The Potential Role of Oil Stocks in Countering Oil Price Volatility

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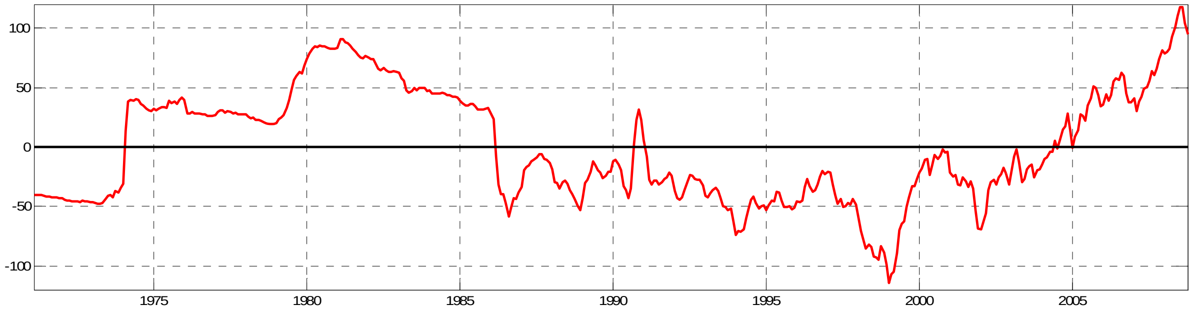
EXECUTIVE SUMMARY

The proposal of using the EU's reserves of crude oil in combating swings in the price of oil relies on governments selling off their oil stocks when the price of oil is high (and replenishing these stocks when the price is low). Estimates of economic models of the global crude oil market suggest that releasing these stocks would lower the price of oil only temporarily and only by a small percentage, if at all. Intuitively, this result makes sense. The recent surge in the price of oil was caused by rising demand for industrial commodities such as crude oil from emerging Asia, combined with strong, but stable demand from OECD economies, resulting in a persistent increase in the global demand for crude oil; thus a one-time release of crude oil will do little to quench the world's thirst for crude oil, beyond the very short run. It would be possible, of course, to spread out the release of oil stocks over several years, but in that case the amount of oil available for release in any given month would be negligible. Either way, the effect on the real price of oil would be small. Moreover, the use of government oil stocks in a futile effort to lower the price of oil would leave the EU unprotected against the real danger of temporary oil supply disruptions in the Middle East. Similar comments apply to the use of emergency stocks of refined products. Finally, there are a number of potential pitfalls in implementing this proposal in practice. It is recommended instead that these reserves be used to deal with unexpected oil supply disruptions only, as originally intended.

A REVIEW OF THE DATA

Headline reports of the price of oil tend to focus on the spot price of crude oil. Since all prices tend to trend upward over time, a more informative measure of the price of oil is the real (or inflation-adjusted) price of crude oil, which captures how much oil-importers have to give up in terms of consumer goods when purchasing a barrel of crude oil. This real price of oil is plotted in Figure 1 and expressed in percent deviations relative to its long-run average. Figure 1 shows that the latest surge in the real price of crude oil started in 1999, following a brief period of unusually low oil prices. While the initial increase of 1999-2001 simply restored the level of the real price prevailing throughout most of the 1990s, the surge resumed in mid-2003 and accelerated in 2007. By 2005, the real price of oil imported by the United States had reached levels comparable to 1974 or 1985. As of March of 2008, it reached a new all-time high, exceeding the previous all-time high in 1981. The real price of oil peaked in July of 2008, followed by a sharp decline.

Figure 1: The Inflation-Adjusted Dollar Price of Imported Crude Oil Relative to its Average for 1971.1-2008.9



Source: Computations by the author based on data from the Monthly Energy Review, EIA, November 2008. The oil price is the refiners' acquisition cost of imported crude oil and has been extended backwards in time as in Barsky and Kilian (2002). The inflation-adjustment is based on the seasonally adjusted U.S. consumer price index for all urban consumers. See: http://research.stlouisfed.org/fred2/.

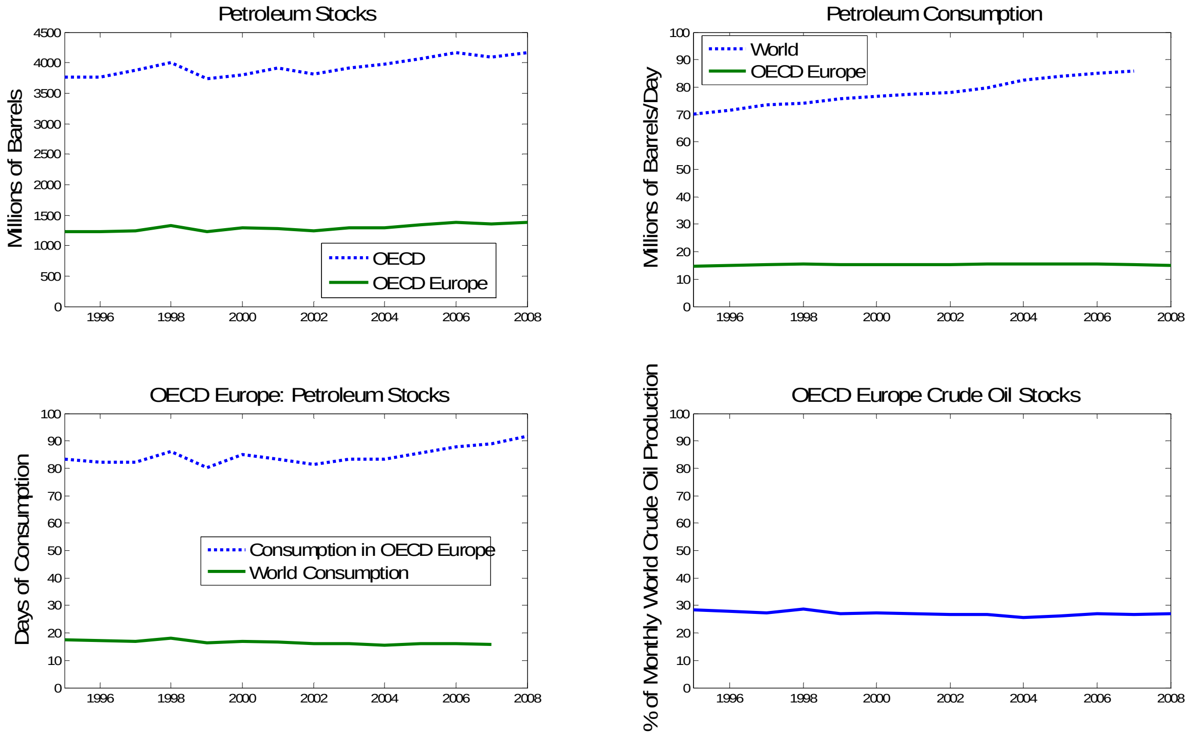
While it makes sense to focus on dollar prices since crude oil is traded in dollars, qualitatively similar, if less pronounced, fluctuations would be observed if we expressed the inflation-adjusted price of crude oil in Euros. Large fluctuations in the price of oil are associated with microeconomic and macroeconomic adjustments in oil importing economies. The question posed in this report is whether EU oil stocks should be used in countering the apparent price volatility in global crude oil markets.

A useful starting point is a review of the data on petroleum stocks in Europe and more generally in the OECD. There are no publicly available data for the EU, but the Energy Information Administration (EIA) provides detailed data for European members of the OECD. *OECD Europe* in EIA publications refers to Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom. While this list does not match the list of EU countries exactly, it comes close enough for our purposes.

Petroleum stocks are measured at the end of each period. Ideally, we would like a measure of crude oil stocks. Petroleum stocks as defined by the EIA include stocks of crude oil (including strategic reserves) as well as unfinished oils, natural gas plant liquids, and refined products.

Hence, these stocks overstate available reserves of crude oil. Especially, the inclusion of refined products is troublesome, since refined products play a very different role from crude oil in the production chain, as discussed further below. Nevertheless, the EIA figures provide some indication of the level of reserves.

Figure 2: Petroleum Stocks in Perspective



Source: Computations by the author based on data from the Monthly Energy Review, EIA, November 2008.

The upper left panel of Figure 2 shows that OECD petroleum inventories in general and petroleum inventories in *OECD Europe* in particular have grown somewhat since 1995, by 11 percent and by 13 percent respectively. The data for 2008 are preliminary estimates as of November 2008 based on data up to July of 2008. These petroleum stocks include inventories owned by market participants as well as governments. Thus, not all of these stocks would be available for government intervention. Nevertheless, it is instructive to evaluate the magnitude of these inventories relative to measures of oil consumption and oil production.

The upper right panel of Figure 2 shows that petroleum consumption in *OECD Europe* has remained virtually flat since 1995, whereas world petroleum consumption has grown by 22 percent. No global oil consumption data are available for 2008 at this point. The lower left panel shows that petroleum stocks in *OECD Europe* on average have amounted to less than 90 days worth of *OECD Europe* petroleum consumption and less than 20 days worth of world consumption. Whereas the former indicator has been increasing in recent years, the latter has been declining, reflecting the growth in world oil consumption. Of course, the focus on petroleum stocks is misleading in that these stocks contain refined products as well as crude oil. For example, 56 percent of European emergency stocks are held in the form of finished products (see European Commission 2008). The lower right panel suggests that European crude oil stocks, on the basis of these data, amount to perhaps 10 days of global crude oil production. This is, of course, only an educated guess, and the actual share may very well be lower.

The proposal of using crude oil stocks in combating swings in the price of oil relies on governments selling off their oil stocks when the price of oil is high (and replenishing these stocks when the price is low). In the absence of detailed data about the composition of European oil stocks, it is difficult to say what fraction of the OECD Europe oil stocks may be available for such a policy intervention and what fraction is owned by market participants.

More detailed data for the United States from the EIA suggests that in the U.S. about two thirds of all petroleum stocks in October of 2008 were held in the Strategic Petroleum Reserve (SPR), with the remainder accounted for by oil market participants. Hence, the working assumption in this report will be that a similar breakdown applies in the EU. Leaving aside the problem of coordinating the use of oil reserves, this suggests that policymakers have at their disposal crude oil reserves amounting to perhaps 20 percent of monthly world crude oil production.

An Economic Perspective on the Recent Surge in the Price of Crude Oil

Before we can assess the prospects of a policy intervention involving the sale of petroleum stocks, we must analyze the determinants underlying the recent surge in the price of crude oil.

