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10 DRAWING DOWN THE STRATEGIC PETROLEUM RESERVE
The Case for Selling Futures Contracts

Shantayanan Devarajan and R. Glenn Hubbard

With over 300 million barrels of oil in place, the U.S. Strategic Petroleum Reserve (SPR) represents a potentially significant tool for reducing the economic damage attendant to oil supply disruptions. However, the ability of the SPR to blunt the oil price increases during disruptions depends critically on how it is drawn down. In this chapter, we propose a particular drawdown strategy for the SPR—one that addresses an often overlooked issue, namely, the response of private stockpiles to an oil supply interruption. While several studies have pointed out that rapid and discontinuous changes in the price of oil can create problems of a special nature (Eckstein 1979; Hubbard and Fry 1982; Mork and Hall 1980), only a few have observed that the price increase caused by the supply disruption is typically heightened by the role of private crude oil inventories (Danielsen and Selby 1980; Verleger 1982). Driven by uncertainty over future supplies and the expectations of profits from still higher prices in the future, private inventory accumulation at the onset of the disruption augments world oil demand, putting further upward pressure on oil prices.

To the extent that private inventory accumulation has contributed to the great price increases during disruptions, it is desirable to develop policy instruments that could manipulate private sector

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stockpiling. In this chapter we analyze one such instrument: the sale of futures contracts in SPR oil. We show how the existence of SPR futures contracts dampens private inventory demand by guaranteeing future supplies. In addition, futures market sales are compared with direct, spot market sales. We conclude that the relative benefits of a futures over a spot market sale from the SPR is an empirical question. We attempt to shed some light on that question by simulating a disruption in a model of the world oil market and measuring the effects of futures and spot market sales of SPR oil. Finally, we summarize the salient points and consider the implications of our results for policy.

FUTURES VERSUS SPOT MARKET SALES OF THE SPR

To make the case for futures market sales of SPR oil, it is important to examine first the rationale behind the private inventory behavior during a disruption. Economic optimization suggests that the speculative component of stocks be built when expected future prices are high relative to today's price, and that they be drawn down when expected future prices are low. A characteristic of disrupted oil markets is the continued increase, rather than a one-shot jump, in the spot market price. There are several reasons for this. The size of the shortfall may increase over time; there is much confusion initially about the magnitude, duration, and even existence of a disruption; since most oil is traded in long-term contracts, agents enter the spot market at different points in time. Whatever the reason, the fact that rising future prices can be identified with disrupted markets makes the observed accumulation of private inventories hardly surprising.

However, because of imperfections in the domestic economy as well as problems with monetary and fiscal policy responses, every barrel of imported oil imposes a cost on the United States over and above the private cost to the importer. Indeed, this is the motivation behind the proposal for an import tariff during interruptions (Hogan 1982; Verleger 1982). The disruption-induced increase in private inventories, therefore, contributes to this social cost insofar as it is a component of import demand. When one considers that the spot market price—which is bid up by all this "panic buying"—acts as a trigger for various crisis-level activities, the case for government interaction becomes all the more compelling.[1]

The link between expected future prices and speculative hoarding provides an opportunity for policy intervention if the government can manipulate price expectations. Here the SPR can play a role. The announcement of an SPR drawdown strategy for the future means more oil will be available at the future date, which lowers the expected future price and, therefore, expected future profits from speculation. This, in turn, reduces inventory demand and spot prices today. Of course, the success of this intervention depends on how credible the announced SPR drawdown strategy is. If firms suspect that the government may not release the oil in the future, they will continue to hold speculative stocks. By selling futures contracts, however, the government can guarantee that a specified amount of SPR oil will be available at a certain time in the future. Thus, instead of its traditional risk-sharing role, the futures contract here plays the role of a credible guarantor of the government's SPR drawdown policy.[2]

By selling futures contracts and thereby agreeing to deliver SPR oil at some future date, the government has effectively decreased world oil demand at that date, putting downward pressure on both the expected future spot price (by directly reducing future demand) and today's spot price (by reducing speculative demand). The government has thus been able to depress the spot market price of oil today *without releasing a drop of oil from the strategic reserve.*

The government can also lower the spot market price by selling SPR oil directly in the spot market. However, because of differences in the way they affect expectations about the future, spot sales and futures sales from the SPR will result in different sequences of oil market prices.

To see this, consider a model where the spot market price of oil is determined by equating supply of oil with demand for oil in the spot market. The latter includes a component for speculative inventory demand which, as we said earlier, depends on the expected future price of oil. Thus, expectations of future prices affect the spot market price of oil via their impact on demand for inventories.

