsequent increase in private oil use and decrease in domestic oil production in

response to the lowering of oil prices. Greater domestic oil use and lower domestic oil production mean higher oil imports--all else being constant.

The third is any subsequent change in the rate of addition to private oil stocks in response to any change in expectations about future market conditions. A lower rate of addition to private stocks means lower oil imports--all else being constant. Numerous studies on the interaction between public and private stocks exist. But the conclusions of those studies vary widely, depending on specific assumptions about how private businesses make inventory decisions.[15] For example, in its analyses of the optimal size for the Strategic Petroleum Reserve, the Department of Energy assumes that private inventories would not change because of an SPR release.[16] Even those studies that do assume some change in private inventories provide little recognition of how price expectations and market uncertainty can vary among different types of disruptions or how a release of SPR oil can affect expectations, uncertainty, and, hence, the incentives to hold private stocks.

In relying on basic economic theory concerning storage decisions and uncertainty, however, two observations are especially useful. First, individual consumers and businesses will add to their private stocks of oil and oil products at a lower rate (or draw from those stocks at a higher rate) whenever expected future prices drop relative to current prices or uncertainty surrounding current oil prices drops relative to that surrounding future prices. Second, from that perspective, a release of SPR oil may help reduce economic losses simply by reducing current market uncertainty. (Note that this view diverges from a common assumption in economic theory related to the factors determining inventory demand--namely, that all uncertainty is in the future. Acknowledging the uncertainty surrounding today's decision is the critical first step in recognizing how changes in uncertainty affect inventory decisions.)

In contrast to the simplicity of these three examples, all else is not constant. A release of SPR oil can simultaneously affect current and future prices and market uncertainty in ways that make the net effect of a release on total oil imports difficult to predict. For example, if the government announces its intention to release SPR oil in the near future, it could lower expected future prices (which lowers imports for private stocks); at the same time, however, it could add to current market uncertainty about when and how much prices will drop, which merely adds to imports.

The nature of the supply disruption itself can also complicate the decision to release oil when a current loss of supply and the prospect of continued or additional losses are connected. In that context, it is useful to distinguish temporary supply disruptions (as in an embargo) from longer-lasting restrictions on oil production (as in a competitive restraint on output).

Temporary Supply Disruptions: Actual or Threatened. Changes in current and expected economic losses--and in current and expected benefits from an SPR release--may be closely linked. For example, a supply disruption may be accompanied by both an immediate loss of oil supplies and a threat of further loss. In that event, an immediate release of SPR oil would not be appropriate if current events simultaneously point to an increased likelihood of additional disruptions in the near future and higher expected benefits.

Longer-Lasting Supply Disruptions. The relative benefits from holding onto SPR oil for later use may rise by even more if the disruption is long lasting. Expected benefits would rise for two reasons. First, the longer the period of curtailed supplies, the greater the likelihood of some additional, unrelated disruption occurring--just as a matter of statistical chance. Second, any subsequent disruptions and price hikes that take place from a higher base price will be even more costly to the economy since it will have already made its easiest and least costly adjustments in response to the first price increment. That logic supports the conclusion that using strategic stocks would not be appropriate to counter permanent price

15. A useful review of studies on the interaction of public and private stocks appears in Frederic Murphy, Michael Toman, and Mark Goldstein, *Strategic Oil Stocks and Public-Private Interactions: A Dynamic Game Analysis* (Washington, D.C.: Resources for the Future, April 1984).

16. For a description of the Department of Energy's model and its assumptions, see Paul Leiby and Russell Lee, *Preliminary Results of the SPR Size Cost-Benefit Study* (Oak Ridge, Tenn.: Oak Ridge National Laboratory, November 17, 1988).

changes, perhaps because of rising costs of oil production or the successful exercise of market power by the Organization of Petroleum Exporting Countries (OPEC).

The economy's long-term response to sustained higher prices would also be likely to develop ways of using oil products more efficiently, switching to other fuels, and increasing domestic oil production. If such changes enhance the economy's ability to import less oil in response to further price hikes without having to cut consumer expenditures, the economic cost of subsequent disruptions in oil supply may be lower, not higher. Thus, over a sufficiently long period of high oil prices, the benefits from an SPR release in response to any particular size of disruption could decline, not rise. However, those changes in the economy's responsiveness would reduce the benefits from an immediate release in the face of future disruptions as well as expected benefits from subsequent release.

How to Use the SPR: Paying Attention to Changes in Domestic Use and Private Stocks

The economic benefits from releasing SPR oil would result from lowering oil imports and oil prices. But the precise contribution from selling a given volume of oil would depend on the state of the economy, the nature of the supply crisis, and how the government goes about the sale. The sales process can influence the level of economic benefits and the decision of whether to release oil in at least three ways.

First, the process can influence the outlook for oil prices by influencing how quickly that release actually adds to the world supply and how quickly oil prices fall. Second, it can lessen the day-to-day volatility of oil prices by making more or less oil available to buyers in response to increasing prices. Third, the sales process can also influence the level of market uncertainty by affecting the market's perception about how much SPR oil the government wants to release and when.

SPR Sales and Change in Current Prices. How quickly a decision to release SPR oil will affect oil prices will depend on how quickly the government can complete the sale of oil and on how much uncertainty the market attaches to the government's willingness to make good on its stated intention to release oil.

With any sales process, some lag between the signing of sales contracts and the physical delivery of oil will occur as a necessary consequence of logistical problems. For example, private companies need time to arrange to transport the oil they purchase. Moreover, ultimately, the existing capacity of pumping units and distribution systems at SPR storage sites will limit the rate of flow.

However, the government has more control over the lag between the decision to release oil and the signing of sales contracts. If the lifting of oil was at the buyer's initiative, only minimal delay would accompany this type of off-the-shelf sale. A sales process wherein the government sets the release price and sells oil to all who are interested--first come, first served--would release oil at the buyer's initiative.

If the sale was at the government's initiative, perhaps as it attempts to sell a predetermined volume of oil by competitive bids, some delay would occur in transferring title to the oil because the government would need to evaluate those bids and perhaps negotiate specific terms of sale. The current sales process, wherein the government sets the release volume and sells oil to the highest bidders, will release oil only at the government's initiative.

That type of sales process can be streamlined to minimize delays--for example, identifying a list of potential buyers by conducting conditional bids in advance of an actual sale or by screening interested bidders for their financial integrity. But at no time can businesses be induced to buy as much oil as the government wants to sell--unless the government is willing to give the oil away at any price.

Announcing a decision to release oil would probably still affect current prices by private-sector arbitrage, even if the sales process causes the final sale to come months after that decision. But the drop in current prices would generally be smaller than the expected drop in the future price. In general, the greater the uncertainty about when and how much oil

the government will ultimately sell, the smaller the impact on current prices.

SPR Sales and Uncertainty About World Oil Prices. How the sale of SPR oil affects market uncertainty will depend in part on how that sale alters the relationship between world oil supply (including supply from the SPR) and oil prices. If the world supply is more responsive to changes in price, then oil prices will be less volatile and less uncertain. Different sales processes can have different effects on the price responsiveness of world oil supply. For example, the current volume-setting process effectively increases the amount of oil available at every price. At an opposite extreme, a sales process that established a set price for SPR oil, selling as much as the market wants at that price, would eliminate all uncertainty about prices above the price set by the government--as long as the supply of SPR oil held out. How the sale of SPR oil affects market uncertainty will also depend on how well the sales process communicates the government's intentions concerning the volume and timing of sales.

The focus should be on reducing uncertainty, not volatility itself. Volatility may merely be evidence of an efficient market, in which changes in supply and demand are reflected quickly in the price level. Constraining price movements in an effort to dampen uncertainty would simply impede the market's operation, creating alternating gluts and shortages. Market uncertainty about prices would give way to consumer uncertainty about supply availability and producer uncertainty about sales. Price uncertainty, however, may be reduced without any sacrifice in market efficiency by policies that make supply or demand more responsive to price changes and that promote full information on future additions to supply.

Chapter Two

Changing Institutions and Policy Needs: The SPR and Oil Markets in the 1990s

Although the threat of economic losses from oil supply disruptions remains, the likelihood of disruptions is smaller today, and the magnitude of economic loss from a disruption of any given size is probably smaller as well. As a result, releasing oil from the Strategic Petroleum Reserve today in response to any particular disruption would offer fewer benefits in terms of avoiding economic losses than in the past. Economic benefits from releasing oil from the SPR would still come through its contribution to lowering oil imports and lowering oil prices. But the precise contribution from selling a given volume of SPR oil would depend on both the nature of the supply crisis and how the government goes about the sale.

How the Economic Impact of Supply Disruptions Has Changed

The Department of Energy's current view of how a release of SPR oil affects oil markets and conveys benefits to the economy may no longer be accurate. Since the nation's basic policies and programs for dealing with energy emergencies first evolved, important changes have occurred in other energy policies and in the structure of oil markets. Those changes point to smaller economic benefits and costs from releasing SPR oil in response to a disruption of world oil supplies. Two reasons account for those diminished benefits. First, oil markets have changed in ways that make a major loss of oil supplies less disruptive than in the past. For example, the response of oil prices to a loss of supplies comes faster, and the resulting drop in the nation's use of imported oil is bigger. Consequently, the final increase in oil prices is smaller and does not stay high as long. Second, the economy has changed in ways that lessen the prospect of economic losses from higher prices. For example, the contribution of oil to the nation's economic output is smaller, and oil consumers in some sectors of the economy are more able to reduce their oil use on short notice.

Viewing the Oil Market's Response to World Supply Disruptions

Changes over the past two decades have altered the way oil markets respond to a sudden loss of oil supplies. Among the most important of those changes has been the end of price and allocation controls on petroleum, the growth of oil futures markets, the increased diversification of oil sources, and the development of increased capabilities to switch among energy sources.

A Faster Price Response: The End of Price Controls and the Growth of New Markets. The economy labored under petroleum price and allocation regulations on petroleum during the oil price shocks of 1974 and 1979 to 1980. The phaseout of price and allocation rules began in the late 1970s, but final decontrol for all categories of crude oil and all refined petroleum products did not come until January 1981.

Box 1.
Current Oil Markets Are in Transition

Changes in oil markets over the past 20 years have encompassed three phases. Up to the mid-1970s, oil was sold almost exclusively at posted prices or under long-term, fixed-price contracts. With posted prices, the world's largest oil companies established both the price they would pay for a certain quality of crude oil and the markups to that price for variations in oil quality. Price controls in the United States replicated the system of posted prices. For the major oil companies that also refined oil and sold petroleum products, crude oil prices were little more than internal transfer costs--important for tax reasons but not for overall profitability. For the national oil companies of the oil-exporting nations, royalty arrangements were more important than oil prices in determining their oil revenues. During this period, price managers wanted stability, and energy prices varied little with short-term changes in supply and demand.

By the late 1970s, a growing number of independent companies were entering the oil market and the national oil companies were asserting their independence. At the same time, a growing share of world oil was selling on a spot basis or under short-term contracts; later it was sold through flexible pricing provisions in long-term contracts. With this flexible pricing, oil prices that companies reported became much more responsive to current and expected market conditions. Prices also became much more uncertain.

The 1980s witnessed the widespread development of formal and informal market institutions for buying and selling crude oil and petroleum products for future delivery at prices set today. Those forward markets, including the government-regulated futures markets and options markets, developed in response to flexible pricing as traders sought new ways to hedge against and speculate in price uncertainty. The availability of forward markets also eased the reluctance of many companies to trade in the spot markets. Forward sales represent a tool for managing price risk, and forward transactions have become highly integrated with physical transactions. Today, traders rarely contract to buy or sell oil without concurrently assuming an appropriate offsetting position in a forward market to protect themselves against adverse price movements.

Other changes in pricing institutions that complemented the move to more flexible markets included a greater use of spot sales (for delivery within one month), futures markets, and long-term contracts with prices tied to futures or spot prices (see Box 1).

The major implication of the policy shift from price controls to relying on free markets is that the price of oil now more fully and quickly reflects the consequences of a disruption of world oil supplies. Because prices in the domestic market can adjust completely, consumers of oil products have a greater incentive than otherwise to make full use of whatever capabilities they have to shift to other fuels or to consume fewer oil-intensive goods and services. Also, oil producers have a greater incentive than before to make full use of existing capabilities to increase their output.

A Bigger Response of Oil Imports for Current Use: Capabilities for Substitution. Some analysts point to a growth in the capability for substitution since 1973. According to them, businesses in some sectors of the economy have invested in capacity that allows them to shift quickly among energy sources. For example, data on multiple-fuel capacity in place in manufacturing and electricity generation suggest greater short-term capability for substituting fuels today.[1] (Fuel switching reflects an ability to substitute one energy source for another with no significant modifications to equipment, while keeping production constant.)

Yet other analysts argue that the capability for substitution may be on the wane. They point out that much of the drop in oil use in recent years has stemmed from declining output in formerly oil-intensive manufacturing sectors, gains in automobile efficiency, population shifts to more temperate regions of the country (that is, regions where oil is not the

1. Energy Information Administration, *Manufacturing Fuel-Switching Capability 1988*, DOE/EIA-0515(88) (September 1991).

primary fuel for home heating), and the replacement of oil heating units in many residential and commercial structures. Since the transportation sector--road, air, and water travel--continues to depend almost exclusively on oil products, further comparable reductions in oil use in response to future price increases will not be forthcoming unless such price increases are much larger than in the past.