1. The Role of Global Demand Shocks

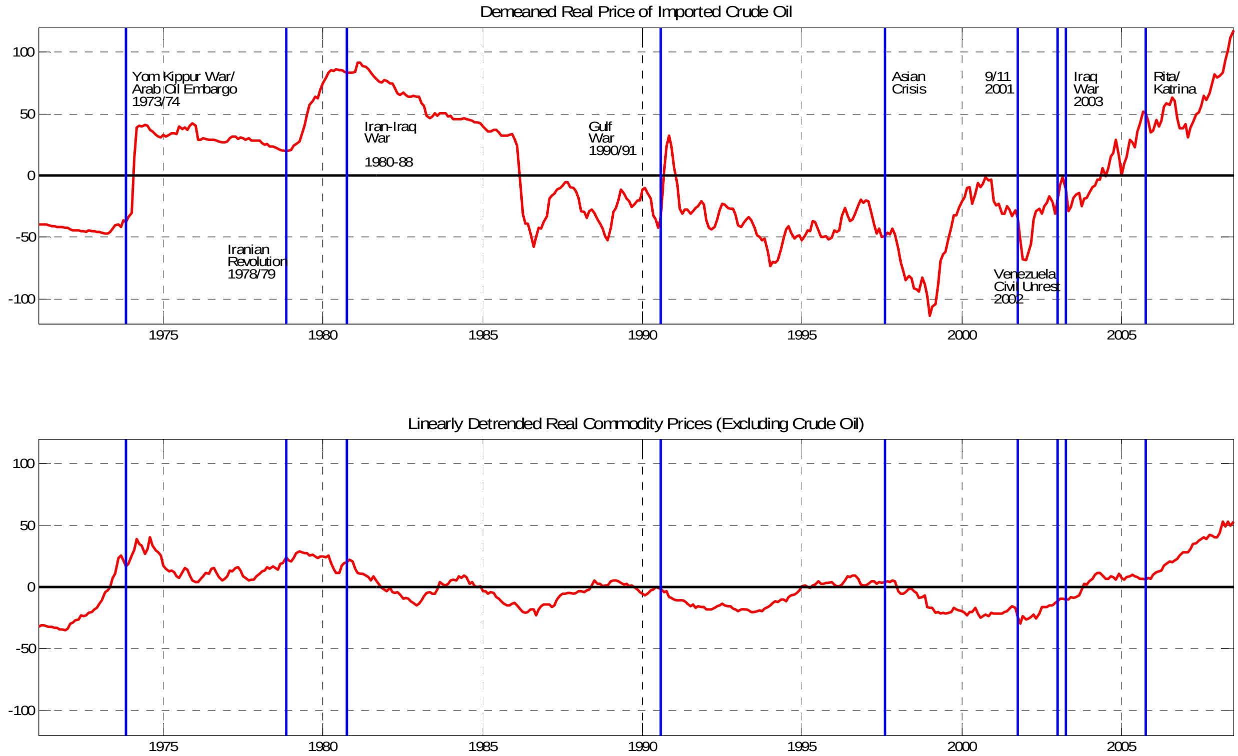
It is widely accepted at this point that much of the recent increase in the real price of crude oil has been driven by shifts in the global demand for industrial commodities, reflecting increased growth in emerging Asia in particular (see Kilian 2008b). One indication of such broad-based global aggregate demand pressures is a parallel shift in other industrial commodity prices. In fact, shifts in global demand for industrial commodities have been an important feature of the oil price data as far back as the 1970s (see Barsky and Kilian 2002, 2004).

Figure 3 presents the real price of crude oil expressed in percent deviations from the mean and an index of real commodity prices expressed in percent deviations from a linear time trend, highlighting the cyclical fluctuations in global commodity prices. Key historical events have been marked by vertical bars. The lower panel shows that there have been three episodes since the 1970s, during which commodity prices have risen persistently above trend: 1971-1974, 1977-1980, and 2001-2008. In all three cases, the underlying cause of the broad-based increases in commodity prices has been strong global demand for industrial commodities, driven by a booming world economy.

The upper panel of Figure 3 shows that these periods were characterized by large increases in the real price of oil as well, although the increases in the real price of oil in the 1970s lagged the increase in commodity prices. For example, commodity prices began to take off in late 1971, whereas oil prices only began to surge in late 1973. Likewise, the boom in other industrial commodity prices in 1977 predated that in oil prices in 1979. The reason is that commodity prices always have been spot prices of freely traded commodities, whereas crude oil was mainly traded in the form of long-term contracts at negotiated prices until about 1980. Since then oil has been trading in spot markets as well.

Table 1 compares the growth rates of real commodity prices during the three periods of high global demand for industrial commodities. The first column shows that during 1971.11-1974.2, other industrial commodity prices increased across the board at rates quite similar to the rate at which the price of oil increased. In fact, considering the secular decline in most non-oil commodity prices the rates are remarkably similar. Since we know that there were no cartel activities or other major supply shocks in industrial commodity markets in the early 1970s, this evidence suggests that all of these price increases were driven by excessive demand for industrial commodities relative to supply. There really is little need for additional explanations of the increase in the price of oil in particular, and recent research has debunked the popular myth that the 1973/74 oil price shock was driven primarily by the Yom Kippur War in October of 1973 or the subsequent Arab oil embargo (see Kilian 2008a,c).

Figure 3: Cycles in Inflation-Adjusted Prices of Crude Oil and Commodities for 1971.1-2008.6



Source: See Figure 1. The CRB index of commodity prices has been linearly detrended to highlight cyclical fluctuations. There is no apparent trend in the real price of oil. The dates of selected historical events are indicated by vertical bars.

Table 1: Growth Rates of Inflation-Adjusted Industrial Commodity Prices in Percent

	1971.11-1974.2	1977.8-1980.2	2001.6-2008.6
Crude Oil	125.3	70.7	327.5
Industrial Raw Materials	92.6	24.2	66.7
Metals	95.9	27.6	234.6
Textiles	81.5	17.0	-2.9

Source: Computed by the author from data provided by the EIA and the Commodity Research Bureau. The non-oil commodity prices are not detrended, so their growth relative to trend will be higher than the raw numbers shown here.

Turning to the 1977.8-1980.2, we again see parallel shifts in oil and other industrial commodity prices, suggestive of a global demand expansion. The increase in industrial commodity prices, however, was at most one third of the increase in crude oil prices, suggesting that there must be additional explanations of the surge in crude oil prices. As we will discuss below, an important factor behind the surge in the real price of oil in 1979, beyond high levels of global real economic activity, was a sharp increase in uncertainty about future oil supply shortfalls associated with the Iranian Revolution, the Iranian hostage crisis, and the Soviet invasion of Afghanistan.

Likewise for the 2001.6-2008.6 period, Table 1 shows massive price increases in some industrial commodities (such as metals prices which have more than tripled since 2001.6) and substantial, but much lower price increases in many other industrial commodities. However, none of these increases rivals that in the real price of crude oil, which has more than quadrupled over this period. The observed differences in the rate of price increases reflect differences in the responsiveness of the supply of these commodities, a point to which we shall return below, when we discuss the evolution of global oil supplies.

Why does global demand for industrial commodities fluctuate so much during these three historical episodes? It has been shown that the two demand expansions in the 1970s were caused by parallel monetary expansions in many industrialized countries including the United States (see Barsky and Kilian 2002, 2004). These monetary expansions caused a temporary boom in the global demand for industrial commodities. In contrast, the global demand expansion since 2001 was not driven primarily by economic growth in industrialized economies (although solid growth in Japan, Europe and the United States has contributed to strong overall global demand), but rather by additional demand form industrializing economies in emerging Asia. Thus, this latest demand boom reflects as much a structural transformation of the world economy, as it is a global business cycle phenomenon.

2. The Role of Oil Supply Disruptions and of Precautionary Demand

A complementary explanation of rising oil prices is that wars cause oil supply disruptions, which in turn drive up the real price of oil. There is not much empirical evidence supporting that view. One reason is that many wars in the Middle East did not cause damage to oil fields. A case in point is the Yom Kippur War of 1973. No hostilities took place on OPEC territory during this war and OPEC oil production was unaffected. A second reason is that historically unanticipated war-related oil supply disruptions over time have tended to induce increased oil production. Increased production took place not only in other oil producing countries with spare capacity, but, as the example of the Iran-Iraq War demonstrates, oil producers at war need the foreign exchange earnings from oil exports to sustain their war effort, creating an incentive for additional oil production. Hence, the overall effect on the real price of oil has tended to be much smaller than a shock that would permanently wipe out oil production (such as a Iranian nuclear attack on Saudi oil fields) or an oil supply disruption taking place in an environment in which oil supplies are constrained. This is not to say that war-induced oil supply disruptions could not cause substantial increases in the real price of oil, but that historically they have not. Figure 3 helps make that point. It is useful to focus on events that did not coincide with major shifts in the demand for oil such as the outbreak of the Iran-Iraq War in late 1980. The outbreak of that war caused only a minor increase in the price of oil. Nor was the 2003 Iraq War associated with a large oil price increase, although it coincided with a major supply cut in Venezuela in late 2002 such that the combined reduction in oil production in Iraq and Venezuela was comparable to the oil supply shocks of the 1970s.

This does not mean that events in the Middle East cannot be important for the real price of oil. To the extent that there is no spare capacity in oil production, the mere threat of future oil supply shortfalls can cause the price of oil to jump. This type of phenomenon is illustrated by the invasion of Kuwait in August of 1990. The reason for the sharp spike in the real price of oil seen in Figure 3 was not the reduction in Kuwaiti and Iraqi oil exports, although there was a supply disruption, but the uncertainty about whether Iraq would invade Saudi Arabia as well and seize Saudi oil fields, creating a tremendous oil supply shortfall. Uncertainty of this type causes so-called precautionary demand for oil. In essence, traders drive up the price by buying oil as insurance in anticipation of possible shortages. Unlike other oil market shocks, precautionary demand shocks may cause immediate and large jumps in the real price of oil, as expectations may shift in an instant. The sharp increase in the real price of oil in mid-1990 shown in Figure 3 illustrates this point. As soon as the U.S. had moved enough troops to Saudi Arabia to forestall an invasion of Saudi Arabia, however, the uncertainty dissipated and the real price of oil fell sharply (notwithstanding the fact that Iraqi and Kuwaiti oil supplies remained off the market and that in fact many Kuwaiti oil facilities were damaged or destroyed during the war in 1991).

For precautionary demand to arise it is essential that there is no excess supply of crude oil. A case in point is the Tanker War in the Persian Gulf in the 1980s. Despite the fact that at times up to 30 oil tankers were attacked per month, the price of oil steadily fell during this period because oil supplies far outstripped demand for oil. In contrast, in 1979 precautionary demand played a central role in driving up the price of oil beyond what the state of the global economy would have justified. Interestingly, it can be shown that precautionary demand has not played an important role since 2001.

Figure 3 also illustrates that negative shocks to the demand for oil and other commodities such as the Asian crisis or 9/11 (which induced a U.S. recession) tend to be followed by declines in the price of crude oil. The same is true of the global slowdown since mid-2008.