How are expectations of future prices formed? It is reasonable to expect that they are formed by buyers' and sellers' expectations of supply and demand conditions in the future. We will see that the dif-

ference between spot and futures market sales of the SPR have to do with their effects on supply conditions in the future.

When the government sells, say, a million barrels in SPR futures contracts for delivery three months from the date of sale, it is guaranteeing that the supply of oil three months hence will be a million barrels greater than it would have been without the sale. Consequently, buyers will lower their expected future price, which in turn will dampen inventory demand today, lowering today's spot market price.

Of course, if the government sold a million barrels in the spot market, that too would lower the spot market price.[3] The relative benefits of the two sales strategies depend on how the combined effects of falling expected future prices from increases in future supply and the response of inventory demand to a drop in the expected future price stack up against the response of spot prices to increases in spot supply.

So far, we have contrasted spot and futures market sales in terms of their effects on the current spot price. What about their effects on the realized spot price in the future—say, for example, the spot price three months from now? Here, the results are unambiguous. If a million barrels of futures contracts were sold today, they would lower effective demand (or increase effective supply) by a million barrels in the spot market three months from now. If the same amount of oil were sold in today's spot market, it would lower effective demand three months from now only to the extent that any of this oil is resold when that market reopens: The *most* by which demand can be reduced is a million barrels. Thus, the spot price in the future under a futures sale is a lower bound on the spot price under spot sales from the reserve.[4]

At the very least, therefore, the trajectory of spot prices will be different between spot and futures sales from the SPR. The question we will turn to in the next section is "How different?"

SIMULATION RESULTS

In this section we examine the impact of a futures sale of SPR oil on private inventory behavior and compare the effectiveness in reducing oil prices of spot and futures market sales. We use the model of the world oil market and the U.S. economy described in detail in Hubbard and Fry (1982). The model allows changes in world oil prices to

affect U.S. economic performance and vice versa. The details of the model's specification are given in Appendix A.

We first simulate an undisrupted market from the first quarter of 1982 (1982:1) to the fourth quarter of 1985 (1985:4). The disruption that we simulate is a reduction in OPEC capacity of 6.5 million barrels per day (mbd) for the whole of 1983; the capacity is restored in 1984. The resulting price increase is not as large as one would expect from the spot price formulation alone because of increased production from nondisrupted OPEC members, the drop in consuming country demand (because of the higher prices), and the soft market at the onset of the disruption. Table 10-1 compares the paths of crude oil spot prices and U.S. private inventory accumulation (of crude oil and petroleum products) across the two scenarios. The assumed accumulation pattern for the U.S. SPR is also given.

Two results illustrated in Table 10-1 are particularly interesting. First, spot prices rise fairly sharply after the onset of the disruption

Table 10-1. Comparison of Control Scenario and Disruption Scenario.

	Spot Price ($/barrel)		*Private Stock Change (1,000 barrels/day)*		*SPR Fill (1,000 barrels/day)*	
	C	*D*	*C*	*D*	*C*	*D*
1982:1	31.70	31.70	-640	-640	200	200
2	31.60	31.60	700	700	200	200
3	31.20	31.20	490	490	200	200
4	31.20	31.20	-670	-670	200	200
1983:1	30.60	36.80	-1080	-910	200	0
2	29.60	45.30	390	700	200	0
3	28.30	54.70	570	960	200	0
4	27.10	59.50	-470	-130	200	0
1984:1	26.20	51.90	-1250	-1180	200	200
2	26.00	45.10	190	370	200	200
3	26.90	39.40	480	580	200	200
4	28.50	35.20	-360	-480	200	200
1985:1	30.40	35.10	-1070	-1250	200	200
2	32.10	31.50	270	80	200	200
3	34.50	29.20	560	360	200	200
4	37.40	28.00	-230	-520	200	200

in 1983:1. (By the end of the solution interval, spot prices are actually lower in the disrupted scenario because of the large reductions in oil demand. The marginal cost of a barrel of oil to U.S. refineries is still slightly higher by 1984:4 in the disruption scenario.) Second, private inventory behavior responds quickly to expected future profits. Inventory accumulation in 1983:2 to 1983:4 in the disruption scenario ran almost 100 percent higher than in the base case. Stocks are decumulated relative to the control by the end of the interval, so that an inventory level equilibrium is restored.