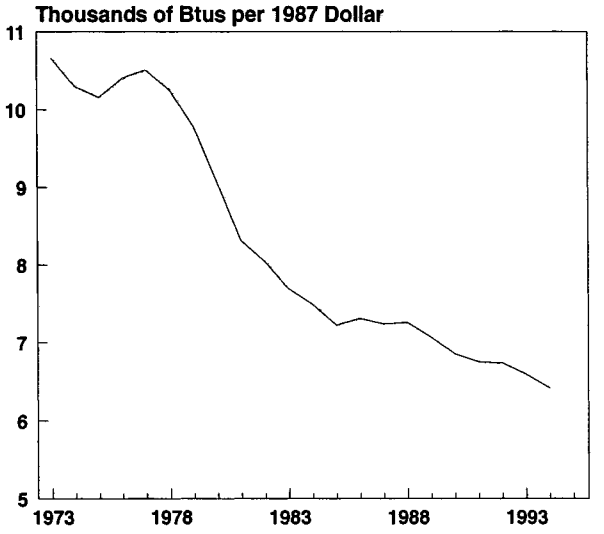
Moreover, on the supply side, the nation's oil fields are more depleted today and less able to increase production in response to higher prices. Aside from large discoveries in northern Alaska and the offshore regions of the lower 48 states in the 1970s, much of the nation's oil output comes from producing regions that were at their peak 20 years ago. The oil fields of Texas, Louisiana, and Oklahoma, which accounted for one-third of total domestic oil production in 1993, produced only half as much oil in that year as in 1973.[2]

Regardless of whether actual capabilities for substitution today are greater or less than in the past, the evidence of the past 20 years on how consumers and businesses actually responded to higher oil prices is clear. The economy is much more flexible than policymakers originally assumed it was (see Figure 1). Consumers have demonstrated a willingness to reduce discretionary driving--for example, by consolidating shopping trips and vacationing closer to home. Over time, they have made greater use of public transportation and shifted their demands away from oil-intensive goods and services. Similarly, businesses have demonstrated a capability to substitute telecommunications for air travel, purchase goods and services produced closer to home, and relocate to more temperate climates. That evidence supports the view that the threat of economic loss from a supply disruption of any given size is more benign today.

A Smaller Rise in Speculative Demand for Stocks: Growth of Futures Markets. A further element of structural change that affects how oil markets respond to price shocks has been the emergence of petroleum futures markets and other pricing institutions for managing uncertainty, in which participants can lock in prices today for oil to be delivered in the future.[3] The growth of the futures markets for crude oil and petroleum products has come hand in hand with the decontrol of oil prices, the entry of new suppliers (including new countries and new companies), the development of other new markets for buying and selling oil (including spot markets, forward markets, and options markets), and the declining use of administered pricing relationships and long-term supply contracts. Futures contracts represent a low-cost alternative to fixed-price contracts and oil inventories for managing price and supply risk (see Box 2).

Facing oil price shocks and significant market uncertainty about price, oil producers and consumers

Figure 1.
Oil Use per Unit of Real Gross Domestic Product, 1973-1994



SOURCE: Congressional Budget Office based on data from the Energy Information Administration and the Bureau of Economic Analysis.

NOTE: Btus = British thermal units.

2. Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves*, DOE/EIA-0216 (various issues).

3. A recent study discussing the importance of futures markets is Philip K. Verleger Jr., *Adjusting to Volatile Energy Prices* (Washington, D.C.: Institute for International Economics, November 1993). For a discussion of the importance of changing market institutions, see Richard D. Farmer, "Forward Markets and Changes in Macroeconomic Performance: The Case of Oil," *Journal of Macroeconomics*, vol. 15, no. 3 (Summer 1993).

Box 2.
Some Common Questions About Futures Markets

What Is a Futures Contract?

A futures contract requires the seller (buyer) of the contract to make (accept) delivery of a specified quantity of a commodity on a specified date in the future. If the purchaser holds the contract until the delivery date, the delivery price will be the sales price for the contract. However, these standardized contracts may be resold many times before the specified delivery date. Further, like other financial derivatives, the value of the contract must ultimately reflect the prices in other closely related markets. In particular, the futures price at the time of delivery must match the going price for spot (or cash) sales of comparable quality oil.

Where Are Futures Contracts Traded?

Futures are traded on commodity futures exchanges--nonprofit corporations regulated by the U.S. Commodity Futures Trading Commission. Brokers, who are members of the exchange, execute orders to buy or sell futures on the behalf of individual traders. The exchange provides a clearinghouse function, accounting for all trades and ensuring settlement. The exchange also supervises the conduct of trade and provides information processing and dissemination services (for example, price reporting).

How Are Futures Contracts Traded?

Trading strategies can be very complex, but the two basic transactions are the short and the long positions. Traders take a short position when they sell a contract, thereby obligating themselves to deliver the commodity ("short" because traders commonly do not possess the product they are selling). They take a long position when they buy a contract. Traders can use futures to help guarantee their future profits because the value of an appropriate futures position (long or short) will move in the opposite direction of the traders' cash market position. For example, when a refiner's purchase costs for crude oil rise (otherwise lowering its profits), the value of a long position in oil would rise too, helping to offset that loss.

who use futures markets can reduce their exposure to that uncertainty without building or holding onto inventories to the extent they otherwise would. The implications of decreased reliance on inventories for changes in oil imports are straightforward. In response to higher prices, oil consumers can meet a greater part of their current oil needs by drawing down their own stocks, hence reducing their oil purchases. Also, domestic producers can satisfy more customers by drawing down their own inventories, hence increasing their oil sales. Fewer purchases and higher domestic production result in lower oil imports.

Diversification and Companies' Concerns with Loss of Supply. Concern over the inability to secure needed oil during a supply disruption may also be smaller today. Internationally, the number of oil-exporting nations has increased, and the large oil companies have worked to diversify their sources of oil. Thus, oil-exporting nations find it more difficult to cut off supplies totally to individual companies or countries. As a result, individual oil companies experience less uncertainty and, again, demand is lower for inventories during a period of supply disruption.

Contrasting the Persian Gulf Crisis with Past Disruptions. A comparison of the Persian Gulf crisis of 1990 and 1991 with the Arab oil embargo of 1973 and 1974 provides perhaps the clearest example of how much the oil market's response to supply disruptions has changed over time.[4]

In past disruptions, as illustrated by the 1973-1974 embargo, refiners held onto oil stocks as prices rose, not knowing how much higher prices might go (see Figure 2). Incentives for suppliers to hold onto or even add to stocks constrained total oil supplies further and added to upward price pressures. Also pushing up apparent demand and prices at the same time were additional demand from retailers and small distributors (to add to their own storage) and more

4. See Congressional Budget Office, "Understanding the Volatility of Oil Prices During the Iraq-Kuwait Crisis," CBO Staff Memorandum (January 1991).

frequent purchases by gasoline consumers in the face of rising prices. Petroleum price controls in effect at that time did two things: they helped to limit increases in consumer prices, thereby fueling the growth in demand, and they capped domestic crude oil prices, which actually caused domestic production to drop.

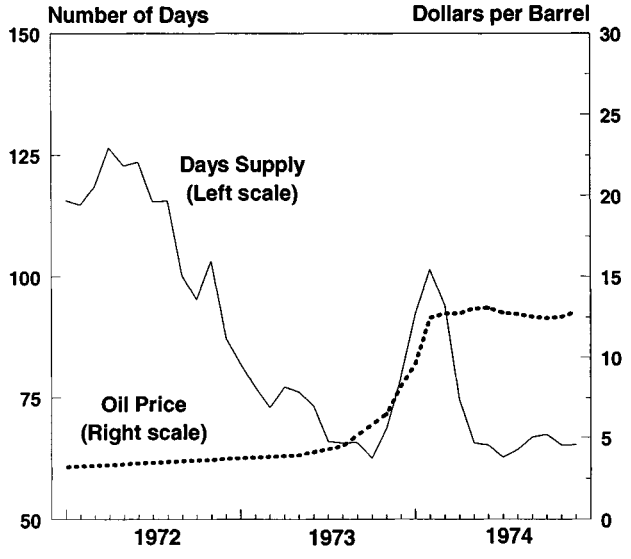
In the Persian Gulf crisis of 1990, demand for crude oil stocks changed little despite the dramatic price rise (see Figure 3). The change that did take place in the product markets was largely the result of normal seasonal movements in the markets for gasoline, heating oil, and residual fuel oil.

How the Economy's Response to Higher Oil Prices Has Changed

One of the most important changes that affect energy policy is the smaller effect that oil price shocks have on the economy today compared with the past. Two reasons account for that change. One has to do with structural changes in the oil markets themselves, as discussed in the preceding section, which have weakened the link between oil prices and economic output. The other is a diminished concern with inflation and its underlying structural causes, including the potential contribution of oil prices to inflation.

Structural changes in the economy at large have meant that the concern about high, uncontrollable inflation is less--especially since the recession of the early 1980s. Deregulation in transportation, less regulation in financial services, more flexible wages, and additional market-based pricing in natural gas and electricity markets all mean greater price flexibility. (The greater flexibility of wages is related to the diminished role of trade unions, downsizing in traditional union industries, greater self-employment and greater employment in the service sector.)[5] Growing competition from abroad for a wide array of

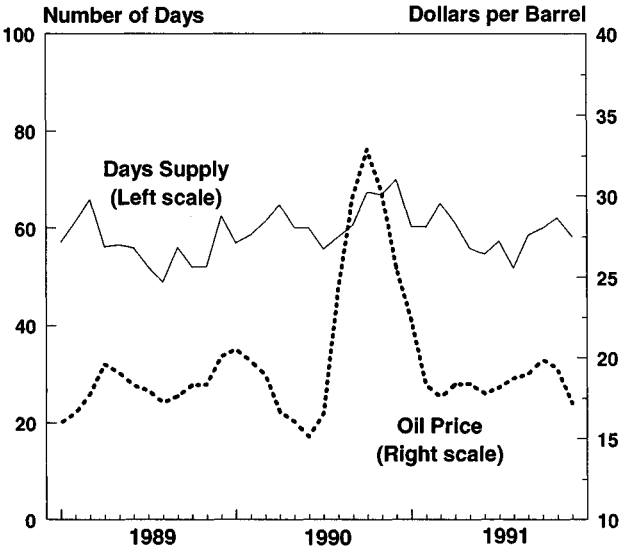
Figure 2.
Comparison of World Oil Prices and Days Supply of Stocks During the Arab Oil Embargo of 1973 and 1974



SOURCE: Congressional Budget Office based on data from the Energy Information Administration.

NOTE: Price represents acquisition cost to the refiner for imported crude oil. Days supply is the number of days that stocks could replace net petroleum imports.

Figure 3.
Comparison of World Oil Prices and Days Supply of Stocks During the Persian Gulf Crisis



SOURCE: Congressional Budget Office based on data from the Energy Information Administration.

NOTE: Price represents acquisition cost to the refiner for imported crude oil. Days supply is the number of days that stocks could replace net petroleum imports.

5. Henry S. Farber, "The Recent Decline of Unionization in the United States," *Science*, vol. 238 (November 13, 1987). Farber documents a decline in trade union membership from 25.6 percent of all nonagricultural workers in 1973 to 14.1 percent of those workers in 1985.

goods and services has also tempered rises in prices and wages in this country. Thus, when oil prices rise today, other commodity prices are under less pressure to increase than was previously the case.

Greater flexibility in oil prices is also apparent from several periods of falling oil prices--after 1981, in 1986, 1991, and again in 1993. Prices for oil products continue to be an important element of producer and consumer price indexes, despite some reduction in the oil intensity of certain manufacturing activities. However, one hears little discussion today about a resource-constrained or uncompetitive oil industry as a major underlying cause of inflation.

Not only are general prices unlikely to rise unchecked, but more people and businesses make use of financial instruments that yield returns at market rates. In addition, more people and businesses have salaries or contract prices tied to inflation. Thus, many of the adverse consequences of inflation, such as the declining real incomes of people on fixed wages and disincentives for businesses to invest in physical capital, are not as big a concern today. That is not to say that inflation is no longer a concern for public policy. Adverse responses to the basic rate of inflation still take place, though to a lesser degree, and adverse business responses to uncertainty about the inflation rate definitely remain a concern.

How the Threat of Oil Supply Disruptions Has Changed

Much of the economic rationale for government programs to reduce oil use and increase domestic oil production rests on the view that the risk of disruptions of imported oil supply grows with the level of oil imports.[6] Examples of such government programs include financial support for research and development of energy-saving technologies and alternative fuels plus various tax incentives for domestic oil producers.

Support for the perception of growing exposure to supply disruptions arises from the belief that a growing share of world supplies must inevitably come from the historically unstable Middle East. That notion, however, fails to account for two fairly recent changes--greater diversity of supplies and growing economic interdependence. Greater diversity of supplies reduces the size of disruptions the nation is likely to face. In turn, growing economic interdependence reduces the likelihood that politically or economically motivated disruptions would occur in the first place. At the same time, growing international interdependence and liberalization of trade also make it more difficult for the United States to isolate itself from world events through policies that would reduce oil imports.

Diversification in the Sources of Oil and Sources of Energy Is Increasing

The rate of discovery and development of oil resources worldwide has far outpaced the growth in demand in the past 20 years. Moreover, much of the growth in the oil supply has been outside the Middle East. Thus, although the Persian Gulf nations accounted for 37 percent of world oil production in 1973, the same countries accounted for only 28 percent in 1993.[7] The production shares for the Organization of Petroleum Exporting Countries, including members outside the Middle East, declined from 55 percent to 43 percent over the same period.

The emergence of new sources of oil came about in part as a response to the jumps in oil prices during the 1970s. With higher prices, deposits that geologists had identified earlier became profitable to explore and develop. Especially noteworthy were the large developments in the North Sea, Mexico, and Alaska. Combined British and Norwegian production of crude oil rose from zero to 2.9 million barrels per day during the decade after 1973; Mexican production increased by 2.2 million bbl/day; and Alaskan production increased by 1.5 million bbl/day. The

6. Department of Energy, *Project Independence Report* (1974).

7. Energy Information Administration, *Monthly Energy Review*, DOE/EIA-0035 (various issues). The Persian Gulf nations are Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

region of the former Soviet Union also became a major exporter of crude oil and oil products in this period. Furthermore, smaller oil discoveries cropped up all over the world.