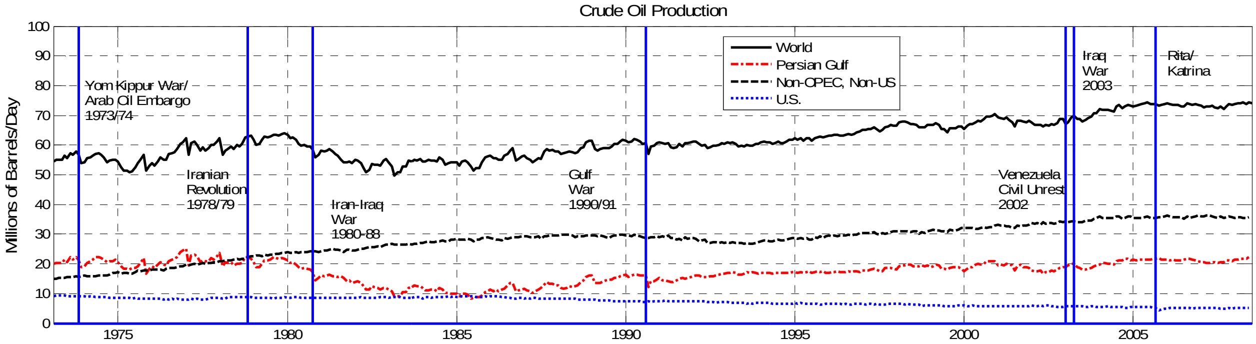
3. The Evolution of Global Oil Production

Since the effects of rising global demand for crude oil on the real price of oil depend on the global supply of crude oil, it is useful to review the trends in global crude oil production. Figure 4 shows that global oil production has steadily increased since the early 1980s. The current overall level of production is at an all-time high. The temporary decline in 1980-1986 owes much to Saudi Arabia’s unsuccessful attempt to reduce its production to stem declines in the price of oil as well as to the global economic decline of the early 1980s (which reduced demand for oil). U.S. oil production has steadily declined since the 1970s, notwithstanding the development of Alaskan oil resources. Production in the rest of the world has been increasing.

One clearly would expect oil supplies to expand over time in response to higher oil prices, provided that oil producers believe that oil prices will remain sufficiently high to make the investment in new capacity worthwhile. For example, the 1973/74 oil shock triggered increased exploration and drilling activities across the globe, which led to a substantial increase in oil production with a delay of about five years. Since the most recent surge in oil prices started more than five years ago, it makes sense to compare the growth rates of oil production during 1974.1-1979.12 and 2001.6-2008.5.

Table 2 shows that contrary to prevailing wisdom there already has been a substantial oil supply response in recent years of roughly similar magnitude to the response following the 1974 oil price shock. Oil production since 2001.6 increased by 12.5 percent compared with 14.5 percent in the six years following 1974.1.

Figure 4: Crude Oil Production for 1973.1-2008.5



Source: Computations of the author based on data from the Monthly Energy Review, EIA.

Table 2: Growth Rates of Crude Oil Production in Percent: Selected Periods

	1974.1-1979.12	2001.6-2008.5	2005.6-2008.5
World	14.5	12.5	0.8
Persian Gulf	4.0	23.7	3.1
OPEC	0.6	19.0	2.4
Not OPEC or U.S.	51.6	11.0	0.3
U.S.	-3.6	-10.4	-5.4

Source: Computations of the author based on data from the EIA.

Nevertheless, there are interesting contrasts. After 1974, Persian Gulf oil producers (and even more so other OPEC oil producers) were reluctant to increase their oil production or to invest in new capacity, reflected in growth rates of 0.6 percent for OPEC as a whole. U.S. oil production even fell at a rate of 3.6 percent, as U.S. oil fields had already peaked. At the same time, non-OPEC, non-U.S. production grew at an astounding rate of 51.6 percent, accounting for the bulk of the response of world oil supply.

Since 2001.6, oil production in the Persian Gulf has increased at a rate of 23.7 percent, suggesting that these oil producers have delivered on promises of increasing oil production substantially. The same is true to a lesser extent for OPEC as a whole, which includes countries with declining oil resources. In contrast, non- OPEC, non-U.S. oil producers have expanded oil production only by 11 percent. A likely explanation of this pattern is not so much that the world is running out of oil in the foreseeable future, but that the threat of expropriation in many oil producing countries prevents the flow of much needed investments. Two prominent examples are Russia and Venezuela.

There is reason for concern in that much of the observed increase took place prior to mid-2005. Since 2005.6, world production of oil has essentially stagnated. Whereas Persian Gulf oil producers still expanded by 3.1 percent, oil production in non-OPEC, non-U.S. countries grew at 0.3 percent only. These data help explain the disproportionate increase in the real price of oil since 2005 relative to other industrial commodity prices.

They also suggest that the real price of crude oil in the foreseeable future is likely to be determined by demand conditions in the global oil market. In the absence of precautionary demand shocks, this means that only reduced demand from industrialized economies and/or reduced demand from emerging Asia will cause the real price of oil to fall.

As of mid-2008, there were indications that a slide in the price of oil may had begun, as Europe and the U.S. economy were slowing down, as was China. The slide has accelerated since September of 2008, with the onset of the credit crisis. In particular, the economic and financial crisis of the OECD economies, which had contributed little to the increased demand for oil in recent years, became a major factor in the erosion of demand pressures. In fact, the price of oil since July of 2008 has fallen about as fast as it rose in the first half of the year. How long this development will continue, depends on the ability of the world economy to avoid a prolonged recession or even depression. All else equal, one would expect to see the real price of oil rebound, as soon as the world economy recovers.

4. The Response of the Price of Oil to Oil Demand and Supply Shocks

The informal analysis of the global oil market in the preceding sections is consistent with estimates obtained from formal econometric models. Recent work by Kilian (2008b) suggests that each of the three types of shocks discussed above has a very different impact on the real price of oil. Figure 5 shows that an oil supply disruption ("oil supply shock") temporarily raises the real price of oil; an unanticipated increase in global demand for all industrial commodities ("aggregate demand shock") causes a persistent increase in the real price of oil that peaks after one year; and a positive demand shock that is specific to the crude oil market ("oil-specific demand shock") - such as an increase in precautionary demand following the threat of war in the Middle East - causes an immediate jump in the real price of oil. In addition to these response estimates, Figure 5 includes error bands to convey the extent of the estimation uncertainty. In particular, the price responses to the two demand shocks are fairly precisely estimated and statistically significant.

Of particular interest is the question of how much of the recent surge in oil prices can be attributed to each shock. Figure 6 shows that each oil price shock episode is different. For example, the 1990/91 episode was driven primarily by shifts in precautionary demand; the 1979/80 episode reflected primarily a combination of strong global aggregate demand and increased precautionary demand in 1979; in contrast, the surge in the real price of oil since 2002 can be attributed almost entirely to increased aggregate demand for industrial commodities. Put differently, the real price of oil rose because the world economy was booming (and more recently has fallen, as the world economy slid into recession).[1]

This analysis will help us assess the likely impact of selling off oil stocks on the real price of oil in the next section. Before turning to this question, it is useful to debunk an alternative explanation of recent oil price movements that has gained popularity in the press. In particular, it has been suggested that speculation in oil futures markets has been the driving force behind the surge in the real price of oil since 2002.

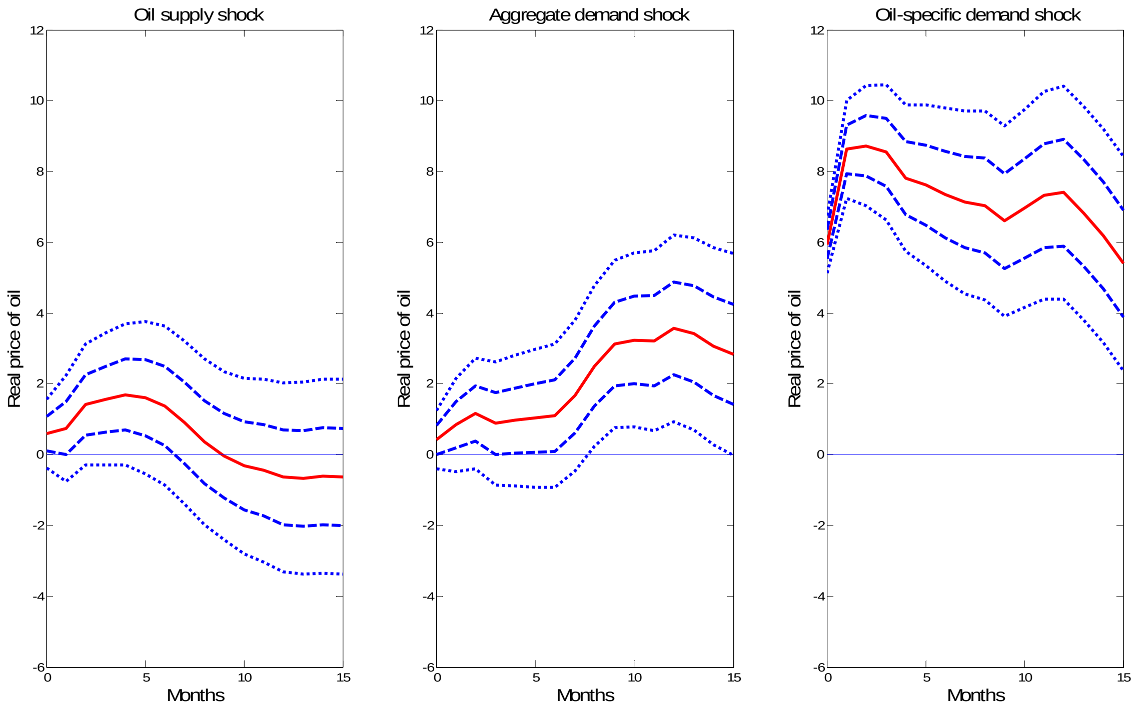
[1] This distinction has important implications for the effect of these shocks on oil importing economies. See Kilian (2008b,c), Kilian and Park (2008), and Kilian, Rebucci and Spatafora (2008) for further analysis.

5. The Role for Speculators

Based on data compiled by the Commodity Futures Trading Commission, Alquist and Kilian (2008) have documented that there indeed appears to have been an influx of speculators (defined as buyers and sellers not customarily in the oil business) in NYMEX oil futures markets after 2003. This evidence is consistent with anecdotal evidence of hedge funds entering the oil futures market. It raises the concern that possibly these speculators might have been responsible for the increase in the spot price of oil at about the same time.