We can now test the effectiveness of two SPR drawdown policies: (1) a spot market sale of 1 mbd during 1983:2 and (2) a sale of futures contracts in 1983:2 to sell 1 mbd in 1983:3. To refill the depleted 90 million barrels, we assume in both cases that the SPR fill rate after the disruption (i.e., in 1984 and 1985) will be 300,000

Table 10-2. Comparison of Spot Market and Futures Market Oil Sales.

	Spot Price ($/barrel)			*U.S. Private Stock Change (1,000 barrels/day)*		
Quarter	*Base Disruption*	*Spot Sale*	*Futures Sales*	*Base Disruption*	*Spot Sale*	*Futures Sales*
1982:1	31.70			-640		
2	31.60			700		
3	31.20			490		
4	31.20			-670		
1983:1	36.80	36.80	36.80	-910	-910	-910
2	45.30	42.50	44.05	700	570	480
3	54.70	52.70	49.20	960	960	850
4	59.50	58.00	55.20	-130	-120	-110
1984:1	51.90	51.10	49.30	-1180	-1180	-1170
2	45.10	44.70	43.30	370	370	350
3	39.40	39.00	38.10	580	570	570
4	35.20	35.40	34.60	-480	-460	-480
1985:1	35.10	35.80	35.40	-1250	-1230	-1210
2	31.50	31.60	31.50	80	100	100
3	29.20	29.70	28.80	360	380	380
4	28.00	28.85	27.70	-520	-570	-490

barrels per day instead of 200,000 barrels per day. Table 10-2 compares the effect on spot prices and on U.S. private inventory accumulation for the two strategies.

Looking at the results in Table 10-2, we see that both strategies influence spot prices and private inventory behavior. The size of the impacts is dependent upon the fact that policy changes are examined in a "U.S. only" analysis; that is, foreign inventory accumulation assumptions are held constant across scenarios (see Chapter 11 for a discussion of international interaction).

Two interesting patterns surface. First, while the direct drawdown (spot market sale) of the SPR oil in 1983:2 lowered the spot price in that quarter, the sale of futures contracts in SPR oil for delivery in 1983:3 also lowered the spot price immediately. Moreover, under the futures sale option, spot prices remained slightly lower for the rest of the interval.

Second, the drawdown strategies blunted some of the extra private stockpiling that occurred because of the higher expected prices during the disruption. Comparing the private stockpiling trajectories in Table 10-2 reveals that part of the spot market sale was added to private stocks. By guaranteeing supplies to the market for 1983:3, the futures sale reduced private inventory accumulation during the disruption by more than the spot market sale. By 1985, both paths returned to that prevailing in the absence of policy intervention.

CONCLUSION

In this chapter we have examined the potential benefits of drawing down the SPR by selling futures contracts. Observing that, during oil supply disruptions, private inventories act to exacerbate the sharp rise in oil prices, we showed how sales of SPR futures, unlike other policy responses, dampen inventory demand by affecting expectations of future oil prices. Using a two-period model we showed how the sale of an equivalent amount of SPR oil in the spot and in the futures market could lead to a more favorable sequence of spot prices in the latter case. Our simulation results, based on a model of the world oil market and the U.S. economy, indicate that futures sales (1) achieved much of the price-reducing benefits in the early stages of a disruption and (2) led to a lower price trajectory overall when compared with spot market sales.

In addition to resulting in a more favorable spot price trajectory, drawing down the SPR by selling futures contracts has at least four other advantages. First, the sale of SPR futures permits the government to achieve significant benefits, in terms of a reduced spot price, before releasing a drop of oil from the strategic reserve. This is important because, as many authors have stressed, delays in decision-making can be extremely costly during interruptions. To the extent that the decision to sell futures contracts is easier to make than the decision to draw down the SPR physically, the futures option "buys time" for the government (Hogan 1981: 277).

Second, even when the contracts come due, the government may be able to avoid drawing oil from the reserve. If the interruption is over before the due date, the contracts would have been priced higher than the now normal spot market price. The government can meet its contractual obligation in this case by buying oil in the spot market and giving it to the holder of the futures contract. Alternatively, the government could just buy back the futures contracts. Even if the interruption is not over when the contracts mature, the government can purchase oil in the spot market to meet its obligations. Of course, this will forego the price-reducing benefits of the futures sales described earlier. However, it is worth noting that if for reasons of national security, say, the government is reluctant to withdraw SPR oil, it need not do so under a regime of futures contracts.