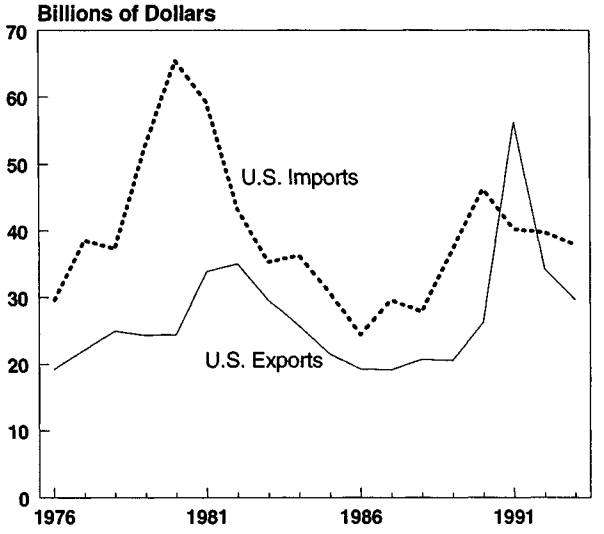
One may further challenge whether dependence on imports is a growing problem by looking at the use of all forms of energy. In 1973, U.S. net imports of all forms of energy (including crude oil, coal, natural gas, and hydroelectricity) accounted for 17 percent of the nation's total energy use. In 1993, the comparable figure had risen to only 20 percent. Meanwhile, the contribution of oil from the Organization of Petroleum Exporting Countries to the total world supply of all energy forms fell from about 27 percent to less than 16 percent.

Growing Financial Interdependence

What has also changed over the past 20 years has been the financial incentive of oil-exporting nations to curtail oil supplies. In the first decade following the price explosion of 1973 and the new-found independence of oil-exporting countries in making pricing decisions, the economies of many of the oil-exporting countries were unable to generate sufficient internal demand for goods and services to spend all of their new-found wealth. As a result of that problem of absorption, disrupting the flow of foreign capital carried little political cost. That is, since those countries had a hard time spending all of their money, they were more willing to interrupt that capital flow than they otherwise would have been. Today many of those same countries once awash in cash now run trade deficits, and most of their capital investments are in the West (see Figure 4).

According to Department of Commerce data, although the countries of the Gulf Cooperation Council (Saudi Arabia, Kuwait, Bahrain, the United Arab Emirates, Qatar, and Oman) accounted for a total of $13 billion in exports to the United States in 1992, those same countries imported $11 billion worth of goods from the United States.[8] In short, the overall trade surplus of those countries with the United States is much smaller than the total value of their oil sales here. In that same year, Saudi Arabia ran a deficit of $19.4 billion on its overall current account (including trade in merchandise and services) with the rest of the world.[9]

Figure 4.
United States' Trade with OPEC in Goods, Services, and Income, 1976-1993



SOURCE: Congressional Budget Office based on data from the Bureau of Economic Analysis, *Survey of Current Business* (various issues), Table T.

NOTES: U.S. exports include U.S. government grants.

OPEC = Organization of Petroleum Exporting Countries.

Not least, progress in 1993 and 1994 toward resolving the long-lasting Israeli and Palestinian disputes and the 1994 peace treaty between Israel and Jordan may improve the stability of oil markets. The unsuccessful Arab effort to interrupt supplies in 1967 and the successful effort in 1973 were both related to conflicts with Israel.

Granted, the Mideast is still a risky place. Growing Islamic fundamentalism in particular threatens political stability throughout the region. But the increasing interdependence of the Mideast economies and the industrialized nations makes it probable that

8. Reported in *Oil Daily*, January 14, 1994, p. 5.

9. International Monetary Fund, *International Financial Statistics* (August 1994).

Box 3.
Recent Developments in Oil Markets

World oil prices have continued on a mostly downward trend since the spring of 1991 and the end of the Persian Gulf crisis. But numerous spikes and dips have marked that downward trend for the past three years, which is consistent with the view that price volatility is a permanent feature of oil markets today.

Upward movements in prices in mid-1992 resulted in part from renewed economic growth in the United States and from the limited success of the Organization of Petroleum Exporting Countries in restraining output as Kuwait resumed exports of oil. More recently, in the first half of 1994, oil prices rose again on the strength of the U.S. economy, political turmoil in Nigeria (and the threat of a strike by oil workers), and problems with oil production platforms in the North Sea. Increasing demand for oil from the rapidly expanding economies of East Asia continues to place upward pressure on oil prices as well. But undermining the prospect of further price rises throughout this period has been the potential return of Iraq to the world oil market and, more recently, low economic growth in both Europe and Japan.

Adding to those past price swings and likely to contribute to future price movements is the great uncertainty surrounding the outlook for oil production in the states of the former Soviet Union and the normal vagaries of weather and accidents (involving tankers, pipelines, and refineries).

Many forecasters point to rising oil prices in the future. For example, the Energy Information Administration projects that prices could rise on average by nearly 3 percent a year over the next 10 years (in constant dollars).[1] However, the experience of the past few years suggests that the ride to higher prices will not be a smooth one.

1. Energy Information Administration, *Annual Energy Outlook*, DOE/EIA-0383(93) (January 1993), Table A-1.

some oil exporters would suffer on net from any shock to the world economy caused by higher oil prices.

Economic Integration Is Growing Worldwide

Some analysts question whether the United States can insulate itself from disruptions of the world oil supply by reducing its direct dependence on oil imports. Regardless of how little oil the United States imports, the nation's non-oil-producing trading partners will still be subject to any disruptions in world supply. Moreover, any economic losses those trading partners incur as a consequence of disrupted supplies and increased oil prices would still adversely affect the U.S. economy.

The exposure of the U.S. economy to worldwide economic events has been increasing over the past two decades with the growing contribution of trade to the nation's overall economic activity. For example, total U.S. exports of goods and services as a percentage of gross domestic product have grown from about 6 percent in 1973 to over 11 percent in 1993.[10] In sum, the growing integration of the world economies indicates a declining ability to insulate the U.S. economy from events in world oil markets.

Examining Price Volatility, Uncertainty, and Private Storage Decisions

Structural changes in the oil markets and the U.S. economy suggest that a given increase in world oil prices may have a smaller adverse impact on the U.S. economy today than in the past. Nevertheless, some of those same changes mean that oil prices today can rise faster and higher in response to a loss of supplies and that oil prices in the aftermath of a supply loss

10. Council of Economic Advisers, *Economic Report of the President* (February 1994), Table B-2.

will be more volatile and uncertain than was true before. Price movements during supply crises are much more complicated than a single, one-time increase. The additional volatility of oil prices and changes in the way the market responds to changes in the outlook for prices and uncertainty have important implications for both the total cost of supply disruptions and the effectiveness of emergency energy policies.

Oil Prices Are More Volatile Today

Small changes today in the current supply or in the outlook for supply can lead to large movements in oil prices--both up and down--within a short time frame. High volatility of prices arises frequently in oil markets because both oil supply and demand are relatively unresponsive to price change. As a result, oil prices have to rise or fall by large amounts to bring supply and demand into balance when even small changes occur in the availability of oil supplies or in consumer requirements (see Box 3).

The fact that price volatility is greater today than in the past reflects the combined effect of price decontrol, more competition among suppliers, and greater price visibility (largely as a result of futures trading). Those changes have outweighed any contribution to greater price stability that would come from an increased capability of oil consumers to substitute oil products on short notice for other forms of energy --if indeed capabilities for substitution are greater.

With decontrol of prices and greater competition, oil prices today serve a more important role in stabilizing the market--rising and falling to bring demand into line with supply. In the years when a few large oil companies dominated the oil markets, reported oil prices were little more than internal transfer costs and changed very little. When independent oil companies and national oil companies emerged in the 1960s and early 1970s, prices changed only slowly because sales were made largely under the terms of long-term, fixed-price contracts. Moreover, throughout the 1970s, average prices reflected the restrictions of price controls here and abroad. In those circumstances, oil prices did not always keep supply and demand in balance. Supply shortages often alternated with gluts on the market.

A larger share of crude oil and refined products is currently sold on a spot basis (for delivery within a month or two), with flexible prices, than was previously the case. And contract prices even for oil sold under longer-term contracts are commonly tied to prices reported in the oil futures markets, which change continuously in response to new information about supply and demand. Futures contracts, spot sales, and longer-term contracts form a single, highly integrated market, with prices for crude oils of various qualities and refined products to be delivered at different locations and times all moving together. In this new environment, price movements are more visible to the public than in the past.

Price Volatility Can Lead to Price Uncertainty

Price volatility is a concern today not just because it is potentially greater than in the past, but because volatility is closely linked to market uncertainty. Uncertainty can affect producer and consumer decisions about the storage of oil in ways that can exacerbate a supply crisis.

Uncertainty about prices reflects underlying uncertainty about changing levels of supply and demand. Such uncertainty may reflect a current assessment of the probability of a single large change in future supply or demand. It may also reflect the likelihood of frequent changes in supply or demand. Or it may reflect structural conditions that would cause any particular change in supply to have a bigger, harder-to-predict impact on prices than otherwise. If one focuses on the frequency of changes and on structural conditions affecting the size of price adjustment, price uncertainty will be greater wherever prices are more volatile.

Prices Can Be Even More Uncertain During a Crisis

Given the basic structure of oil markets, oil prices can be even more volatile and uncertain during major supply disruptions for two reasons. First, an increased frequency of smaller changes in supply--both

actual and threatened--usually accompany large supply losses. Second, if the loss of supply diminishes the worldwide buffer of excess capacity to supply oil, the world supply of oil can become even less responsive to price changes during a supply crisis.[11]

The availability of excess capacity means that additional quantities of oil can enter the market from the private sector at only small increments in price. Without the buffer, businesses may expect oil prices in the future to be more volatile in the face of further changes in supply or demand, since bigger price movements are needed to balance changes in supply and demand than would otherwise be the case.

11. The importance of this supply buffer is discussed in Congressional Budget Office, "Understanding the Volatility of Oil Prices During the Iraq-Kuwait Crisis."

Chapter Three

Energy Policies and the Experience of the Persian Gulf Crisis

The experience of the Persian Gulf crisis provided the first occasion for testing the usefulness of current policies guiding the release of oil from the Strategic Petroleum Reserve and activating emergency programs of the International Energy Agency (see Box 4). The performance of the SPR and the IEA in that crisis, however, presents serious cause to rethink the design of the nation's basic policies for responding to energy emergencies.

A Look at Government Actions and the Market's Response During the Persian Gulf Crisis

At the outset of the Persian Gulf crisis, the official policy of the U.S. government called for the early, coordinated release of the nation's emergency stocks, stored in the Strategic Petroleum Reserve, to offset that supply loss. That policy continues today.[1] The stated objectives of SPR release were to replace lost supplies and lower oil prices. Early in the crisis, however, the difficulties of deciding whether those actions were necessary or even desirable became apparent.

What the United States Did on Its Own

The first substantive action by the United States in response to the August 2, 1990, invasion of Kuwait by Iraq was to suspend further acquisitions of oil for the Strategic Petroleum Reserve. Measured at purchase rates before August, that step reduced U.S. oil demand by less than 50,000 bbl/day. Although not significant in volume, the action did reduce the demand for oil imports and contributed in a positive, although minor, way to reducing price volatility.

Next, on August 9, President Bush publicly called on U.S. oil companies to exercise restraint in raising the prices of petroleum products. The White House later gave this request more support when the Department of Justice subpoenaed oil companies' records on gasoline pricing.[2] Although some analysts viewed that action as de facto price control, little evidence exists that gasoline or heating oil prices nationwide changed as a result.[3] In fact, the President's action in this case was inconsistent with the U.S. policy of letting the market system work and probably

1. Department of Energy, *Energy Security: A Report to the President* (March 1987), p. 215; and Department of Energy, *United States Policy for Responding to Oil Supply Disruptions* (February 1994).

2. Analyses of the events of this period appear in Philip K. Verleger Jr., "Understanding the 1990 Oil Crisis," *The Energy Journal*, vol. 11, no. 4 (1990); M.A. Adelman, "The 1990 Oil Shock Is Like the Others," *The Energy Journal*, vol. 11, no. 4 (1990); and George Horwich, "Energy Policy, Oil Markets, and the Middle East War: Did We Learn the Lessons of the 1970s?" in J. Dorian and F. Fesharaki, eds., *International Issues in Energy Policy, Development, and Economics* (Boulder, Colo.: Westview Press, 1992).

3. An analysis of the relationship between petroleum price changes and the President's call for restraint by U.S. oil companies appears in Horwich, "Energy Policy, Oil Markets, and the Middle East War."

Box 4.
Economic Highlights of the Persian Gulf Crisis

The United Nations' boycott of Iraqi and Kuwaiti oil in response to Iraq's invasion of Kuwait on August 2, 1990 had the effect of taking a total of 4.3 million barrels per day (bbl/day) of crude oil and petroleum products out of the world market. As a result, the average landed cost of imported oil in the United States went from $17.65 per barrel in July 1990, to nearly $31.50 in October. (Landed cost includes the purchase price and transportation costs.) At the outset, oil markets were concerned that any replacement crude oils would be markedly heavier than the lost Iraqi and Kuwaiti supplies.