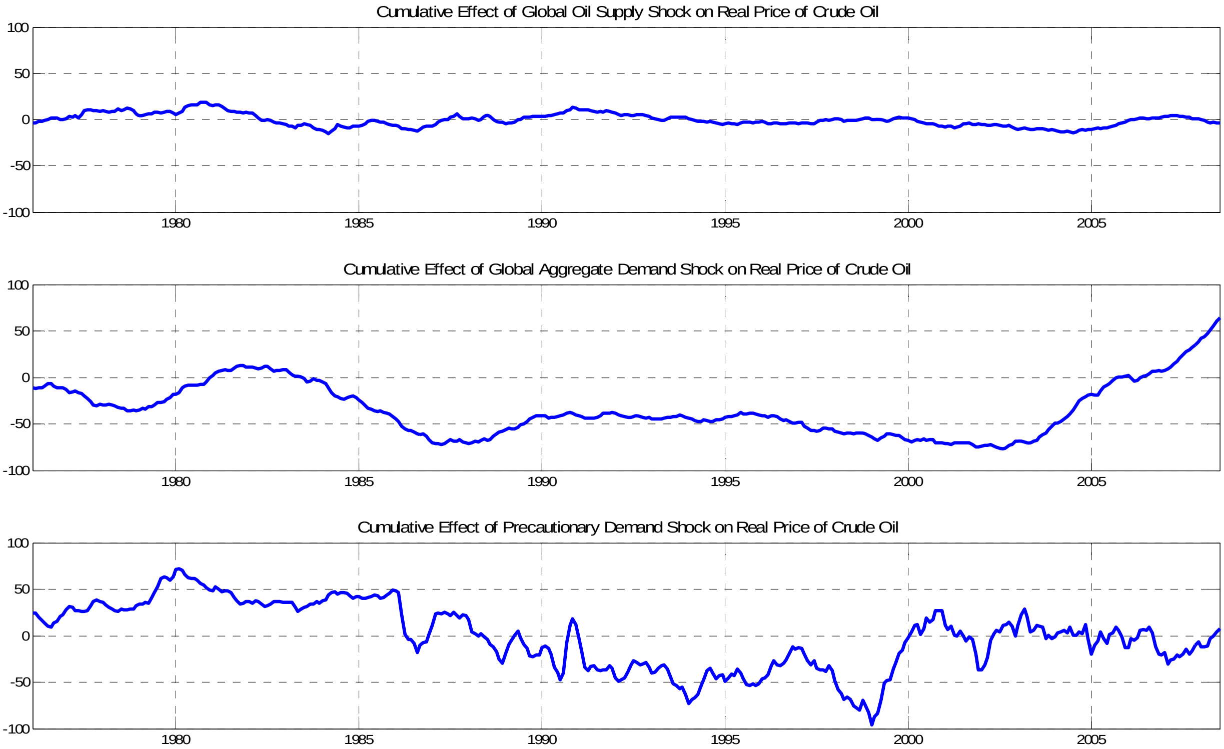
Figure 6 shows that such speculation could not have been oil-market specific or the econometric model underlying Figures 5 and 6 would have picked up the additional speculative demand as an oil-market specific (precautionary) demand shock. This leaves the possibility of futures-market driven speculation in many industrial commodity markets. One problem with that explanation is that industrial commodity prices rose as fast or even faster in commodity markets for which no futures contracts exist (see Bini Smaghi 2008). Another problem is that speculators in oil futures markets appear to have played both sides of the futures markets rather than consistently betting on higher prices. A third problem is that it is not clear how exactly speculators in oil futures markets drive up the price of oil in the spot market. The implicit argument is that traders in the spot market interpret higher oil futures prices as a prediction of higher spot prices; thus spot traders will buy a barrel of oil and store it with the intention of selling it a year later at a higher price and making a profit.

Figure 5: Responses of the Price of Crude Oil to Oil Demand and Oil Supply Shocks



Source: Kilian (2008b). All shocks have been normalized such that they tend increase the real price of oil. In particular, the oil supply shock represents an oil supply disruption and the demand shocks a demand expansion.

Figure 6: The Contribution of Each Shock to the Evolution of the Real Price of Oil during 1976.1-2008.6



*Source: Kilian (2008*b).

There are several problems with that interpretation. First, Alquist and Kilian (2008) have shown that oil futures prices are no more accurate predictors of the spot price than the current spot price, raising the question of why traders would rely on predictions from oil futures prices. Second, according to standard economic models, one would expect oil inventories to have increased sharply relative to trend since 2003, if spot traders had responded to higher oil futures prices. That did not occur in the U.S. and OECD data (see Kilian 2008d). On the other hand, if, for technological reasons, the stock of oil in inventories had been fixed, increased speculation in the spot market would have implied that traditional buyers must have received less crude oil. Those traditional buyers are refineries, so their output in the form of gasoline, heating oil, etc. should have fallen. This implication again is inconsistent with the data. Thus, there is no real evidence for the view that speculation is behind the recent surge in the price of oil (or that diminished speculation explains the subsequent fall of the real price of oil). Thus, there is no reason to believe that additional regulation of oil futures markets would have brought down the price of oil. The next section will evaluate the alternative policy proposal of releasing government-held crude oil stocks in an effort to ameliorate the shortfall of oil supplies.

ANALYSIS OF THE POLICY PROPOSAL

1. The Need for a Global Approach

The preceding analysis illustrated that the root cause of the recent surge in the price of oil was that demand for crude oil grew faster than its supply. A fallacy in discussions of this problem is to view any increase in the domestic availability of oil relative to domestic needs rather than the global demand for oil. For example, during the U.S. election campaign, a popular proposal involved increased domestic drilling for crude oil. The implicit premise was that this oil would become available domestically, making it unnecessary to purchase expensive oil from abroad. In reality, the price of crude oil is determined in global markets. Unless the increase in domestic production is truly large (which seems unlikely given the continued decline in U.S. oil production since the 1970s, even as Alaskan oil was discovered), its effect on the world price of oil will be negligible. Any additional oil produced domestically will simply be valued at the same high global price.

This would be true, even if sales of domestic oil were restricted, as oil supplies are fungible. History has taught us that attempts to steer oil supplies in any one direction are futile. For example, in 1973/74 Arab oil producers attempted in vain to punish the Netherlands for its pro-Israeli stance by restricting oil deliveries to the Netherlands. The market responded by simply substituting other crude oil supplies for those from Arab oil producers, undermining the embargo. Likewise, if the U.S. substituted domestically produced oil for imported oil, this would simply free up oil for consumption elsewhere. Either way, the market for crude oil is truly global. The implication is that we must judge the impact of releasing crude oil stocks on the price of oil not relative to the level of domestic consumption, but relative to world-wide levels of oil consumption and oil production, as illustrated in Figure 2.

2. The Best-Case Scenario

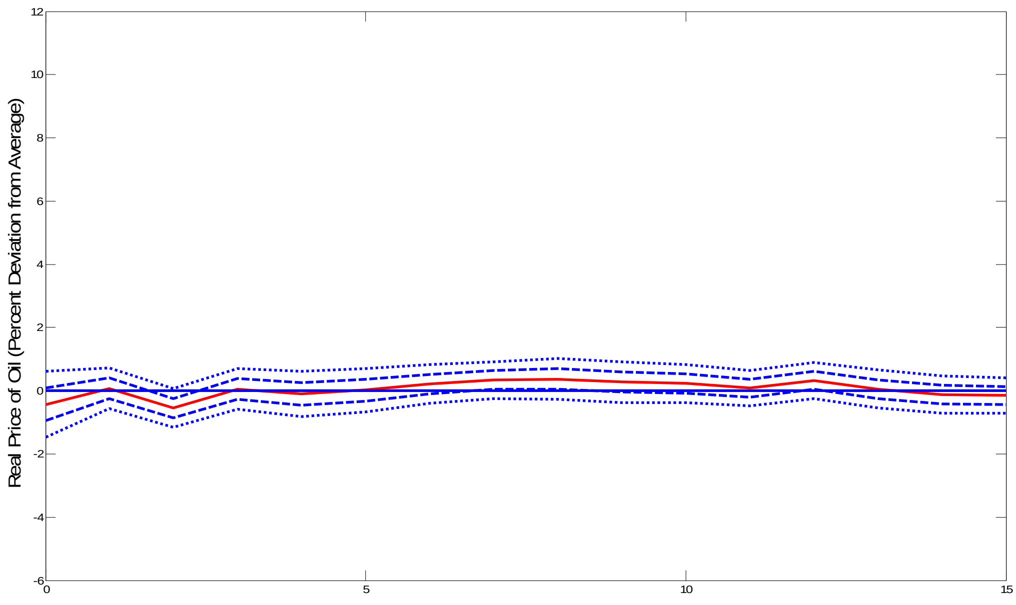
One interpretation of a release of oil stocks is as a surprise increase in world oil supplies. In the context of the model discussed earlier we can easily ask what the effect of an increase in crude oil supplies of a magnitude corresponding to the current EU government oil reserves would be. This interpretation is likely to be too optimistic. Unlike other shocks to world crude oil production (such as opening a new oil field) that tend to raise the level of production persistently over time, a release of petroleum reserves would tend to be short-lived. Once the petroleum stock is spent, no new stocks will be forthcoming. This suggests that such a policy intervention would actually be less effective than an unexpected expansion of oil production, which as we have shown has at best moderate price-dampening effects (see Figure 5).

One way of mimicking this situation in the model underlying the results in the preceding section is to allow for a positive oil supply shock in a given month, followed by a negative shock of the same magnitude in the following month. Below we assume that EU crude oil stocks amount to 20 percent of the monthly global production of crude oil. The release of a different quantity of crude oil would simply result in a scaled version of the same plot. The response has been plotted on the same scale as the response to an oil supply disruption in Figure 5 to facilitate a direct comparison. Figure 8 shows a minor reduction in the real price of oil two months after the release of the oil inventories, but the overall effect is very small and so imprecisely estimated that one would be hard-pressed to justify any policy actions on this basis.

As discussed earlier, it is difficult to know what the actual level of EU crude oil inventories is, but Figure 8 indicates that regardless of the quantity of crude oil stocks released to the market, there will be no statistically significant reduction in the real price of oil. Ignoring estimation uncertainty, the model implies that the real price of oil would temporarily drop by 0.5 percentage points, although accounting for estimation uncertainty the effect may very well be much smaller. Although this best-case scenario postulates that all crude oil stocks are released, few proponents of the use of strategic oil reserves would advocate such a radical course of action (see Emerson 2006). It seems prudent to keep some stocks in reserve, in which case the response of the real price of oil will fall proportionately. Moreover, the premise that the EU has at its disposal stocks amounting to 20 percent of monthly world crude oil production may be overly optimistic; any reduction in this stock would further reduce the estimated response proportionately. Even a coordinated multilateral release of oil reserves beyond the EU would not change the results in Figure 8 materially.

The evidence in Figure 8 suggests that the idea of countering global demand pressures based on the release of crude oil stocks is not feasible. The effects of such a policy would be too short-lived and too small to make a difference. Intuitively, this result makes sense. If the problem is rising demand from emerging Asia combined with strong, but stable demand from OECD economies, resulting in increased demand for crude oil not just this month, but in every month for the foreseeable future, then a one-time release of oil will do little to quench the world’s thirst for crude oil. It would be possible, of course, to spread out the release of oil stocks over several years, but in that case the amount of oil available for release in any given month would be negligible. Either way, the effect on the real price of oil would be small.

Figure 8: The Effect of an Unanticipated Release of All *OECD Europe* Oil Stocks on the Real Price of Crude Oil



Source: Computations by the author based on the model in Kilian (2008b). Results shown assume that current EU crude oil stocks amount to 20 percent of monthly world crude oil production. The thought experiment is an unanticipated release of this stock in period 0, followed by a reversal of that increase in period 1.