Third, by selling SPR futures, the government is effectively betting on the future price of oil. If the price turns out to be lower than forecast—the disruption ends sooner than expected, say—the government has registered a revenue gain. If, on the other hand, the price in the future rises even higher than was reflected in the sale price of SPR futures, the government has lost money. However, this revenue loss is consistent with the proposed stabilization rules for energy emergencies (Mork 1981), namely, that the government should follow an expansionary policy to counteract the disruption-induced slowdown in economic activity.

Fourth, SPR sales in the spot market will end up being held as inventories, so that the oil is simply transferred from the public to private reserves. By selling futures contracts, the same ownership transfer is accomplished without having to transport any oil; the social costs of transportation are therefore saved.

To be sure, this chapter represents a first pass at analyzing a new policy option for responding to a disruption in the oil market. Both the theoretical and empirical analyses can be extended to incorporate more realistic features of the world oil market. Yet, we suspect the qualitative nature of our results will remain unchanged: selling futures contracts in SPR oil can be at least as effective in dampening spot market prices as a direct sale in the spot market.

On the other side of modeling and estimating the benefits of selling futures contracts in SPR oil there lies the question of how such a scheme may be implemented. As there currently exists only a small futures market in crude oil, and as attempts to set up such a market in the past have met with limited success, the procedure by which the government could sell SPR futures contracts deserves considerable attention. Although we believe sales of SPR futures during a disruption are feasible, and in many ways easier to effect than spot market sales, we also feel that the success of such a policy depends on the amount of thought given to its implementation before the interruption occurs.

NOTES TO CHAPTER 10

1. Our analysis (and, indeed, that of other authors) is based on the assumption that the disruption is temporary. If the disruption is permanent, then it is not clear that releasing the SPR is a prudent strategy. Hence, in this chapter we are taking as given the decision to use the SPR and are comparing the relative merits of spot and futures market sales.
2. It is reasonable to ask why futures markets in crude oil are underdeveloped. In addition to the institutional reasons given by Safer (1979: 92) and Plummer (1982: 142), we can pose possible economic reasons. During "normal" times, there is not much variability in crude oil prices. While there is a lot of variability in prices during an interruption, finding short-sellers is likely to be difficult. Supplies of oil are constrained and holders of available stocks expect rapidly rising prices. Having the SPR as a participant in a crude oil futures market would be valuable both as a marginal supplier of oil and as an insurance mechanism.

   Plummer (1982: 142) points out that "there is a fallacy of composition involved in thinking of futures markets as an overall protection against oil supply disruptions." While it is true that such an option should be only part of a complete energy policy, Plummer's contention that "aggregate risk has not been reduced" (1982: 142) is not completely true. To the extent that a futures market, either in the United States alone or as an international effort, can manipulate private sector stockpiling and reduce the price runup

during supply interruptions, the consuming nations' *economic* risk has been reduced.

3. A spot market sale of SPR oil may also affect future price expectations to the extent that some of the oil may be resold in the future. However, it cannot affect price expectations more than a futures sale would, since, with a spot sale, there is uncertainty over which date in the future the oil will be resold. Typically, a fraction of the oil can be expected to be resold three months in the future. By contrast, with a futures sale, agents can expect all the oil to be available at the date the contract is due. Hence, the impact on the expected future price will be greater with a futures sale than with a spot sale.
4. This conclusion holds a fortiori in a multiperiod world, so long as there is no further policy intervention in the subsequent periods.

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11 GOVERNMENT STOCKPILES IN A MULTICOUNTRY WORLD
Coordination versus Competition

R. Glenn Hubbard and Robert J. Weiner

Three times in the past decade, the world has witnessed major disruptions in the supply of crude oil from the Middle East. Twice—in 1973–74 and again in 1979—the result has been havoc in the international oil markets and substantial damage to the Organization for Economic Cooperation and Development (OECD) economies. But the experience was not repeated when the Iran–Iraq War broke out in late 1980. General consensus attributes the relatively high level of stocks at the war's outset with facilitating the ensuing drawdown, thereby making up part of the loss and easing pressure on the spot markets. In contrast, world stock levels were below historical averages in the last quarter of 1978. The ensuing scramble to build up stocks is widely credited with exacerbating the price effects of the relatively small Iranian disruption. In this chapter we undertake an economic analysis of stock behavior and, utilizing an econometric model that links the world oil market and the economy, investigate the effectiveness of so-called "stock policies" in avoiding a repetition of 1979.

The Iranian crisis left in its wake numerous scholarly studies, many of which were variations on the theme "What happened, and how can we avoid similar disasters in the future?" Among the con-

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