That loss, which amounted to about 7 percent of a world supply that was just over 60 million bbl/day, was nominally sufficient to activate the International Energy Agency's emergency programs for restraining demand and sharing oil, which are triggered by a 7 percent loss of world supplies. However, in the succeeding months, Saudi Arabia and other countries increased their sales significantly, and by November 1990, had completely offset the supply lost as a result of the boycott--both in volume and quality. Demand had remained high for light crude oils by refineries in Europe and Asia, which had difficulty in compensating for the loss of Kuwaiti refined products.

From their peak in early October 1990, oil prices fell progressively through the winter and spring of 1991--even before the start of the air and ground wars. Rising oil production worldwide was reaching the market, and a weakening U.S. economy and mild winter were contributing to lower demand. The beginning of the end for the oil crisis came with the mounting success of the Allied air campaign, which began on January 16, 1991. A final price collapse occurred with the immediately apparent success of the Allied ground initiative, which began on February 24, 1991. The United Nations forces declared a unilateral cease fire on February 28, 1991.

exacerbated the supply situation by a small amount, undermined the nation's progress in reducing oil imports, and made prices more volatile. (One Southern California oil company that heeded the President's call encountered a minor supply shortage and gasoline lines--a natural consequence of price controls.)

The Administration also reacted with concern to the increased exports of petroleum products in the fall of 1990, though it took no actions under available authority to restrict export licenses. The increase in exports of light petroleum products (such as gasoline and jet fuel) at that time, however, was totally consistent with the efficient operation of the market at the time. Refineries in Europe that lost access to light petroleum products from Kuwaiti refineries were experiencing great difficulty in raising their product yields to make up for that loss. (Kuwait was exporting over half of its crude oil at the time in the form of products, primarily to Europe.) In comparison, refineries in the United States were technologically more sophisticated and more capable of adjusting to the changing mix of crude oils and simultaneously increasing the supply of light petroleum products. Thus, had the Administration succeeded in restricting product exports, world oil supply problems would only have become worse.

Also at the President's direction, the Department of Energy initiated a test sale of SPR oil at the end of September 1990. On September 28, DOE issued a Notice of Sale for up to 5 million barrels of crude oil to be delivered over a 30-day period.[4] That offer included 2.8 million barrels of high-sulfur (or sour) oil and 2.2 million barrels of low-sulfur (or sweet) oil. Bids were received by October 5, and contracts were awarded on October 18 for almost 4 million barrels. The sale included about 1.7 million barrels of sour oil and 2.1 million barrels of sweet oil. Actual delivery of this smaller amount took place over the next 45 days at an average rate of less than 90,000 bbl/day.

On the whole, the oil industry reacted negatively to the test sale. The test demonstrated a number of problems that indicated DOE was not ready for a full-scale drawdown. Also, many analysts believed

4. Department of Energy, *Strategic Petroleum Reserve Annual/Quarterly and Test Sale Report*, DOE/FE-0220P (February 15, 1991).

that DOE should have conducted a larger sale in a serious effort to bring oil prices down. (Test sales are limited by the Energy Policy and Conservation Act to 5 million barrels.)

Among the most obvious problems, the base reference price for the sour crude oils in the Notice of Sale was too high--only $0.54 per barrel lower than the price for sweet oils. As a result, DOE sold much less of the sour oil than it had planned. Even after increasing its offering of low-sulfur crude oils beyond the initial level, DOE was not able to sell the entire 5 million barrels it had planned to release. In addition, the U.S. Jones Act restriction that only U.S. tankers and barges could pick up this oil made it difficult for oil companies to locate qualified vessels.

The relative offering of sweet and sour oils was additionally troublesome because it generally approximated the relative volumes DOE had stored based on past expectations of future market needs, not on actual current market needs. The sweet oils in the SPR are generally lighter oils, which yield higher volumes of light petroleum products such as gasoline and jet fuel. It was precisely that type of oil that was thought to be in short supply at the outset of the crisis. By way of explanation, many analysts believed that the lost crude oils were of higher quality than the oils that would replace them, which later turned out not to be the case.[5] Also, some refiners abroad were having difficulties in meeting the demand for light products with the available crude oils.

Even though the test sale demonstrated that the Strategic Petroleum Reserve could deliver some oil to the market, the fundamental message the test sent to oil market analysts was that the government was not willing to make the oil available even in the face of a 7 percent loss of world supplies and a doubling of world oil prices. After the test sale, the industry greatly discounted the potential contribution of the reserve to restoring the world's supply buffer.

What the International Energy Agency Did

The Governing Board of the International Energy Agency first met on August 9, 1990, to review their options. At that time, the board endorsed activating the agency's Emergency Data System but concluded that the disruption was not severe enough to trigger the Emergency Sharing System. The agency estimated a net loss of oil volumes that reflected expected increases in oil supply from excess production capacity worldwide and from the potential drawdown of nonemergency stocks. Although the market would have responded favorably to a substantial release of emergency reserves, oil traders were relieved that oil sharing was not invoked.

The IEA's Standing Group on Emergency Questions worked throughout the crisis with individual members on measures to be taken in case of further disruptions and on profiles of emergency capabilities. Yet little came of it. Up until the start of military actions, the IEA watched and talked but took no active role in helping to resolve local product imbalances (jet fuel in particular).

In anticipation of imminent military action, the IEA's Governing Board decided on January 11, 1991, to put into place a contingency plan. It had advertised that the plan would increase the available world supply by 2.5 million bbl/day through stock release, restraint on demand, fuel switching, and increased indigenous production (see Table 3). The plan was implemented on January 17, 1991, with the start of the air war.

Nominally, stock drawdown was to account for 80 percent of the total emergency response (2 million bbl/day), with 17 members of the Organization for Economic Cooperation and Development purportedly making stocks available. In reality, any real increase in supply from the stock drawdown in that plan could only have come from the large government-owned stocks of the United States and Germany. The state-owned Japanese National Oil Company also held about 200 million barrels of oil in the fall of 1990 but chose not to release that oil.[6]

5. "Products a Problem Due to Heaver Crude Slate," *Petroleum Intelligence Weekly* (September 3, 1990), p. 4.

6. "Big Strategic Stocks Held Closely Outside US," *Petroleum Intelligence Weekly* (October 15, 1990), p. 1.

Some countries counted on private stock drawdown in response to higher prices, others encouraged private companies to reduce stocks, and still others lowered minimum stock requirements for private companies. But those measures were largely voluntary, and none would have placed more oil in the world market. For example, Japan lowered its requirement for the number of days supply (stocks divided by consumption) that private companies should hold. But companies could meet that goal by increasing their sales (and imports) rather than reducing stocks--just the opposite of what was wanted.

The remaining 20 percent of the plan (0.5 million bbl/day) was to be met by restraining demand (0.4 million bbl/day), switching fuel (0.1 million bbl/day), and increasing indigenous production. Most of that response, however, was to stem from higher prices

Table 3.
Emergency Response Program Implemented by the Governing Board of the International Energy Agency

Country	Proposed Contribution to Oil Savings (Thousands of barrels per day)				
	Stock Drawdown	Demand Restraint	Fuel Switching	Increased Production	Total
Australia	0	33	0	13	46
Austria	6	5	5	0	16
Belgium	9	18	0	0	27
Canada	0	115	0	0	115
Denmark	11	2	0	0	13
Finland[a]	0	12	0	0	12
France[a]	59	58	9	0	126
Germany	169	18	0	0	187
Greece	9	9	0	0	18
Iceland[a]	0	1	0	0	1
Ireland	5	1	0	0	6
Italy	74	24	32	0	130
Japan	350	0	0	0	350
Luxembourg	0	2	0	0	2
Netherlands	25	7	0	0	32
New Zealand	3	0	1	3	7
Norway	5	7	0	0	12
Portugal	10	2	5	0	17
Spain	0	62	0	0	62
Sweden	0	21	0	0	21
Switzerland	6	12	1	0	19
Turkey	0	20	11	0	31
United Kingdom	120	0	0	0	120
United States	1,125	0	0	0	1,125
All Countries	1,987	429	64	16	2,500

SOURCE: Congressional Budget Office based on data from the International Energy Agency.

a. Not members of the International Energy Agency before the Persian Gulf crisis.

and responses to government information campaigns or requests for restraining demand voluntarily. There was certainly no analytic basis for projecting any particular level of demand savings for these programs. For some nations, previous reductions in demand or increases in production were counted (see Table 4).

Overall, the restraints on demand by the International Energy Agency could not have added any measurable volume to the available world supply of oil. If fully implemented, the IEA contingency plan would actually have increased available supply by only about 1.5 million barrels per day in January 1991--much less than the 2.5 million barrels per day claimed by the agency. And of this smaller amount, 75 percent would have come from the United States.

Within the first hours of the air war, it was immediately apparent that the United Nations' forces would be successful and that Saudi oil supplies were no longer threatened. Accordingly, the IEA's Governing Board decided on January 28, 1991, to keep the contingency plan in effect, but allowed members to carry it out flexibly according to conditions of supply and demand.

From the perspective of the oil market, the available buffer of excess production capacity increased. Prices became less volatile, and the demand for oil for private inventories declined.

With the collapse of oil prices, the IEA members only partially carried out the program, and only a part of the strategic stocks offered by the United States and Germany were taken up. The average price of imported crude oil in February 1991 was $17.26 per barrel, slightly below the level in July 1990. The United States sold 17.3 million barrels of the 33.75 million barrels offered for sale, and Germany sold about half of the 5 million barrels it pledged, all in diesel and fuel oil.

What the United States Did Within the IEA

In coordination with the International Energy Agency, the U.S. Department of Energy activated its emergency data systems on August 10, 1990. In addition, the Energy Information Administration instituted a new publication, the *Energy Situation Analysis Report*, which was issued weekly until the first week of March 1991. The availability of solid information on petroleum production, consumption, stocks, and prices--both through data publications and special telephone hotlines--helped to control rumors and reduce uncertainty.

The U.S. government carried out portions of its Federal Emergency Management Plan in September. Among other things, the plan directed federal agencies to change their buildings' thermostat settings to conserve energy. In addition, the Secretary of the Interior authorized increased, emergency production rates for oil wells on government lands, as permitted by the Energy Policy and Conservation Act.

Moreover, DOE launched a major publicity campaign, in conjunction with the Advertising Council, to encourage conservation through voluntary actions. According to the General Accounting Office, the federal government received $36.6 million worth of free advertising in the fourth quarter of 1990.[7]

Most significantly, on January 16, 1991, President Bush authorized the drawdown and distribution of oil from the Strategic Petroleum Reserve as part of the coordinated contingency plan agreed to by members of the Organization for Economic Cooperation and Development. (The IEA countries at that time were a subset of the OECD membership, with France, Finland, and Iceland not formally in the IEA.)

On January 17, the Department of Energy issued a Notice of Sale for 33.75 million barrels of oil. The notice advertised 11.25 million barrels of low-sulfur oil at a base reference price of $28.90 per barrel and 22.5 million barrels of high-sulfur oil at a base reference price of $26.16 per barrel. To meet the U.S. commitment to the IEA of 1.125 million bbl/day, that oil was to be sold within a month, with

7. General Accounting Office, *International Energy Agency: Response to the Oil Disruption Caused by the Persian Gulf Crisis*, GAO/NSIAD-92-93 (1992).

Table 4.
Plans of the Member Countries of the International Energy Agency for Responding to the Persian Gulf Crisis

Australia	Meet share of 2.5 (46 thousand barrels per day) with price response already taken (no additional plans)
Austria	Meet share of 2.5 with voluntary actions (nothing planned)
Belgium	Nothing additional planned
Canada	Nothing additional planned
Denmark	Meet share (2,000 barrels per day) with energy savings campaign (no additional plans)
Finland	Nothing planned (no capability exists)
France	Meet share of 2.5 with energy savings campaign, reduced speed limits, and lower private stock-holding obligations (total 94,000 barrels per day)
Germany	Meet share of 2.5 with release of 650,000 metric tons of oil products (168,000 tons finally sold)
Greece	Meet share of 2.5 (71,000 tons) with information campaigns, compulsory measures (speed limits and so on) and stock draw (only 20,000 metric tons). No stocks actually drawn.
Iceland	Meet share with information campaign (no additional plans)
Ireland	Meet share of 2.5 with stock draw by national electric utility company (no stocks drawn). Price controls were in effect.
Italy	Meet share of 2.5 with stock draw, fuel switching, temperature reduction (no stocks drawn)
Japan	Meet share of 2.5 with release of 350,000 barrels per day, to be accomplished by lowering company-required holdings by four days supply. Nothing done. No additional plans.
Netherlands	Meet share of 2.5 by selling government stocks. None sold.
New Zealand	Meet share of 2.5 with increased production, draw of private stocks (nothing done)
Norway	Meet share of 2.5 with voluntary demand restraint (no additional plans)
Spain	Meet share of 2.5 with demand restraint measures already taken
Sweden	Meet share of 2.5 with information campaign (nothing done)
Switzerland	Meet share of 2.5 with voluntary demand restraint and reduction of private storage requirement (200,000 tons); 50,000 metric tons actually made available (no data on actual use)
Turkey	Meet share of 2.5 with information campaign and support for utility fuel switching. No additional plans.
United Kingdom	Meet share of 2.5 (120,000 barrels per day) by voluntary private stock draw. Companies asked to release 450,000 metric tons. (Savings calculated from difference between forecast and actual indicates 54,000 metric tons were drawn in February. No additional plans.)

SOURCE: Congressional Budget Office based on information from the International Energy Agency.

delivery taking place over an extended period. On January 25, the agency received bids for a much greater amount, 44.8 million barrels, but not in the proportions offered: 27.9 million barrels for low-sulfur oil, and 16.9 for high-sulfur oil. (The relative volumes the Department of Energy offered reflected the relative volumes the SPR held.)