3. Unintended Consequences of a Policy Intervention

The preceding analysis has focused on the best-case scenario for policy intervention. Even for that scenario, the case for selling off crude oil stocks is very weak. There are additional reasons to be very cautious about such a strategy. One reason is that the level of oil inventories held by market participants such as refineries depends on their perception of the risk of an oil supply shortfall. Government oil inventories act as an insurance against possible oil supply shortfalls. An obvious concern is that the private sector may choose to increase its inventory holdings in response to a meltdown of government-held inventories, which would counteract the policy intervention.

More importantly, a sell-off of crude oil stocks would leave the oil-importing country vulnerable to unanticipated political events in the Middle East such as the threat of war or terrorist attacks. Historically, such events have been responsible for sharp spikes in the price of oil. The most prominent example has been the invasion of Kuwait in 1990 (see Figure 3). As Figure 5 shows, such shocks tend to cause sharp swings in the price of oil as well as in domestic economic activity, as shown in Kilian (2008b).

This observation suggests that it would be imprudent to sell off all government-held petroleum stocks. A likely political disturbance in the foreseeable future would be a shipping accident, terrorist attack or war resulting in the closure of the Straits of Hormuz, through which most oil exports from the Persian Gulf must pass. If a supertanker were sunk in the Straits, for example, merely clearing the obstructed shipping lanes would likely take months. The effect on the price of oil would be dramatic. If the existing petroleum stocks had been sold off, there would be no cushion left to deal with this emergency. There are many other scenarios involving military conflict or political upheaval in the Persian Gulf region with qualitatively similar outcomes.

A case can be made that the primary function of government-held oil stocks is to provide insurance against such events. Selling of oil stocks to combat an increase in the price of oil driven by shifts in global demand is akin to a homeowner cancelling his fire insurance to make ends meet in tough times. That additional cash may come in handy, but the consequences could be catastrophic in the event of a house fire.

This line of reasoning suggests that the level of petroleum stocks available for policy interventions aimed at stabilizing the price of oil is actually somewhere between nil and negligible, measured relative to the likely risk of an oil supply disruption. Moreover, strategic reserves seem more suited to coping with the temporary shortfalls associated with political disturbances in the Middle East such as a closure of the Straits of Hormuz than with persistent changes in the structure of the world economy or the global business cycle.

4. Further Caveats

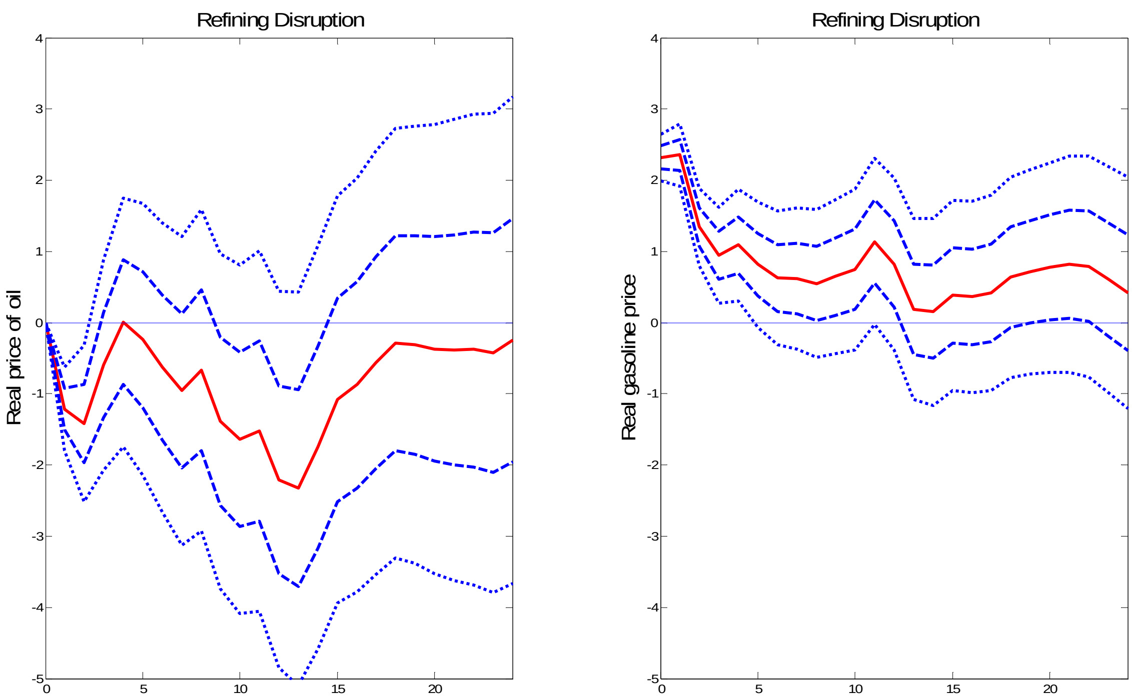
Calls for the use of strategic petroleum reserves have been voiced in response to events outside of the Middle East as well. For example, it is common for U.S. policymakers (and, more generally, the media) to call for a release of crude oil from the SPR in anticipation of hurricanes making landfall in the Gulf of Mexico. The premise of such calls to action is that hurricanes are likely to disrupt drilling on off-shore oil platforms, causing an oil supply shortfall and higher crude oil prices. Historically, this analysis has proved incorrect. Not only were the disruptions of oil production in the Gulf negligible on a global scale (see Figure 4), but, more importantly, these hurricanes have tended to disrupt refining activities in Texas and Louisiana.

Since refiners produce refined products such as gasoline from crude oil, rather than representing a crude oil supply disruption, the shutdown of Gulf refineries represented a disruption of gasoline supplies and an unexpected reduction in the demand for crude oil. This observation explains the fact that crude oil prices actually fell slightly following these hurricanes (contrary to the predictions of the media), while U.S. retail gasoline prices skyrocketed. This phenomenon is captured by estimates of an economic model of the global crude oil market and the U.S. gasoline market in Kilian (2008d), shown in Figure 9.

The ultimate aim of the proposal of releasing strategic reserves is not to reduce the price of crude oil, but to reduce the prices of gasoline, heating oil and other refined products faced by domestic consumers and firms. As the example of the hurricanes Rita and Katrina illustrates, releasing crude oil reserves will have the effect of lowering retail energy prices only if refiners have sufficient spare capacity to process the additional crude oil. This was not the case in the United States following the devastation caused by these hurricanes. All remaining refineries were already operating at full capacity, and a release of oil from the SPR, while politically expedient, would have done nothing to keep gasoline prices in check. Similarly, any release of EU oil reserves would require careful analysis.

In addition, one must take into account that there are different grades of crude oil differentiated by their sulphur content. Crude oil is not a homogenous product. For example, Venezuelan oil is quite different from Libyan oil. Not all refineries are capable of processing all types of crude oil. Again, it is quite likely that a given refinery may not be able to process oil from strategic reserves, if the grades available do not correspond to those the refinery is set up to process.

Figure 9: Price Responses to an Unanticipated Disruption of U.S. Refining Activities



Source: Kilian (2008d).

The relative demand for different grades of crude oil also depends on the desired mix of refined products. The demand for crude oil is derived from the demand for diesel fuel, gasoline, heating oil, and other refined products, and a shortage of one of these final products may have differential effects on the demand for crude oil of different types.

Finally, there is an active trade in refined products such as gasoline. For example, following Rita and Katrina gasoline was shipped from Europe to the United States, in response to the price differential. If the EU, for example, had decided unilaterally to increase gasoline production by releasing its crude oil reserves, it is likely that European gasoline would have been sold to the highest bidder abroad until the price of gasoline (adjusted for transportation costs) is equalized.

While this study has focused on the effect of releasing crude oil emergency stocks, similar comments would apply if the EU chose to release its stocks of finished and intermediate products. While releasing EU stocks of gasoline, for example, would bypass the refining bottlenecks discussed above and may allow policymakers to lower gasoline prices more directly, the relatively small size of EU gasoline stocks and the fact that gasoline is traded globally would limit the reduction in the domestic price of gasoline. Given the lack of detailed data on the availability of EU gasoline stocks, it is more difficult to assess these effects quantitatively, but the underlying mechanisms (and the dangers posed by such a strategy) are essentially the same as in the case of crude oil.

CONCLUSION

The latest oil price boom ensued when countries in emerging Asia increased their demand for industrial commodities during a period of already strong growth in OECD economies. Asia's increasing appetite for industrial commodities including crude oil reflected the growing industrialization of that region. Global oil supply increased substantially in response, but not enough, and in the last three years the growth of world oil supplies has all but ceased. This supply-demand imbalance in oil markets explains the bulk of the recent surge in oil prices. There is no evidence of that increase being fueled by speculation in oil futures markets, by oil supply disruptions in the Middle East, or by market concerns about future oil supply shortfalls.

Given the state of oil supplies, the price of crude oil for the foreseeable future is likely to depend primarily on the evolution of the global demand for oil. This point is confirmed by the decline in the price of crude oil since July of 2008. The initial decline coincided with evidence of a cooling world economy with recession fears looming large in Europe, the United States and China. Indicators of global demand pressures such as international shipping rates suggest that global demand peaked in June of 2008, right before the price of oil began to decline. The fall in global demand for oil and hence in oil prices accelerated with the onset of the current financial and economic crisis, which has led to a sharp contraction in world real activity and consequently in the demand for industrial commodities including crude oil. In fact, the decline in common indicators of global demand (such as the Baltic Dry Cargo Index) since June of 2008 has been at least as dramatic as its increase earlier this year.

The fact that recent oil price fluctuations have reflected shifts in global demand rather than short-term supply disruptions has important implications for the use of strategic oil reserves. The analysis in this report suggests unequivocally that the use of strategic reserves of crude oil or other petroleum products would have been futile in the recent economic environment. Such reserves were created to combat temporary shortfalls of oil supplies such as closure of the Straits of Hormuz. They are ill-suited to offsetting persistent shifts in the global demand for oil that are associated with long-term changes in the structure of the world economy (such as the rise of Asia as an economic power) or with fluctuations in the global business cycle. Moreover, the use of oil reserves in an effort to stabilize the price of oil would make the EU economy even more vulnerable to oil supply disruptions in the Middle East. It is recommended instead that these reserves be used for genuine emergencies only, as originally intended.

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How Emergency Oil Stocks Fit the General Oil Challenge

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EXECUTIVE SUMMARY

The challenge in today's oil market has three dimensions – volatility, the end of cheap oil and growing environmental pressures. It is the issue of volatility where oil stocks might play a role. Volatility has two aspects – immediate physical availability and price volatility, both clearly linked. The key for the EU is that price volatility has increased and security of supply has moved up the policy agenda. Oil stocks can be categorized as primary, secondary and tertiary. They are held to ensure security of supply and – more controversially - as a possible mechanism of price management. In general the quality and accuracy of stock data are poor.

The usage of stocks held by the IEA, the US and the EU has been mixed but generally poor. Furthermore, they have yet to be tested in a real emergency. There is a debate whether stock release should be ruled based or discretionary.