After the International Energy Agency called for voluntary implementation of the contingency plan, the Department of Energy scaled back its offer. Between February 1 and February 6, DOE awarded contracts for 17.3 million barrels: 14.35 million barrels of low-sulfur oil at $28.52 per barrel and 2.95 million barrels of high-sulfur oil at $25.67 per barrel. Deliveries took place between February 5 and March 31, reflecting an average flow rate of 313,000 bbl/day for two months.

The Department of Energy was able to apply some lessons from the test sale in September 1990 to the sale in January 1991. In particular, the Jones Act, requiring that oil moving between U.S. ports be transported in U.S.-flag vessels, was temporarily waived to expedite the SPR distribution. However, although DOE offered a greater price differential on low- and high-sulfur oil, the differential was still not sufficient to attract the level of interest in high-sulfur oil that DOE expected. The difference between the offer and award reflected heavy demand for light, low-sulfur oil (as reflected in the demand for light products) and little demand for heavy, sour oil (as reflected in the glut of heavy products like residual fuel oil).

Identifying Problems with Policy Goals and Implementation

Many analysts were critical of the response by the Department of Energy and the International Energy Agency to the events of the Persian Gulf crisis. Despite nearly two decades of planning, both agencies found themselves back at the drawing board in deciding whether the crisis, which disrupted a large but replaceable share of the world's oil supply, was enough of an emergency to require a government response. Yet for all of that fretting, no actual evidence of physical shortages in the country emerged. Prices rose quickly but subsequently retreated without the benefit of the government's policy tools for energy emergencies. The U.S. economy was slipping back into recession, but the contribution of higher oil prices to the decline in economic growth did not appear to be great.

The benefit of hindsight makes it easier to criticize government decisions about when and how to respond. The rapid increase in oil prices, coupled with indicators of an economic downturn in the United States, would suggest significant economic benefits from government actions to lower prices. But at the time decisionmakers faced enormous uncertainty about how the Persian Gulf crisis would come out and how long it would last. The crisis could have ended rapidly, in which case the SPR would not have been needed; conversely, it could have dragged on for years, in which case the SPR would not have helped. Moreover, the politics of this situation extended well beyond the economic effects of a loss of oil supplies. For example, because the loss resulted from a United Nations' boycott--spearheaded by the United States--some analysts have argued that a release of SPR oil was justified on the basis of compensating U.S. allies for participating in the boycott and the war effort.[8]

Even given the uncertainties and political constraints on policy in this period, the experience of the crisis highlighted a number of fundamental problems with the policies guiding the use of the SPR and IEA programs and with the programs themselves. Those problems fall into two areas: impediments to carrying out the basic U.S. policy of early, coordinated drawdown of SPR oil; and problems related to the process for selling SPR oil.

What Are the Impediments to Planning for an Early SPR Release?

U.S. policy calls for the early, coordinated release of SPR oil in response to a severe supply disruption. However, the concepts of "early" and "coordinated"

8. Based on a conversation with Lawrence J. Goldstein, President, Petroleum Industry Research Foundation, Inc.

do not mix well in the context of SPR release policy. Significant obstacles exist inside the United States and within the IEA community that make early coordination difficult. The bureaucratic process for decisionmaking itself presents an obstacle. In addition, the parties or countries involved have fundamental differences, including different positions as oil consumers and producers, different degrees of reliance on free markets, and different outlooks for economic growth. All of these factors impede basic recognition of the problem, not to mention any agreement on solutions. Finally, domestic and international indecision on the use or nonuse of emergency reserves merely adds to market uncertainty.

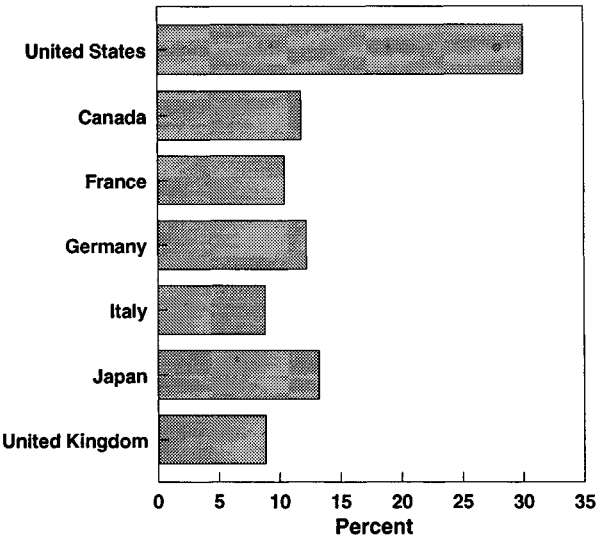
Obstacles to Developing a U.S. Consensus. Among the most basic problems are certain misconceptions about what an SPR release can and should accomplish. Related to that issue are inherent conflicts between the potential price effects of a release and other policy goals.

Lowering oil prices has been the stated, direct objective of U.S. policy for the sale of SPR oil. Yet at the same time, the United States supports relying on the free-market system and rising prices as the most important vehicle for restraining oil demand, raising domestic oil production, and lowering oil imports. In the international arena, higher oil prices during the Persian Gulf crisis were widely seen as necessary to bring forth higher oil production from other countries and even to help Saudi Arabia pay for its defense--hence, a further conflict of goals.

The political side of this dilemma is that the interests of oil producers and oil-producing regions of the United States are pitted against those of oil consumers. Oil producers benefit directly from higher prices; oil consumers are harmed. Those different interests are echoed in the Congress and in the political pressures brought on the Department of Energy and the President in deciding whether to authorize the sale of oil from the Strategic Petroleum Reserve.

Obstacles to Developing an International Consensus. Early coordination is also difficult if other industrialized nations and the United States do not share the same view of the seriousness of a crisis or the economic benefits of a given response. Indeed, any inability to reach consensus adds to uncertainty in oil markets.

Figure 5.
Change in Local Gasoline Prices for G7 Nations, Second Quarter 1990 to Fourth Quarter 1990



SOURCE: Congressional Budget Office using data from the Organization for Economic Cooperation and Development.

NOTES: Changes are based on quarterly averages.

G7 nations = Group of Seven industrialized countries.

Countries differed as to what to do during the Persian Gulf crisis based on different domestic exposure to oil price increases, states of economic health, levels of dependence on oil supplies from the Persian Gulf, and levels of capability to respond to emergencies. Most important, those differences still persist and suggest future difficulties in establishing an international consensus for response.

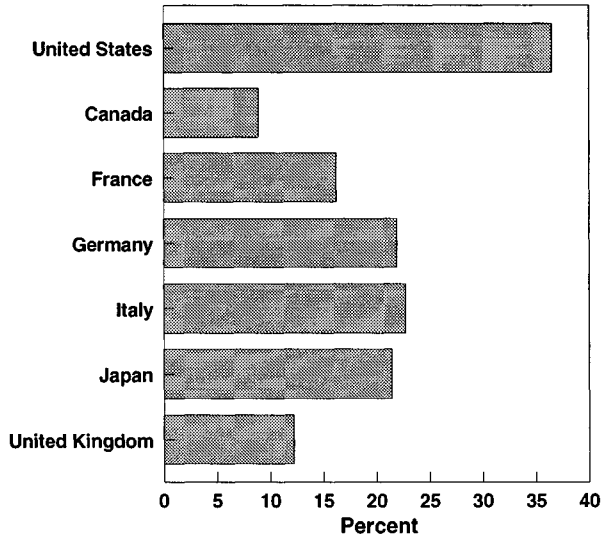
Smaller Changes in Oil Product Prices Abroad. First and foremost, retail prices for key petroleum products purchased by consumers increased by a smaller percentage in many countries than in the United States. Hence, other countries may not have sensed the same political urgency as the United States to do something about the price change. That lack of urgency was especially true for gasoline and diesel in the first months of the crisis (see Figures 5 and 6).

The basic reason for this difference is that energy taxes in other industrialized countries are much higher than in the United States. As an arithmetic consequence, a given change in crude oil costs leads to a smaller percentage change in retail prices there (see Figure 7). For residential heating oil, which other countries tax at a lower rate, percentage increases in prices were comparable with those in the United States (see Figure 8). In addition to their general value-added taxes, which increase with oil prices, the larger European countries and Japan all have special excise taxes on consumer oil products. (A supplemental motor fuels tax imposed in Germany in the spring of 1991--to help pay for their contribution to Desert Storm and for reunification--later pushed up their retail gasoline prices even more.)

A second reason for the smaller relative increase in prices abroad was the depreciation of the U.S. dollar against other major currencies during this period. The depreciation and the denomination of world oil prices in U.S. dollars meant that crude oil costs in local currencies abroad did not increase as much as crude oil costs in the United States (see Figure 9). The depreciation may have stemmed from factors unrelated to the oil crisis--such as rising interest rates in Germany, a consequence of that country's reunification efforts. Regardless of the reason, had the value of the dollar been rising instead of falling, those countries might have felt a greater urgency to act.

Another reason for differences in relative price changes among nations is their different market structures. For example, in markets with less competition, retail prices change less with changes in the costs of raw materials than otherwise. Less competition and less variation in retail prices would most likely be the case in nations where a single, large national oil company dominates sales of refined petro-

Figure 6.
Change in Local Diesel Prices for G7 Nations, Second Quarter 1990 to Fourth Quarter 1990

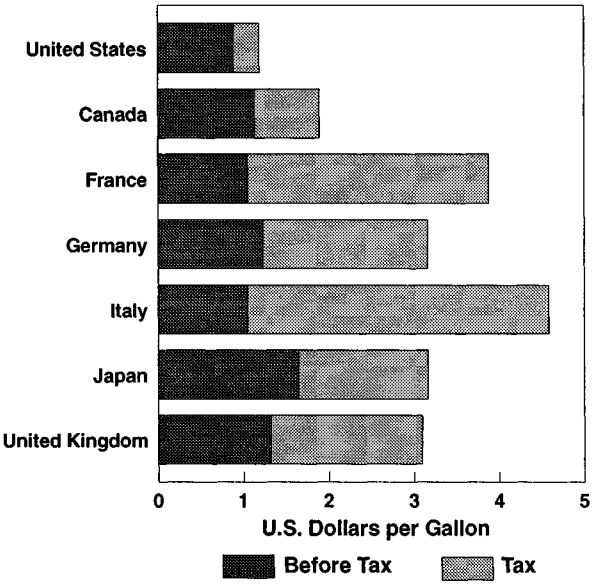


SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTES: Changes are based on quarterly averages.

G7 = Group of Seven industrialized countries.

Figure 7.
Tax Share of Prices on Gasoline Collected by the G7 Nations, Second Quarter 1990

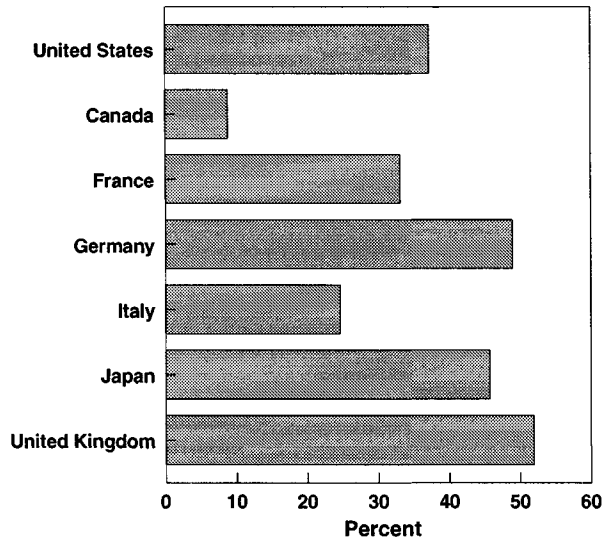


SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTES: Prices for France and Germany are for leaded regular gasoline. Price for Italy is for leaded premium gasoline. All other prices are for unleaded regular gasoline.

G7 = Group of Seven industrialized countries.

Figure 8.
Change in Heating Oil Prices for G7 Nations, Second Quarter 1990 to Fourth Quarter 1990



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTES: Changes are based on quarterly averages.

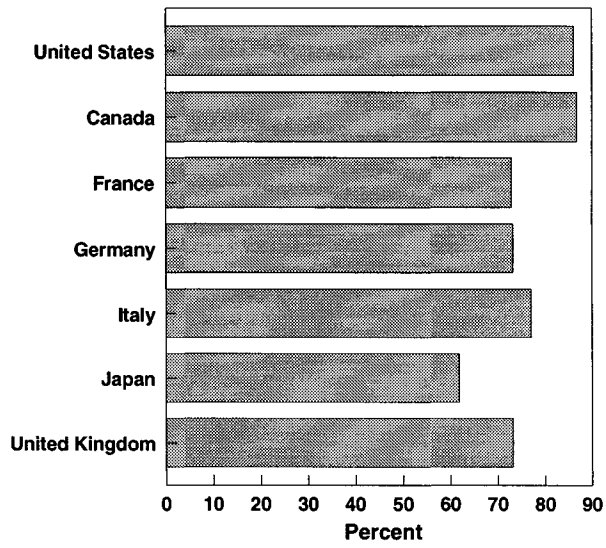
G7 = Group of Seven industrialized countries.

leum products. Economies with government price controls or other competitive restrictions would also exhibit less variation in retail prices.

Unresponsive pricing in Japan, for example, diminished any incentives Japanese consumers had to reduce purchases of petroleum products.[9] Those prices reflected a market dominated by a few large firms, a tradition of administered pricing, and the industrial policy of the government. In addition, restrictions in Japan on petroleum product imports--designed to protect Japanese refiners from world competition--hampered the efforts of Japanese consumers to find the products they needed in world markets. Although the use of jet fuel for military purposes increased, world demand for the product changed little because of the offsetting loss of demand in civil aviation. That loss, in turn, was precipitated by the public's diminished appetite for air travel in view of the terrorist threat.

An important consequence of the smaller percentage changes in prices for motor fuels in Europe and Japan was that consumers there did not reduce their consumption of petroleum by as much as did U.S. consumers, and the net oil imports of those nations did not drop as much (see Figure 10). Indeed, Japan and the European members of the Organization for Economic Cooperation and Development actually increased their oil consumption during the fall of 1990 (see Figure 11). The large drop in U.S. oil imports occurred as much because of an increased drawdown in stocks as because of falling consumption (see Figure 12). In contrast, Japan and several European nations increased oil imports, in part to

Figure 9.
Change in Crude Oil Prices in Local Currencies for G7 Nations, July 1990 to October 1990



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTES: Changes are based on monthly averages for free-on-board (FOB) crude oil delivered to the United States. FOB is the cost of oil, loaded on ship, at the port of export.

G7 = Group of Seven industrialized countries.

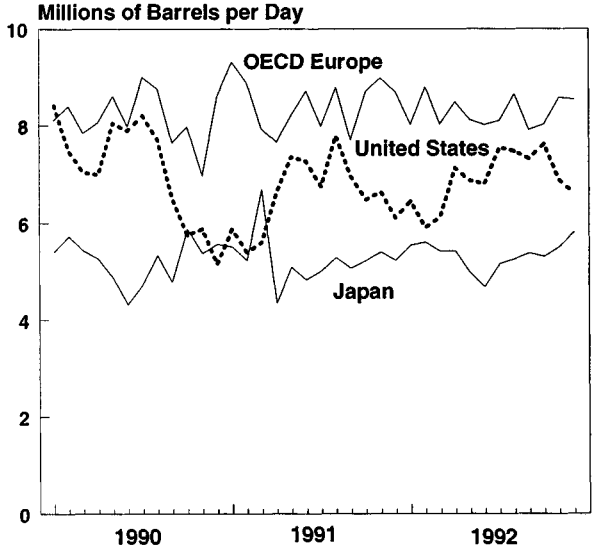
9. The competitive structure of oil markets in Japan are discussed in Philip K. Verleger Jr., *Adjusting to Volatile Energy Prices* (Washington, D.C.: Institute for International Economics, November 1993).

sustain oil stocks at an essentially constant level throughout the crisis.

In any country where retail prices do not rise despite increases in crude oil prices and where industry's efforts focus on building stocks for speculative or precautionary reasons, supply will not balance demand and consumers will have difficulty finding oil products. In that environment, political interest in imposing constraints on demand, requiring businesses to draw down oil stocks, or sharing the remaining oil with other countries is likely to be weak.

Different Underlying Economic Conditions. A second reason other countries may have had less incentive to take emergency actions relates to local differences in economic growth and weather. Countries experiencing severe winter weather or high economic growth are less likely to want to share remaining available supplies.

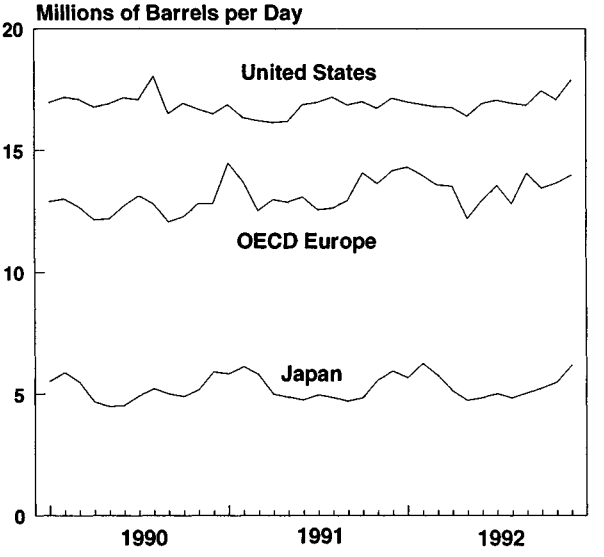
Figure 10.
Net Oil Imports of OECD Countries, 1990-1992



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTE: OECD = Organization for Economic Cooperation and Development.

Figure 11.
Oil Consumption by OECD Countries, 1990-1992



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

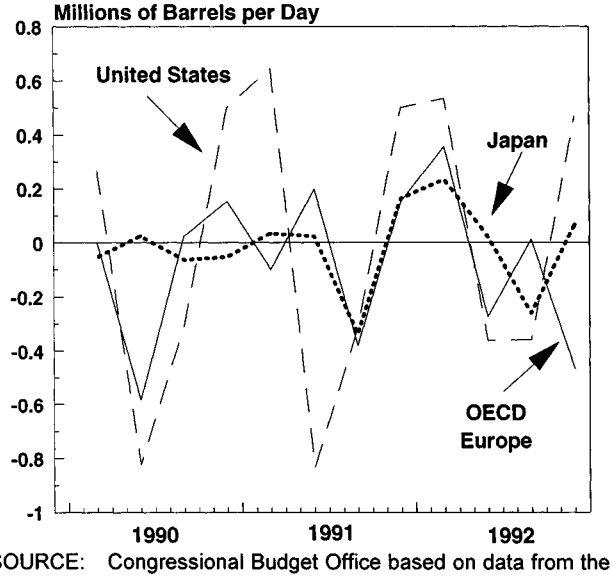
NOTES: Changes are based on quarterly averages for free-on-board (FOB) crude oil delivered to the United States. FOB is the cost of oil, loaded on ship, at the port of export.

OECD = Organization for Economic Cooperation and Development.

During the fall of 1990 and the winter of 1991, the weather was much milder in the United States than in Europe.[10] Also, the U.S. economy was dipping into recession, while the major industrialized economies of Europe and Japan remained healthy. Growth in real gross domestic product in the European Community was 3.0 percent in 1990 and 0.8 percent in 1991; in Japan, 4.8 percent and 4.0 percent in the same years; and in the United States, 1.2 percent and negative 0.7 percent, respectively. Although the Congressional Budget Office has identified the rise in oil prices as helping to tip a teetering United States economy into recession, other industri-

10. Energy Information Administration, *Energy Situation Analysis Report* (February 13, 1991, and February 19, 1991). Weather in the United States in the fourth quarter of 1990 was unseasonably mild, and weather in Europe in the first quarter of 1991 was unseasonably cold.

Figure 12.
Drawdown of Oil Stocks by OECD Countries, 1990-1992



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTE: OECD = Organization for Economic Cooperation and Development.

alized nations did not perceive the same threat to their economies.[11]

In any case, U.S. requirements for oil were declining in the autumn of 1990 for economic reasons beyond rising prices, while in Europe and Japan oil requirements were rising. Growing consumer demand in Europe and Japan was a consequence of economic growth, relatively severe weather, administered prices, and possibly consumer stockpiling.

In sum, it was much easier for the United States to argue for restraining demand in the face of falling domestic demand. Also, despite the disruption of world supplies, Japan and some European nations did not feel the full consequence of the loss of oil supply.[12] Falling oil consumption and drawdown of stocks in the United States helped to ensure adequate supplies for the rest of OECD and to moderate the total price increase.[13]

Greater Long-Term Dependence on Individual Oil Exporters. A third reason exists that various countries may have had different views on whether or how to respond to the Persian Gulf crisis--namely, the differences in their dependence on imported oil in general and Persian Gulf oil suppliers in particular (see Figure 13).

The absolute dependence on imports (as a share of total oil use) is not as relevant for determining economic losses from a supply disruption as is the technological dependence--the ability to reduce imports by using less energy or switching to other forms of energy when oil prices rise. Yet countries with long-standing commercial ties with oil exporters were reluctant to risk antagonizing those suppliers by invoking policies that would reduce oil prices.

Little or No Emergency Preparedness. Fourth, some countries may have been reluctant to take action simply because they had no way to deal with the problem. Only three members of the International Energy Agency maintain large government-owned, strategic stocks of crude oil or petroleum products: the United States, Germany, and Japan. Other governments have small volumes of product stocks, primarily held by government-owned utilities. As indicated by the actions of individual countries participating in the International Energy Agency's contingency plan in January 1991, a handful of other countries have imposed storage requirements on private companies, and the rest maintain programs calling for voluntary restraint on oil consumption. Relying on changes in utility stocks or private storage requirements or on advertising campaigns does not, however, constitute real emergency preparedness.

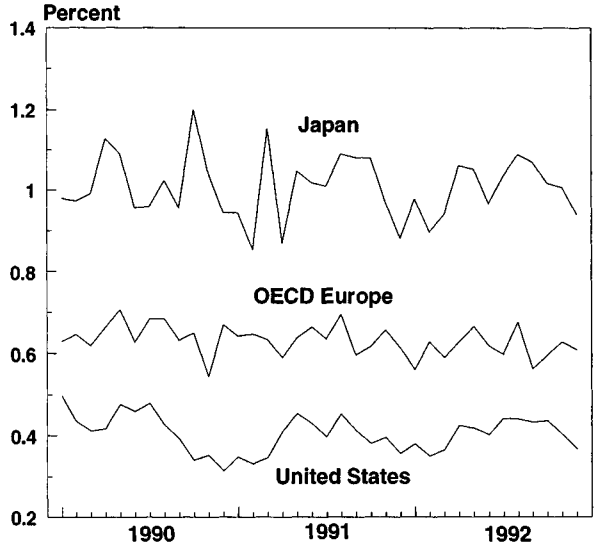
In particular, emergency reserves of oil that are privately held will not be available to increase world supply if the owners have wholly or partially integrated that oil with their supply systems. In that case, those stocks have merely displaced other pri-

11. Council of Economic Advisers, *Economic Report of the President* (February 1994).

12. Subsequent problems in Japan with high domestic prices for jet fuel and heating kerosene were largely a consequence of restrictions on petroleum product imports--designed to protect the domestic refining industry--and the domestic hoarding of oil supplies, as evidenced by the stock buildup.

13. International Energy Agency, Governing Board and Management Committee, "The Gulf Crisis of 1990/91, the IEA Response and Lessons for IEA Emergency Preparedness" (IEA, Paris, December 2, 1991).

Figure 13.
Net Oil Imports by OECD Countries as a Share of Oil Use, 1990-1992



SOURCE: Congressional Budget Office based on data from the Organization for Economic Cooperation and Development.

NOTE: OECD = Organization for Economic Cooperation and Development.

vate stocks. Moreover, volumes of oil that countries define as available stocks to meet their IEA commitment of a 90-day supply may not actually be available for emergency distribution. (For example, Turkey has counted Iraqi crude oil sitting in pipelines that cross Turkey toward its stock commitment.)

How the SPR Sales Process Adds to Market Uncertainty

Inaction by the U.S. government and the International Energy Agency on the release of emergency oil reserves in the early months of the Persian Gulf crisis made sense, given a policy of letting oil prices rise to restrain demand and stimulate oil production. It may also have made sense given the lack of information about the ultimate duration and severity of the crisis. Nevertheless, virtually every step the United States and the International Energy Agency took in response to the management of emergency reserves and demand reduction simply added to uncertainty in the oil markets.

For example, the IEA Governing Board met in early August 1990 but failed to act when everyone expected it to. The U.S. test sale of SPR oil in September 1990 was counterproductive, in part because the market expected a full-scale release and in part because problems with the test indicated that DOE was not prepared for a full-scale drawdown.[14] The IEA contingency plan for making 2.5 million bbl/day in additional supply available was largely window dressing. Even the solid part of the plan--the sale of government-owned stocks by the United States and Germany--was vague in not specifying how much oil for how long. Moreover, once the flow started, the demand for this additional supply was negligible, thereby exacerbating the downward movement in oil prices that followed the success of the allied military effort.

Part of the problem had to do with the obstacles to early coordination discussed above. But problems with the SPR sales process itself also added to market uncertainty. In particular, the process is inherently backward looking, which contributes to making wrong and ill-timed decisions, and the process also fails to work through the market to gain maximum effect.[15]

Backward-Looking Decisions to Release Oil. Altogether, the process for making decisions to release oil and the contractual procedure for selling oil resulted in an ill-timed release of total supplies and difficulties in selling the desired mix of crude oils.

The bureaucratic process of recording oil prices, evaluating them, and deciding what to do will unavoidably entail delays. As a result, the government must rely on past market conditions in deciding how much and what kinds of SPR oil to sell. More significant, when oil prices are going up and down rapidly, government decisions will almost always be out of step with current conditions.

14. "Test Sale of Oil Reserves Reveals Major Problems," *Oil Daily*, December 10, 1990, p. 1.

15. Department of Energy, *Strategic Petroleum Reserve, Annual/Quarterly and Test Sale Report*, DOE/FE-0220P (February 15, 1991). A DOE evaluation of the 1991 SPR drawdown appears in *Strategic Petroleum Reserve, Quarterly Report*, DOE/FE-0220P-1 (May 15, 1991). The General Accounting Office prepared a critique of the DOE and IEA response to the Gulf crisis in *International Energy Agency: Response to the Oil Disruption Caused by the Persian Gulf Crisis*, GAO/NSIAD-92-93 (1992)

In contrast, oil companies deciding how much SPR oil to buy base their decisions on expected market conditions, even though those expectations will reflect currently available information. One consequence of this discontinuity between backward-looking decisions by government and forward-looking decisions by industry is that the Department of Energy has a difficult time determining how to establish minimum prices that will help to ensure that it can actually sell all the crude oil it offers. That difficulty was exemplified during both the test sale and the January sale, when DOE offered sour crude oils at too high a price. The mismatch with market needs was further exemplified by the relative volumes of sweet and sour crude oils offered. The relative offering simply reflected the relative volumes the SPR held, which were based on assessments of past market conditions rather than the current market's high demand for light, sweet crude oils.

Failure to Work Through the Market. Problems with the SPR sales process itself are also counterproductive with the goal of reducing prices. Moreover, the process may add to market uncertainty.