Stocks can be held by private companies or governments (or both). Private stocks are held for operational reasons although the volumes for this have been reduced. Private stocks are also held for speculative motives although in recent years this motive has weakened as companies are less able to benefit. Governments hold stocks for strategic reasons to be able to run the military and emergency services. They may also hold them to influence prices although the record has been extremely poor.

There is clearly a need to refine, clarify and harmonize the rules by which stocks can be used. However, excessive reliance on rules is dangerous since crises can vary enormously in their nature and flexibility is required.

The issue of an optimal size for reserves and the issue of coordinated release is dominated by the presence of market failure, in particular the fact that stocks involve strong elements of a "public good". The problem is that any stock release by one country benefits all because of the fungible nature of international oil markets. Thus there is a strong incentive for governments to "free ride" i.e. let others bear the cost of storage. What is clear is that cooperation in creating stocks among a large group of countries increases the optimal size of reserves compared to the optimal size for individual countries. The argument that self interest would create a coordinated stock release without intervention is flawed.

There are measures to improve the effectiveness of rules, not least to ensure existing rules are actually observed. Two other issues concern increasing the coverage of the IEA's scheme to include OPEC and other large consumers currently not IEA members and the need for credibility and coherence in managing stocks. Finally the report argues that the EU stock holding system would be far better and more effective if merged into the IEA's system. Arguments for maintaining a separate EU system of stock holding can easily be refuted.

1. INTRODUCTION

The starting point for analysis is to try and define what is meant by the "oil challenge". The challenge in today's oil a market has three dimensions – volatility, entering the era of an end to cheap/easy oil and growing environmental pressures.

Environmental pressures relate not only to greenhouse gas emissions and climate change but also increasingly to problems of urban air pollution arising from the growing use of liquid fuels in the transportation sector, especially in developing countries. The end of the era of cheap oil has two dimensions[2]. The first relates to geological or "below ground" constraints. This links to ideas associated with "Peak Oil" and the general depletion of conventional oil resources[3]. The second concerns "above ground" constraints which relate to oil inaccessible for political reasons ranging from sanctions to the spread of "resource nationalism" and supply shortages arising from a lack of investment both by international oil companies (IOCs) and national oil companies (NOCs)[4].

Both these challenges are important and require serious policy attention aimed at encouraging substitution to cleaner fuels including squeezing more out of conventional oil sources since the unconventionals, for the most part, are a disaster in terms of CO2 emissions and generally improving energy efficiency. However, there is little role for oil stocks in the agenda for solution[5].

It is the first challenge – volatility – where oil stocks can play a role. Oil market volatility has two dimensions, both obviously linked. The first is immediate physical availability of oil products. Sudden physical shortages create problems in terms of an impact on economic output in terms of "outage costs" and, in its more extreme form, an inability to operate the military, police and emergency services. The second dimension is crude and product price volatility. This creates macro economic problems and potentially problems of fuel poverty[6].

These two elements of volatility – availability and price - are linked by virtue of the two markets for oil. The wet barrel market is where producers sell and refiners (or distributors) buy physical barrels of crude oil (or products)[7]. The paper barrel or futures markets are where promises to deliver and take delivery are made. The links between the two markets are complex but can be simplified to the following. The wet barrel market looks to the paper markets to signal what prices might be while the paper markets look to the wet barrel market to indicate surplus or shortage and on that basis drive futures prices.

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[2] A good exposition of some of these issues is provided by Shell, 2008. These scenarios discuss three "hard truths" which set the context for the future – 1. A step change in energy use as countries such as China and India take off in development terms. 2. Supply will struggle to keep pace as large mature fields face accelerating natural decline rates. 3. Environmental stresses are increasing especially in the context of climate change.

[3] The term conventional is used to distinguish from other sources of liquid fuels such as those from tar sands and shales; heavy bitumen; coal and gas to liquids; and biofuels.

[4] For example see Stevens, 2008.

[5] Interestingly, as will be developed below, part of the IEA's International Energy Programme (IEP) requires governments to have contingency plans to address all three – squeezing more from conventionals; increasing fuel substitution and demand reduction; as well as stockpiling as part of the plans for dealing with emergency supply disruptions.

[6] Fuel poverty is commonly defined as a situation where households spend more that 10 percent of the income on fuel.

[7] This is sometimes referred to as the "fundamentals". However, this is misleading since it implies that physical supply and demand are the only things which matter. This is not the case.

These two elements of volatility also provide a definition of security of supply. While this means many different things to many different people it is usually defined as ensuring adequate physical supply at affordable prices. Thus the threat is a short term physical or supply discontinuity.

The latter can be the result of a geo-political event such as the Arab oil embargo of 1973 or Iraq's invasion of Kuwait in 1990; an accident such as the Pipe Alpha disaster in the North Sea in 1988; or some form of weather disruption such as Hurricanes Katrina and Rita in 2005[8].

An important question is how far, from the EU point of view, this sort of volatility is increasing in recent years and as a result how far security of oil supply has moved up the agenda of concerns. Several reasons support the view that this is indeed the case. First, EU oil import dependency is rising as the North Sea oil production plateau declines. In 2006, 85 percent of EU oil consumed was imported from third countries. By 2030 this is expected to rise to 93 percent (EC, 2008). Second over the last few years there has been periods when there has been a serious disconnect between wet and paper barrel markets such that the "money managers"[9] who operate in the paper barrel markets misunderstand the wet barrel market with the result that oil prices over or undershoot. Thirdly, all forecasts imply that there will be growing dependence upon the Middle East for oil supplies simply as a result of the location of proven conventional reserves[10]. All the signs are that this region (at best) is unlikely to become less politically unstable than in recent years.

It is in this context of the challenge of justified growing concerns about security of supply that the issue of oil stocks becomes highly relevant. The economics of oil stockpiling relates to the motives for holding stocks coupled with the costs, benefits and risks of doing so. Much of the discussion also revolves around the need for governments to intervene in stockpiling for reasons of market failure. It is these issues which form the basis for rest of this paper.

[8] It might be argued that an OPEC decision to cut production to defend prices also constitutes a discontinuity

[9] Players in the paper barrel markets are conventionally divided into commercial and non-commercial players. Commercial players are interested in wet barrels but normally the non-commercials have no interest in physical barrels. However, there is a further division within the non-commercials between "speculators" and "money managers". "Speculators" move in an out of the markets on a daily and weekly data and are interested in and benefit from short term (i.e. daily or weekly) price fluctuations. "Money managers" by contrast are seeking an investment class to invest part of their portfolios and tend to invest for the longer term. Whether this also classes as "speculation" is essentially an exercise in semantics.

[10] For example see the IEA, 2008; DOE, 2007 and OPEC 2008.

2. WHAT IS THE ROLE OF OIL STOCKS IN SAFEGUARDING SECURITY OF SUPPLY?

Security of supply has already been defined in Section 1. However, it is also important to understand exactly what oil stocks are and what their role is seen to be. There are three kinds of oil stocks –Primary, Secondary and Tertiary.

Primary stocks are those (crude and products) held by governments or oil companies (usually in large-scale storage facilities). In the case of the IEA members these are the stocks requirement by the International Energy Programme (IEP) detailed below. In addition to the stocks held by consuming countries, many producer governments also hold primary stocks either in storage depots or at sea (en route to market or slow steaming). However, the level of these producer stocks is sensitive, since they can represent a form of overproduction by OPEC members. Data on them are thus extremely uncertain. Producer stocks are also highly volatile since their purpose is to be located close to the market to take advantage of price fluctuations.

Secondary stocks are product stocks held by wholesalers in gasoline stations and small fuel depots.

Tertiary stocks are those held by the final consumer and they can range from a household's winter heating oil supplies to the gasoline motorists carry in their tanks.

There are no comprehensive data on secondary and tertiary stocks[11], but the volume of inventories held at this level can be quite significant. Also they can be volatile. Fears of impending shortages trumpeted in the media will cause consumers to increase tertiary stocks. This in turn draws down secondary stocks which also draws from primary stocks. Thus since primary stocks are the only ones formally measured by governments, often it can appear stocks are falling while all that has changed in reality is the property rights to stocks. This can sometimes mislead the “money managers” in the paper market to believe there to be a “shortages” of oil.

C**onsuming countries hold strategic stocks for two main reasons:**

1. Security of supply. Stocks provide an important cushion against unanticipated interruptions of supply.

Part of stocks are often termed **strategic stocks**. All governments need strategic stocks to ensure they can run police, emergency and military services in the event of a national crisis. Such national strategic security motives for storage of oil products have been long standing. For example, in the UK they were introduced in 1917[12] and in France in 1925 (Emerson, 2006). During the Cold War, Western Europe within the context of NATO developed a whole network of product pipelines specifically for military use. However, their very nature tends to restrict information on both their level and indeed their whereabouts.

In less dramatic mode, maintaining adequate stocks helps limit the price spike in the event of a temporary supply disruption and contain the resulting damage from “outage costs” to the macro-economy.

[11] There are estimates made in a few cases. For example,for household heating oil stocks in Germany but such data are rare.

[12] Arguably an even earlier example was the British Governments purchases of 51 percent of the Anglo-Persian Oil Company (later BP) in 1914 when the Royal Navy switched its battle fleet from coal to oil.

2. Price management. More controversially as will be discussed below, inventories can be used to manage prices in non-emergency situations. For example, following Iraq's invasion of Kuwait in August 1990 oil prices rose sharply, and the IEA came under intense pressure to use its inventories to stabilise the market. Proponents argued that the IEA should announce a price ceiling and stand ready to make crude available to prevent prices breaching this level. The IEA initially refused, stating that this type of active market management was not within its remit[13]. In the event, stocks were released on the first day of Operation Desert Storm (in January 1991), following Saudi pressure on the United States. However, the stocks were actually released into a market which was already falling, and aggravated the subsequent price collapse creating a negative precedent for future use of stocks to manipulate prices. Nevertheless, the pressure to use official holdings to manage the market and prevent prices breaching a "reasonable" upper limit remains very strong.

Stock uncertainties. The IEA in its Monthly Oil Market Report calculates stock levels as a residual from changes in supply and demand (other organisations use a similar approach). Problems arise because both supply and demand data are themselves estimated and generally of poor reliability[14]. The implied stock level is thus the difference between two very large numbers, both of which are inexact. The stock data are therefore subject to a considerable degree of uncertainty. Despite this, they play an important role in moving the oil markets. Oil traders wait and respond to the weekly release of stock estimates by the American Petroleum Institute (API) and oil prices move as a result[15]. This is despite the fact that weekly releases are notoriously unreliable because of the very short time frame for collecting the data.

There is clearly a case for developing much better data on stock holding at primary, secondary and tertiary levels. This will be discussed below.

[13] In mitigation, the IEA's Charter explicitly excludes the IEA from interfering with prices. Thus the only valid "emergency" is a physical shortage. However, it was also believed (Emerson, 2006) that the failure to release was the fear that the crisis might get worse and stocks should be held back for a "real emergency". As will be developed below this is a major problem with the release of strategic stocks.
[14] One only has to see the constant revision of demand and supply data to realize the truth of this observation.
[15] This is known as the "Thursday Effect".