When the ultimate decision to sell SPR oil came in January 1991, a sales procedure patterned on only half of the process followed by private companies cushioned the effect of that decision on oil prices. Companies base their bids on a base reference price in the DOE Notice of Sale--the minimum price--which in turn reflects an average of market prices for different types of crude oil in the days immediately preceding the notice. DOE then awards contracts, starting with the highest bidder and going down until all the oil offered is taken or until the minimum price is reached.

The actual price of oil at the time of delivery, however, reflects the bid prices adjusted for the change over the intervening period in the market prices used by DOE to establish the initial reference price. That is, if the market price declines between the award date and the delivery date, the delivery price would be lower than the bid price by the amount of the change.

Under the SPR sales process, companies had to sign contracts between January 17 and January 25 for buying oil at a price to be determined between February 5 and March 31. The standard procedure for those companies was to hedge against the price uncertainty on at least a part of their purchase by buying futures contracts (or making use of comparable financial vehicles that lock in the delivery price) at the time the contract was awarded. In that way, they would be protected against a price increase: with rising oil prices, they would lose by paying DOE more for the SPR oil but gain an offsetting amount on the rising value of their futures position. Up to this point, the SPR sales procedure is similar to the process private companies use.

Unlike its private-sector counterparts, however, the Department of Energy makes no effort to hedge its sale of SPR oil with a concurrent, offsetting sale of oil futures. Because oil prices fell between the award and delivery dates, DOE lost on its oil sales. However, if the agency had sold futures, it would have gained an offsetting amount on the rising value of its futures position. As it was, DOE lost $9.95 per barrel on low-sulfur oil and $8.70 per barrel on high-sulfur oil.

The issue, however, was not whether the Department of Energy made or lost money but whether it achieved its stated policy goals. Most important, DOE missed an opportunity to apply downward pressure directly on world oil prices by selling futures in January 1991. Not only are futures prices an important indicator of current market conditions, but many contracts for physical delivery tie their price to the price of futures contracts: any action that affects futures prices directly can have an amplified impact on all contract prices.

In contrast to the effect DOE desired, clear upward pressure on oil prices came from the oil companies contracting for SPR oil that purchased futures to hedge their position. The only opportunity for futures prices to decline was if speculators, in anticipation of the physical release of SPR oil, had expected that oil prices would fall and, hence, would have been willing to sell futures to the oil companies at a lower price than otherwise. Any such expectations, however, would have been tempered by the knowledge that DOE was not actually committed to releasing the maximum volume of oil it had contracted to sell; the market's independent assessment of near-term market conditions would also have tempered

expectations. Thus, the immediate effect of the SPR sale announcement on oil markets could only be indirect and had to be less than DOE probably expected.

Revisiting the Decision Against an Early Release of SPR Oil

The U.S. government and the International Energy Agency probably made the right decision in not releasing emergency stocks of oil at the outset of the Persian Gulf crisis, but they did so for the wrong reasons. Moreover, they may have exacerbated the crisis in the process of coming to that decision. The initial loss of Iraqi and Kuwaiti oil on its own supported a decision to release SPR oil. But the prospect that additional Saudi oil supplies might be lost as a result of subsequent Iraqi actions indicated greater expected benefits from holding SPR oil for later use. That conclusion is independent both of the likelihood that the United States could not have reached a consensus with its IEA partners on the need to release stocks and of the fact, established more recently, that the Strategic Petroleum Reserve was not actually in a sufficient state of readiness to support a full, sustained drawdown.

The Benefits from Immediate Release of SPR Oil Rose by Only a Small Amount

Economic benefits from an immediate release of SPR oil in the early fall of 1990 rose to the extent that additional supply at that time could have avoided the near doubling of oil prices between July and October 1990 and helped to lower the nation's imports. With the advantage of hindsight, however, the potential benefit of release was probably small. The losses in output attributable to the price rise were not very large. Hence, the potential gain in output from using a stock release to reduce oil prices would have been small as well. Also, market conditions at the time indicated that any drop in the nation's total imports of oil would have been less than the amount of release.

A Small Loss of Economic Output. Predictions of economic losses as a result of sharply higher oil prices in the fall of 1990 provided support for proponents of government action to bring down prices. For example, the Department of the Treasury put first-year losses in the range of 0.5 percent to 0.75 percent of gross national product, or about $25 billion and $40 billion, respectively.[16] The Congressional Budget Office estimated first-year losses at between 0.4 percent and 0.9 percent of gross national product.[17] CBO also concluded that the price shock contributed to the onset of economic recession in mid-1990.[18]

However in retrospect, some of those estimates of economic loss were probably too high, partly because the price shock of 1990 was much different from those in early periods for at least three reasons.

First, the shock was so short-lived. Second, few analysts expected oil prices to remain permanently at their high, October 1990 level of $31.50 per barrel (the landed cost of imported oil). Evidence of price expectations comes from the futures market, in which contract prices for later-month deliveries were consistently lower than prices for current-month deliveries throughout the crisis (see Figure 14).

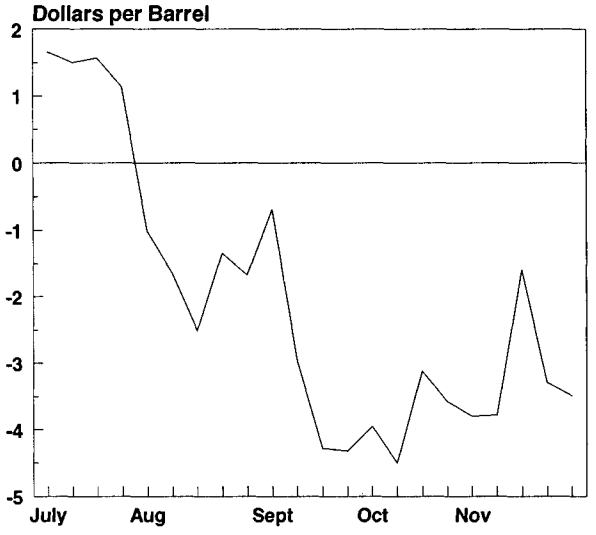
Despite significant uncertainty about when and how far oil prices would ultimately decline, a range of scenarios pointed to some fall in prices, with the circumstances supporting higher prices becoming increasingly less likely as the war progressed. In the most optimistic scenario, if the United Nations forces were to prevail--without the need for a continued boycott of Iraqi and Kuwaiti oil--and Iraq withdrew from Kuwait, oil prices could have fallen to as low as $15 per barrel. That was the level in June 1990, be-

16. Secretary of the Treasury Nicholas Brady, quoted in S. Mufson and H. Rowen, *Washington Post*, August 12, 1990, p. A21. Citation appears in William Hogan, *Oil Markets After Saddam Shock: Prospects and Policies* (Cambridge: John F. Kennedy School of Government, Harvard University, March 1991).

17. Congressional Budget Office, "Effects of the Recent Oil Price Rise on the Economy," CBO Staff Memorandum (September 1990), Table II.

18. Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1992-1996.*

Figure 14.
Maturity Spread on Weekly Futures Prices for Crude Oil, July 1990



SOURCE: Congressional Budget Office based on data from the New York Mercantile Exchange.

NOTE: The maturity spread equals futures contract price on West Texas Intermediate crude oil for delivery in four months minus contract price for delivery in current month.

fore Iraq moved troops to the Kuwait border. In a more pessimistic scenario, if Iraq were to prevail--before it had destroyed the Kuwaiti oil fields--oil prices at worst could have returned to the $20 per-barrel level that Iraq had wanted all along. Initial market uncertainty surrounding the most extreme case, wherein Iraq would exert control over or cause damage to Saudi oil fields and send oil prices higher yet, diminished throughout the fall of 1990 as U.N. forces moved into the region.

Third, the significant withdrawal of private oil stocks muted the effects of higher prices on the U.S. economy. Those withdrawals enabled the economy to reduce its oil imports further (that is, beyond the reduction made possible by lower oil use and greater domestic production) and helped to limit the total increase in the nation's import bill.

In addition to these three factors, the economy may have received some stimulus during the Persian Gulf crisis in the form of cash contributions from its United Nations' allies (see Box 5). Those contributions totaled about $48 billion--exceeding most estimates of a first-year loss to the economic output of the U.S. economy (see Table 5).

The weakening state of the general economy between the second and third quarters of 1990, which coincided with the more than doubling of oil prices after the Iraqi invasion, provided support for proponents of early SPR release. Based on statistical relationships between changes in economic output and oil prices during the preceding 20 years, some energy analysts concluded the oil price rise of 1990 could fully explain the economic downturn at that time.

Box 5.
Foreign Contributions for Operation Desert Storm Brought Small Economic Stimulus

Because of the Persian Gulf crisis, the United States spent more on defense activities in 1990 and 1991 than it had planned. Some of that spending was done abroad; some was done at home. Whether such increased spending at home represented a fiscal stimulus to the U.S. economy would normally depend on how the government financed that spending. In this case, cash contributions the United States received from its United Nations' allies more than covered the U.S. government's increased spending at home. As a result, the government did not have to borrow or raise taxes to finance that spending. Hence, some level of economic stimulus is indeed likely to have occurred. Because the contributions also financed some defense spending that would have taken place without the Persian Gulf crisis, U.S. government borrowing to finance those activities was lower than otherwise--providing a further stimulus to the economy.

Changes in reported economic output in 1990 and 1991, however, do not fully reflect the consequences of the cash contributions the United States received. The national income and product accounts recorded those contributions as net transfer payments from the United States to foreign governments--in this case, a negative value indicating payments from foreign governments. Those payments represent a purely financial transaction, not directly related to the nation's output of goods and services for export.

Table 5.
Foreign Contributions Pledged to Offset U.S. Gulf War Costs (In millions of dollars)

	Receipts		
	Cash	In-Kind	Total
Saudi Arabia	12,809	4,046	16,854
Kuwait	16,015	44	16,059
UAE	3,870	218	4,088
Germany	5,772	683	6,455
Japan	9,466	546	10,012
Korea	150	101	251
Bahrain	0	12	12
Oman and Qatar	0	7	7
Denmark	8	3	11
Total	48,090	5,659	53,749

SOURCE: Congressional Budget Office based on data compiled by the Office of Management and Budget (OMB) and reported in a letter from the Director of OMB to the President of the Senate, November 15, 1992.

NOTE: UAE = United Arab Emirates.

However, alternative explanations for the post-1973 and post-1980 recessions exist, which gives cause to question the usefulness of established statistical relationships. In particular, most analysts point to the restrictive monetary policies--which focus on reducing inflation--as a major culprit behind some economic slowdowns.[19] Actions by the Federal Reserve starting in 1979 to limit the growth of the money supply were probably a major contributor to the onset of recession in 1981. Other analysts have blamed the severity of economic recessions in the past on the existence of price controls.[20] Still others have pointed to the consequences of closer synchronization of business cycles among major industrialized countries in those years.[21] Indeed, the statistical relationship between changes in oil prices and economic activity in later years appears much weaker.

Limited Ability of SPR Release to Bring Down Oil Prices. In any case, the relevant calculation for estimating the cost of holding onto SPR oil was not how big the economic loss was but rather how much a release of SPR oil could reduce the loss. A release could push down losses by contributing to lowering both oil prices and the nation's oil imports.

In focusing solely on the immediate volume of lost supply, many energy analysts pointed to the positive value of SPR release. SPR supplies were nominally sufficient to replace most of the lost Iraqi and Kuwaiti supply for a limited period of time, which led some analysts to conclude that a release could have fully reversed the price increase. The direct level of the U.N. boycott was 4.3 million barrels per day. But, if one accounts for oil production going into storage, Iraq and Kuwait together were supplying only 3.5 million bbl/day to the world market in the second quarter of 1990.[22] At the time, DOE believed the drawdown capability of the SPR also to be 3.5 million bbl/day.

However, the addition to world supply from a release of SPR oil would have had only a small effect on oil prices because factors other than the immediate loss of supply were supporting high prices. For example, CBO's analysis of oil prices at the time observed that total world production by October 1990 was only 1.1 million barrels per day lower than it had been in July 1990.[23] In normal times, such a loss would have justified a price increase to only $25 per barrel, compared with the average price of $31.50 per barrel actually recorded in October. The explanation for the higher price came from the diminished price responsiveness of incremental oil supplies at the

19. Douglas R. Bohi, *Energy Price Shocks and Macroeconomic Performance* (Washington, D.C.: Resources for the Future, 1989).

20. Michael Darby, "The Price of Oil and World Inflation and Recession," *American Economic Review*, vol. 72, no. 4 (September 1982).

21. Michael M. Hutchison, "Aggregate Demand, Uncertainty and Oil Prices: The 1990 Oil Shock in Comparative Perspective," BIS Economic Paper No. 31 (Bank for International Settlements, Basel, Switzerland, August 1991).

22. Adelman, "The 1990 Oil Shock Is Like the Others."

23. Congressional Budget Office, "Understanding the Volatility of Oil Prices During the Iraq-Kuwait Crisis," CBO Staff Memorandum (January 1991).

time, the uncertainty surrounding the duration of the immediate supply loss, and the prospect of greater losses in the future. On that basis, any reduction in oil prices and the related boost to economic output from a full SPR release for a limited period of only several months would have been much less than the initial increase in oil prices.

A Small Offset to Total Oil Imports. The benefits of an SPR release in helping to lower the nation's oil imports would probably also have been small, largely because of offsetting changes in withdrawals of private stocks. A release of SPR oil can change incentives for withdrawal of private stocks if it alters the relative levels of current and expected future prices or of current and future uncertainty.