3. USAGE OF OIL STOCKS TO DATE

The International Energy Agency (IEA). The IEA was formed in November 1974 as a direct response by Secretary of State Kissinger to the Arab Oil Embargo of 1973. One of its first acts was to create the IEP intended to create a multilateral response system to deal with any future supply disruptions.

The basis of the IEP was a collective response of which strategic stocks was only a part and indeed effectively a last resort. It would be triggered for any member by a reduction in oil supplies (effectively imports) of at least 7 percent. The first line of defence was a programme created by each government to reduce oil demand, switch fuel away from oil and where feasible produce a surge in production. There was a supply allocation plan for members to step in and assist any country facing a shortfall[16]. The IEA set a level of stocks in 1974 of an amount to sustain at least 60 days of consumption with no net imports. In 1975-6 this was raised to 90 days with a producer of crude oil allowed to reduce this by up to 25 percent (76.5 days). As the Second Oil Shock crisis developed the 7 percent for a member effectively morphed into a collective 7 percent.

The IEP had been developed in an oil market where the global oil flows were managed by a few major oil companies operating essentially on a bilateral basis. However, by the 1980s the oil markets had changed and the number of players in creased enormously as indeed did spot trade in the wet barrel market and paper transactions in the futures markets. At the same time, the threat began to be seen as a pricing rather than a volume problem because the new oil markets meant that supply and demand imbalances quickly translated into a price response, often over or under shooting. This rather invalidated the original command and control reaction which was embodied in the IEP to respond to a supply disruption by simply replacing volume.

In this new context in 1984, Coordinated Emergency Response Measures (CERM) were created which effectively converted the response mechanisms into a

> *"consultation process rather than a set of guidelines" (Emerson, 2006, page 3377).*

This change reflected the clear fact that there was no agreement amongst Member Countries over how collectively to deploy the reserves and maximize their role in a global market. Unlike IEP, the CERM trigger had no clearly defined trigger[17]. The stock level was also retained at a minimum of 90 days. In practise, the actual stock levels held by IEA members exceed this and in 2005, the IEA collectively held 118 days of the previous year's net imports and when stocks held by net exporting members are counted the figure rose to 152 days (Emerson, 2006). However this represents the average and the numbers of each country vary considerably.

Subsequently, CERM contingency plans were created four times. In 1991, in anticipation of the military action to liberate Kuwait a stock release was announced. In 2005, CERM released stocks in the aftermath of Hurricanes Katrina and Rita although again the release of 20 million barrels did little that was not achieved by increasing product imports and the US government relaxing the obligations under the 1990 Clean air Act (Victor & Eskreis-Winkler, 2008). On two other occasions – in anticipation of the Y2K computer problem and the imminent invasion of Iraq in 2003 - CERM contingency plans were drawn up but they were not implemented.

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[16] In this context it is important to remember that the whole system was created by the US who had been the prime target of the Arab Oil Embargo in 1973. It was clearly designed with that eventuality in mind.

[17] It is worth emphasising –see section 10 – that CERM did not replaces the IEP. Rather it was seen as a supplement to allow greater flexibility in the absence of a full scale global supply disruption.

The Strategic Petroleum Reserve This was created by US President Gerald Ford in December 1975 and began filling in July 1977.

The Energy Policy and Conservation Act (EPCA) of 1975 gave the President broad discretion to withdraw oil from the reserve in the event of a "severe energy supply interruption" which included one that "may cause major adverse impact on the national safety or the national economy". This has been interpreted to include an oil price spike. In the event of a major interruption, the administration would authorise an early draw down "in coordination with IEA allies". Oil drawn from the reserve would be auctioned on a commercial basis to the highest bidders. There is also the option to release the SPR on an exchange basis whereby companies promise to replace the oil at some future date. There are three categories of drawdown available to the President - Full Drawdown; Limited Drawdown (up to 30 million barrels); and Test Sales (up to 5 Million barrels).

Use of the SPR has been extremely erratic. At the time of the Iranian Revolution it was not used, allegedly because there was no pumping capacity to recover the stocks. In general Republican Administrations have been reluctant to use the stocks in response to high oil prices. The only release under a Republican Administration was in 2005 at the time of the Hurricanes but this was actually under the auspices of an IEA CERM release. By contrast President Clinton was more willing to use the SPR when faced with higher prices and between 1992 and 2000 there were several releases of which at least two were intended to try and reduce prices, most notoriously just before the Presidential Election of 2000. The release was intended to ease higher heating oil prices in the North East USA as a result of severe weather. However, while it did lower the New York Harbour heating oil prices this led to a narrowing of the spread between those prices and heating oil prices in Rotterdam and so inhibited greater European imports to relieves the shortages. Also the spread between New York and the US Gulf Coast did not widen enough to invoke Jones Act tankers to move crude into New York (Emerson, 2006). Thus the release actually worsened the shortage of heating oil since physical volumes did not respond to the changes in price. The cynics might argue that since the SPR release was designed only to allow the politicians to be “seen to be doing something” then it did actually achieve its objectives. Also in 1996, in order to raise revenue to reduce the Federal Budget deficit, stocks were also sold off. During the Clinton Presidency a heating oil reserve was created to try and mute prices in the North East USA during severe winters.

In 2002, the Bush Administration began filling the SPR to reach a target of 700 million barrels. The process continued despite the increasing oil prices. In President Bush’s January 2007 State of the Union Address, he called for the capacity to be increased to 1.5 billion in the “near future” (by mid 2008 it was 728 million barrels).

The EU

In 1968, the European Economic Community’s six members agreed (68/414/EEC) to maintain a minimum level of stocks of crude and products amounting to 65 days of domestic consumption. In 1972, this was increased to 90 days (72/425/EEC). This stock holding system was strengthened and clarified in 1998 (98/93/EC). It was also allowed for members to hold stocks on behalf of others.

There had been an attempt in 2002 to adopt a proposal to overhaul the EU’s energy security policies. This had several specific suggestions. To increase strategic reserves from 90 to 120 days and at the same time to give central control of them to the European Commission. To segregate a larger proportion of stocks from those held by private companies. To develop specific intervention criteria to allow stock release which would also include price triggers.

In reality, member government were simply not prepared to cede control over their strategic oil stocks and the result was that there was “little chance of this happening” (Emerson, 2006 page 3382) as indeed proved the case and the proposal was dropped.

In 2006 after much negotiation, 98/93/EC was superseded by 2006/67/EC which laid out more or less the same terms, similar to the IEA although the EU stock requirements are expressed in terms of product – gasoline, middle distillates or fuel oil or their equivalent in crude before refining. The IEA requirement does not specify the form of stocks. A key change in 2006/67/EC was that members could no longer make a withdrawal from stocks which would reduce their coverage below the minimum before a “consultation” between member states except in a “particularly urgent situation” although what this might be was left undefined.

In March 2007 the issue again came back onto the agenda and the European Council underlined the need to enhance energy security of supply for EU and members states by developing a more effective crisis response mechanism and argued that an analysis of the current system revealed flaws and a tendency among some members to free ride, an issue developed below.

Others

In recent years, others consuming countries outside of the EU or IEA context have been developing strategic stockpiles although data are sparse. China has begun to develop a strategic stocks reserve aimed at protecting refiners from volatile global crude prices. While it has certainly been building the capacity it is not at all clear that in the period of high oil prices they have actually been filling it. It seems likely that India has also been pursuing such a route. At the start of 2004 they announced the creation of a strategic reserve amounting to 15 days consumption with the ultimate target being 45 days.

In 2003, the Asia-Pacific Economic Cooperation Organization (APEC) endorsed its Energy Security Initiative (ESI) which encouraged members to develop emergency preparedness plans which might include strategic stocks although this was left as a voluntary option. The “ASEAN plus Three” grouping has also been discussion the option of strategic oil stocks.

4. IS THERE ROOM FOR IMPROVEMENT?

The first point to make is that strategic oil stock systems around the world have never been tested in anything approximating to a real emergency. The only times such emergencies have occurred was been the consequent shortages following the Iranian Revolution and the immediate aftermath of the Iraqi invasion of Kuwait. On both occasions the system was not invoked.

However, there is a sense that in general the usage and management of oil stocks has been poorly handled.

"In practise, however, strategic stocks can only boost energy security when they are handled properly. And on that front the track record of most states with large holdings is discouraging." (Victor & Eskreis-Winkler, 2008 page 1)[18]

Arguably this unfortunate since the very large stocks which have been accumulated in the OECD either under the IEA or the EU system –

"Deserve a credible deployment policy"(Emerson, 2006 page 3383)

To date this has been conspicuously absent. Two issues are paramount – whether release should be rule based or discretionary and the relationship of IEA/EU stocks to OPEC.

In most cases, the basis for a stock holding strategy is far from clear –

"Most countries have opaque and unreliable procedures governing when their governments can fill the stocks and when they can release oil." (Victor & Eskreis-Winkler, 2008 page 1)

The argument for a rule base system is that it avoids the accusation of the strategic reserves being "politicized" and used for narrow political interests rather than the greater good. However, the problem with any rule based system as that it lacks flexibility to adjust to specific circumstances. One obvious solution which has been called for (Victor & Eskreis-Winkler, 2008) is the creation of an "independent reserve board" drawn from experts who will then make the decisions although this could still be done within a range of rule based options[19]. While this clearly makes sense at a national level, for example for the SPR, at a regional level it may prove more problematic since governments tend to see such strategic oil reserves as a key national interest. This clearly underlies the reluctance of the EU members to delegate responsibility for oil reserves to the Commission following the 2002 proposals.

It is tempting to leave security of supply issues to the market and there is a general view within the oil industry itself that:-

"Energy security comes above all from well-functioning markets" (Victor & Eskreis-Winkler, 2008 page7)

This view was strongly reinforced by the loss of Iraq and Kuwait in 1990. The "doomsday scenario"[20] was a major disruption to supplies coming out of the Straits of Hormuz. However, this was perceived to be managed perfectly well by leaving it to the market. This led to considerable complacency over oil security issues.

[18] A key source of criticism was that stocks should be bought while prices are low and released while they are high whereas for the SPR since 2000 the opposite has been the case.

[19] A similar argument has been applied to the operation of monetary policy.

[20] In scenario building methodology, the "doomsday scenario" is the event with a low probability of occurrence but a very major impact if it does happen.

However, such complacency misses two key points. The first is the public good/market failure dimensions of oil stocks which will be developed in detail in Section 8 below. The other is the fact that previous disruptions occurred at a time when there was considerable spare capacity to produce crude within OPEC, notably in Saudi Arabia and the UAE which could be brought to market very quickly. OPEC spare capacity is an important part of the stocks story.

It has also been suggested (Emerson, 2006) that the nature of the stock release and possibly the criteria used for the release could be linked into the estimated spare capacity within OPEC based upon a specific numerical rule. It has also been suggested (Stevens, 2008) that a deal between the IEA/EU and OPEC is needed such that OPEC will develop and maintain a degree of spare capacity and if there is an outage, OPEC's spare capacity will be given first option to fill the gap. Informally is has been suggested this is already the case. At the time of the Venezuelan oil workers strike at the end of 2002 and the impending attack on Iraq, the IEA indicated that OPEC's spare capacity

"…would officially be the first line of defence in an emergency" (Emerson, 2006 page 3382

A final important question on improving stock holding policies relates to holding crude rather than products. For example, Iraq's invasion of Kuwait caused few problems in terms of the availability of basic crude, but the loss of Kuwait's refinery capacity with its specialised configurations caused a major shortage of middle distillates. Of particular concern is that often the global spare capacity to produce crude oil is heavy sour crude which given the current shortages of upgrading capacity is a serious problem. While it may seem obvious to solve the problem by holding stocks of oil products rather than crude this neglects the fact that oil products have a definite shelf life and, unlike crude oil, would need to experience a regular turnover which might complicate the stock holding. Although the EU system encourages stock holding of products, it is allowed to hold the equivalent in crude. Thus the EU system does not really address the refinery constraint problem.

5. WHAT ARE THE PROS AND CONS OF DIFFERENT STOCKHOLDING SYSTEMS?

GOVERNMENT VERSUS PRIVATE

Oil stocks can be held privately and/or by governments. Private stocks are defined as those held voluntarily for commercial reasons. However, since the IEA's Treaty requirements, many stocks are held in private hands on behalf of the government as a result of a requirement imposed by government regulation. Such stocks are effectively excluded from a discussion of private stocks since they are (de jure) government held stocks although in many cases they are effectively also needed for operational purposes (see below). As such they are not strictly emergency stockpiles since they could not be used without compromising the effectiveness of industry operations.

Privately held stocks

Voluntary private oil stocks are held for two commercial reasons. First, oil operations require a certain minimum level of stocks to fill the pipes and the tanks. This is for technical reasons to allow pipelines to operate effectively, distillation processes to refine, tankers to load efficiently etc. However, such stocks are also required for economic reasons. Because of the very high capital intensity of all stages of oil operations, full capacity operation of capital equipment is crucial to profitability. Operating equipment below capacity spreads these very high fixed costs over a lower throughput. This raises average fixed costs exponentially and seriously damages profitability. Thus security of supply in the various stages of the industry is crucial. One way of ensuring this continuous reliable supply is to feed the equipment from storage rather than from direct flow. Thus most refineries and loading terminals have considerable storage capacity[21].

What the "correct" level for operational stocks should be is much debated. Prior to the first oil shock of 1973, virtually all stocks held privately were for such operational reasons. Real prices were falling which would discourage stockholding for speculative purposes (see below) since a falling price trend implies negative profit from holding stocks. Thus private stock levels before 1973 could be taken as indicative of what the industry regarded as necessary for operational purposes. In the United States which is a reasonable benchmark, the industry held declining relative levels as the industry got better at managing its logistics in part as a result of the growing use of linear programming and computing in the industry (Bamberg, 2000 Chapter 13). In 1960, the US industry held the equivalent of 80 days of domestic consumption; in 1965 the figure was 72 days and in 1970 66 days[22] (Horwich & Weimer, 1987). Today, in part in response to financial pressure to reduce working capital (see below) such operational levels would be regarded as extremely high and much lower numbers would be the norm.

There is a further observation relevant to stock holding today. In the 1960s and 1970s the international oil business was dominated by a small number of major IOCs[23]. These companies were all "operationally vertically integrated"[24].

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[21] This is why most export pipelines are much less vulnerable to interruption by military action than is generally understood. This is because the pipeline does not feed directly into the export tankers (VLCCs and ULCCs) but into storage. The tankers are then loaded from this storage. So unless the authorities cannot get access to the pipeline to effect repairs terrorist would find it very difficult to halt the export flow (Stevens, 2000)

[22] In fact this still represented an increase in the total number of barrels held – 830 million barrels in 1965 and 971 in 1970.

[23] These were usually called the Seven Sisters". They were Exxon, Mobil, Chevron, Gulf, Texaco, Shell and BP. Often CFP was added to make what became known as the "majors".

[24] For a more detailed discussion of what this actually meant see Stevens, 2003.

Thus it was their own equity crude oil which was transported in their own chartered tankers to be processed in their own refineries and the products distributed via their own marketing and distribution networks[25]. Thus despite this physical chain with no paper contracts, oil companies still felt it made sense to maintain real physical stocks. This is important when the issue of physical stocks versus "tickets" is discussed below.

The second commercial motive for holding private oil stocks would be for speculative gain. This would require buying oil cheaply now to store, selling it at higher prices in the future. This makes sense if the difference between the expected future price and the current price covers the transactions costs of buying the oil plus the storage costs. However, holding stocks by private companies for speculative motives carries several risks. The most obvious is that the future price falls, leaving the stock holder facing a lower value to the stock assets. A variation is if price fails to rise leaving the stock holder to cover the costs of stock holding. Another major risk is that in the event of a disruption and higher oil prices, governments introduce price regulation to prevent the stock holder taking advantage of the higher prices by "profiteering" and hence benefiting from their "foresight" in holding stocks. A variation on this theme is not actual price regulation but "moral pressure" from consumers and governments. This results in damage to the corporate reputation if companies are seen to be "profiteering" from supply disruptions. This has been a relatively common reaction in the OECD and over the last 20 years has been a major inhibitor to private stock holding[26].

There are several important questions with respect to private stock holding. Since the oil price collapse of 1986, the industry has had a growing struggle to increase shareholder value by reducing working capital. Holding oil stocks is an important element of working capital for companies. In recent years, there has been a growing tendency to reduce operational stock levels and move closer to a "just-in-time" system of inventory management. Thus the trend of private oil stocks has been for them to be progressively lower although it is far from clear how far lower stocks (compared to history) can be attributed precisely to this trend.

Another question concerns the impact of the development of futures markets for oil and oil products. In theory, both operational and speculative motives can be met by buying paper barrels rather than buying wet barrels and storing them, providing the paper barrel requires physical delivery. For operational purposes it makes absolute sense to buy paper barrels rather than wet for "storage" if the futures market is in backwardation. When the prompt price is higher than the futures price it makes no sense to secure a barrel for use in three months by paying a high price today and paying to store it when the barrel can be bought at a lower price than today with the only storage involving a piece of paper[27]. Even if the market is in contango i.e. the future price is above the prompt price, the difference between the prompt and future price may be large enough to offset the cost of storage encouraging paper barrels to be purchased for "stocks". The rise of paper markets for oil in the last 10 years is another major explanation of why privately held oil stocks are generally, allowing for regulation, much lower than they used to be given that "backwardation tends to be viewed as the normal state of nature in paper commodity markets. The paper markets also discourage holding physical stocks for speculative purposes. It is much cheaper to hold a piece of paper rather than a barrel of oil.

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[25] Of course the relative capacities were in many case unbalanced. Some companies such as BP were "crude long" and had access to more equity oil than refineries. Some such as Shell were "crude short" and had more refinery capacity than equity crude.

[26] As will be developed below, the rise of the future markets has also complicated the issues of oil stocks held by private companies

[27] This of course neglects an issue to be developed below that if you put a piece of paper promising delivery of oil into a car tank, it will not get very far!

Government held stocks

Governments hold oil stocks for a number of reasons[28]. There is the requirement for strategic stocks to run the military and emergency services already alluded to. Governments might also hold stocks to limit the economic damage arising from physical shortage of oil into the economic system. These economic costs are effectively the "outage costs" if the economic system is forced to operate below capacity because of a physical shortage of oil products.

More formally is the IEA (or indeed EU) member countries Treaty requirement to hold stocks – minimum 90 days consumption - to meet their legal obligations under the Emergency Sharing scheme of the IEA.

There may also be political motives for holding stocks. These might range from political or foreign policy considerations to fulfilling some sort of "leadership role". For example, such considerations are central to Saudi Arabia's stock holding policy, much of which involves overseas storage or slow steaming to provide an instant mechanism to supply markets to mute price rises without the usual lag imposed by travel time[29].

Governments might also be tempted to hold stocks in an attempt to stabilize oil prices. Price spikes also carry a cost to the economy in terms of their macro-economic impact on GDP, balance of payments etc. However, using stocks to stabilize oil prices is controversial since it involves government intervention in the market place which many would regard as dangerous and undesirable. As already outlined, in the aftermath of Iraq's invasion of Kuwait in 1990, the IEA attracted a huge amount of criticism for not using the stocks to try and mute what was seen as a very short term mini-price spike. In both Japan and South Korea the government has in the past swapped strategic reserves with commercial oil companies to try and insulate companies from short term price spikes (Emerson, 2006) [30]. In general, attempts by governments to control commodity prices have proved to be largely ineffective[31] and oil appears to be no exception to this rule[32].

[28] APEC, 2004 lists six advantages to government held oil stocks. However, it noticeably fails to discuss the disadvantages arising from politicization which will be discussed below.

[29] A central part of this policy is the decision since 1985 to carry a significant amount of excess capacity to produce crude oil. An issue discussed later.

[30] South Korea also had an oil stabilization fund which was used to protect the government administered crude price from extremes of volatility. Thus when crude prices were low the fund was filled, when high depleted and the administered price held constant.

[31] For a comprehensive examination of the costs and benefits of various commodity stabilization schemes (which have a very long history) see Greenaway & Morgan (1999), especially Part III.

[32] This is a view strongly reinforced by Kilian, 2008 in the context of EU stock control.

6. PHYSICAL STOCKS VERSUS "TICKETS"

The EU system allows a country to hold stocks on another member's territory provided a bilateral intergovernmental agreement exists. For example, in 2007, Denmark, Ireland and Sweden all held some of their stocks in the UK under a series of bilateral deals. Across the EU there are 40 such agreements in place with 10 under discussion (EC, 2008).

It is also estimated that around 11 percent of emergency stocks are held through "ticket" arrangements where by the stocks are owned and physically stored by another country (EC, 2008). These tickets entitle the holder to buy the stock in a crisis situation at the price stated in the agreement. Such agreements tend to be done on a three month basis. The advantage is that it removes the cost of storage from the ticket holder although this would be implicit in the agreed price. It also helps to get round the problem mentioned earlier that oil products have only a limited shelf life so "ticketing" allows a regular turnover of the product. However, the obvious problem is that with the best will in the world, a "ticket" as a piece of paper will not power a vehicle or an aircraft. In other words such a system is vulnerable to the view which has wide currency in the context of the IEA's schemes that in the event of a major global emergency affecting oil supplies, it is unlikely that agreements will be kept in a context of a scramble for oil supplies (Horwich & Weimer, 1987). This also appears to be the view of some in the Commission. Thus "… there is practically no experience with these of "tickets" in a supply disruption. Critics may assume that, depending on the specific supply disruption, it will be very difficult or even impossible to purchase the reserved oil" (EC, 2008 page 13).