Market circumstances in the early months of the Persian Gulf crisis indicated businesses generally expected that oil prices in the future would be lower, as evidenced by consistently lower prices for later-month futures contracts compared with current-month contracts. Heightened uncertainty surrounding future prices may also have caused later-month contracts to have less value. Those circumstances created incentives for U.S. businesses to draw down their private stocks of oil. A release of SPR oil at that time could have dampened incentives to draw down private oil stocks by causing an immediate drop in oil prices relative to later months. Such a reduction in private stock withdrawal would have offset some of the contribution of that SPR release to lowering the nation's oil imports.

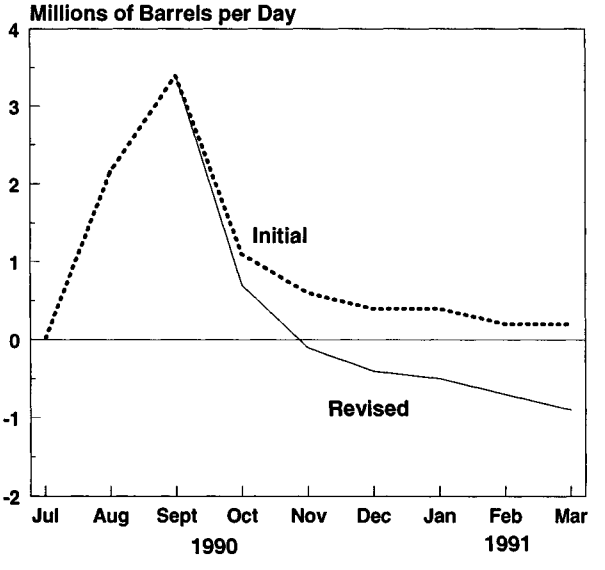
By contrast, there was some reason to believe that, by helping to restore the buffer of worldwide excess capacity to supply oil, a release of SPR oil in August 1990 could have helped to reduce current market uncertainty. That reduction would have amplified incentives to draw down private oil stocks and thereby helped to increase the contribution of an SPR release to lowering the nation's oil imports.

As circumstances evolved, however, the combined effects of rising oil production worldwide, declining oil use (in some countries), and the drawdown of private oil stocks (in some countries) restored the supply buffer by November 1990 (see Figure 15). Thus, the potential benefits of SPR release from further reducing uncertainty would have been limited. Moreover, some of the increase in production by oil-exporting nations would not have been forthcoming had the United States sold SPR oil. Consequently, even the net contribution of an SPR release to reducing market uncertainty would have been less than the direct contribution of SPR supplies to restoring the buffer.

The Expected Benefits from Releasing SPR Oil Later Rose Even More

Regardless of whether a supply disruption indicates that a release of SPR oil can help to avoid some level of economic losses, a release may still not be appropriate if the market circumstances simultaneously point to an increased likelihood of additional disruptions in the near future (and higher expected benefits

Figure 15.
Initial and Revised Estimates of the Shortfall in World Oil Supply, July 1990 to March 1991



SOURCE: Congressional Budget Office based on data from the Energy Information Administration, *Energy Situation Analysis Report* (various issues).

NOTE: Initial estimates prepared by the Energy Information Administration (EIA) in August 1990 indicated how new supplies of oil were expected to offset the loss of Iraqi and Kuwaiti supplies over time. Revised estimates by EIA in succeeding months indicated how fast supplies were actually entering the market.

from a later release). That was the situation facing the U.S. government in the early months of the Persian Gulf crisis. The initial loss of Iraqi and Kuwaiti oil supported a decision to release SPR oil, but the prospect that additional Saudi oil supplies might be lost as a result of subsequent Iraqi actions indicated continued positive benefits from holding onto a large stockpile.

More than one-third of Saudi Arabia's oil comes from fields within 150 miles of the Kuwaiti border. The Safaniya field, which was producing 1.3 million bbl/day in December 1990, is just 75 miles from that border.[24] Those fields were directly threatened by Iraqi forces and were completely undefended until United Nations forces moved into the region later in the fall. Much of the remainder of the Saudi oil fields lie within 300 miles of the Kuwaiti border, including the giant Ghawar oil field, which itself accounted for over half of Saudi oil output in late 1990.

Had additional supplies been disrupted, the subsequent increase in oil prices and economic costs could have been disproportionately greater than the increase in prices and costs attributable to the initial boycott of Iraqi and Kuwaiti oil. The reason is that the world market possessed sufficient flexibility to replace the boycotted 4.3 million bbl/day within a few months through higher production worldwide and lower oil use and private stock withdrawal (primarily in the United States). Oil prices, which had nearly doubled between July and October 1990, were only about 50 percent above their July starting point by December 1990. The market's flexibility was not sufficient to replace quickly another 4 million or 5 million bbl/day within the same time frame. Thus, oil prices would have gone much higher and remained at those levels much longer.

Holding onto SPR oil may also have offered a benefit in deterrence. Because the United States maintained a capability to lower oil prices, it may have kept some oil-exporting countries from taking advantage of the situation. Indeed, some analysts suggest that certain nations deliberately held supply off the market to help boost oil prices.[25]

24. "Saudi Floating Stocks Ready to Replace Shut-In Production," *Petroleum Intelligence Weekly* (January 21, 1991), p. 3.

25. M.A. Adelman, in "The 1990 Oil Shock Is Like the Others," suggests that an early release of SPR oil could have helped to counter any uncompetitive withholding of supplies.

Chapter Four

Program Options for Increasing the Economic Benefits from SPR Use

The experience of the past 20 years provides important lessons on how the government can get greater economic benefits from releasing strategic stocks in a crisis. In particular, institutional changes and the experience of the Persian Gulf crisis have direct implications for how the design of the sales mechanism could help a release of oil from the Strategic Petroleum Reserve to be more effective in reducing economic losses.

The original thinking on the benefits of releasing SPR oil identified only two direct effects of a release toward reducing economic losses: how much SPR oil flows out, and how much oil prices drop as a consequence of that flow. That early focus on volume provided the rationale for the current process for releasing a set volume of oil. The basis for the government's decision to release oil was the immediate loss of supplies and, later on, the immediate rise in prices.

The current view, however, is that the immediate benefits of releasing SPR oil stem from its effect on lowering oil prices and the nation's total oil imports. The drop in total imports may be greater or less than the amount of SPR released. The exact drop would depend on how current oil use and production respond to any decline in oil prices and on how private oil stocks respond to any change in the outlook for oil prices and uncertainty. A final decision to release oil should take into account the circumstances of the disruption and a determination of whether the economic benefits from immediate release exceed those from later release, recognizing that oil prices may rise or become more uncertain with time.

Three Basic Options for How to Sell SPR Oil

The sales mechanism the government establishes for releasing oil from the Strategic Petroleum Reserve can determine how a decision to release oil affects the immediate drop in oil prices. Equally important, it can also affect the expected path and uncertainty of prices, management decisions on inventories, and whether oil imports indeed would fall by more or less than the amount of the SPR release. As a result, the sales mechanism can also affect the benefits from release and, hence, the decision as to when to release oil. With these considerations in mind, one needs to compare the benefits from releasing SPR oil, in terms of lowering world oil prices and reducing the nation's total oil imports, under three different sales mechanisms.

The first, a volume-setting release, is similar to the current sales process, whereby the government attempts to set the volume to be released and lets the market set the price, subject to a minimum acceptable sales price. The presumption in this case is that the government sets the minimum bid price at a level sufficiently below the current market value of the oil. Otherwise, the minimum price would limit the total volume the government can sell, and such a situation would be equivalent to one in which the government sets the release price. If the government decides when and how much oil to sell, the decision to release the oil is effectively at its discretion.

In the second sales mechanism, a single price-setting release, the government establishes a single price for all the SPR oil it releases and allows the market to set the volume--up to the maximum release rate the reserve is capable of supporting. A release price at or above the market value would attract zero bids. In such a case, the government would have to be prepared to accept all bids. Thus, release would be at the buyer's, rather than the government's, discretion.

In the third sales mechanism, a multitier price-setting release, the government establishes multiple tiers of release prices, with increasing volumes of oil to be available at increasing prices. As a result, the market sets both the price and the volume. In economic terms, the government establishes a supply schedule for the SPR oil it wants to release. The government must again be prepared to accept all bids up to the maximum release rate the reserve is capable of supporting. Thus, release is at the buyer's discretion.

For all three mechanisms, whether the sale is at the government's or the buyer's discretion is an important issue because a buyer-initiated sale can be completed faster, signal government intentions about volume and timing of the sale more clearly, and, as a result, entail less market uncertainty.

Providing a Common Basis for Comparing Options

Identifying the fundamental differences among sales mechanisms is complicated because the effect of each on world oil markets varies considerably. For purposes of clarification, consider the market impacts of releasing oil by all three mechanisms under a basic set of assumptions. Specifically, assume that the government chooses a volume to release (for the volume-setting process), a release price (for the single price-setting process), and a price-volume relationship (for the multitier price-setting process) so that the government can sell SPR oil at the same price using all three mechanisms. The basis for comparison is the current, volume-setting type of sales process.

Option I: A Volume-Setting Sale

With a volume-setting sale, oil prices would fall and current market uncertainty would decline if the sale helped to restore the worldwide supply buffer. Under this option, the government would release SPR oil at the maximum rate supportable by existing capacity for pumping and distribution. The assumption is that potential price volatility and uncertainty drop as the buffer is restored. The subsequent effect of lower uncertainty would be to depress the demand for private oil stocks. Consequently, total world and U.S. demand for oil would both drop, as consumers purchased less oil for private stocks.

In this volume-setting option, the government would achieve economic benefits from lowering both prices and imports. Any subsequent rise in oil consumption or drop in domestic oil production as a result of lower prices would diminish the benefits from lowering imports. However, by stimulating an increase in the rate at which private stocks are withdrawn, currently lower market uncertainty would contribute to at least a partial offset to the effects of those changes in consumption and production on total imports.

Despite official statements supporting a maximum drawdown in any situation that warrants release, government efforts to set the minimum release price near the current market price make this a difficult prospect. If the minimum price was too high, the government might end up selling no oil. Any market uncertainty about how low the government would set the minimum price would translate into uncertainty about how much SPR oil would be released. Heightened uncertainty, in turn, would diminish the benefits from a higher rate of withdrawal of private stocks.

Option II: A Single-Price Sale

With a single price-setting sales process, the effects of a release on the market would be different. The most significant consequence of a single price-setting sale would be the change in price volatility and market uncertainty. The drop in the potential volatility

of oil prices and uncertainty would be greater than that resulting solely from restoring the buffer of excess productive capacity--as in the volume-setting option--because the release policy establishes a guaranteed price for oil over a limited range of changing production and consumption. The market effect of this lower uncertainty is a greater reduction in world and U.S. demand for oil, compared with the volume-setting option, since the accompanying reduction in current uncertainty would stimulate a higher rate of withdrawal of private stocks. As a result, the drop in imports would be greater than in a volume-setting sale. The amount of SPR oil that the government would need to release would also be lower than in the volume-setting option.

Less delay from the decision to release to the final sale might also result if a buyer could initiate a price-setting sale, with little of the need for requesting bids and awarding contracts that would mark a government effort to release a set volume of oil. Whether the full impact of the sale on current oil prices would indeed come sooner with a price-setting sale would depend on the specific design of the sales process. The Department of Energy would achieve a greater direct impact on world oil prices than otherwise if it simultaneously hedged that sale of the Strategic Petroleum Reserve by selling futures.

Option III: A Multitier Price Sale

With a multitier price-setting sale, the effects of a release on the market would be different yet. The reduction in current market uncertainty and the stimulus to withdraw larger stocks would again be greater with a multitier price-setting sale than in a volume-setting sale, since the varying availability of SPR oil places limits on price movements. However, that reduction in uncertainty could be greater or smaller than that for a single price-setting sale, depending on whether the release price in the single price-setting sale was far below or close to the prerelease market price of oil.

Benefits may also exist from speeding up the drop in current oil prices by lessening the delay between the decision to release and the final sale. Those benefits would be comparable for both price-setting types of sales if the buyer initiated the multitier sales process and if the process could avoid some of the administrative delays associated with a government-sponsored competition for a set volume of oil.

Legal Impediments to Changing the Sales Process

The current sales process is a part of the Strategic Petroleum Reserve Plan, submitted to the Congress as required by the Energy Policy and Conservation Act. Thus, if the Department of Energy wanted to change its planned method of drawdown and distribution of SPR oil to some type of price-setting process, it would probably have to seek Congressional approval, if not legislative authorization, for that change.

Other legal issues may arise if, in addition, DOE wanted to make use of futures markets or other types of financial instruments to hedge its SPR sales and have a more direct impact on world oil prices. Of particular concern is the issue of whether the Federal Acquisition Regulations would apply to the government's purchase and sale of futures contracts. Those regulations provide detailed requirements on how the federal government is to procure goods and services from the private sector. In contrast to the procedure it follows in most competitive procurements, DOE would not be in a position to solicit and review bids (a process that can take weeks and months) if it wanted to buy a futures contract (a process that takes minutes).

Summary of Findings

In sum, any decisions about what type of sales mechanism would be most effective should reflect an assessment of the relative benefits of each process--in terms of its contributions both to lowering oil prices and total oil imports as well as the subsequent bene-

fits of those changes for the overall performance of the economy. Those benefits may differ depending on market circumstances.

The current policy of releasing a set volume of oil could yield benefits comparable with the other two mechanisms given a supply disruption of known size and duration--that is, zero uncertainty. The principal advantages of both the price-setting sales mechanisms over the volume-setting mechanism is the greater reduction in market uncertainty. A further advantage of the price-setting mechanism may be the greater speed with which SPR oil enters the market.

For any sales mechanism, the benefits from gaining a quick and complete drop in current oil prices would be greater if the government makes efforts to reduce uncertainty about the sales process itself and the government's intentions, expedites the final transfer of title for SPR oil to purchasers, and hedges its sales by using futures contracts or some related risk-management tool.

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