PIRINC

You may be interested.

PIRINC has prepared the enclosed report, *Why Do Oil Prices Jump So High When Supply Glitches Occur?*

In recent years, consumers have seen oil prices move up dramatically in response to supply shortfalls. The reason for the sharp increases seems to be that consumer responsiveness to changes in oil prices, or price elasticity, is very low, so that disproportionate increases are required to clear the market when supply problems occur. This indeed appears to be the case for the oil barrel as a whole. After all, the price of crude oil this year to date is more than double its average for 2003---$67/barrel for WTI this year versus $31 in 2003---while overall oil demand appears to be up by about 3%. Of course higher levels of economic activity and income would, other things equal, push up demand and GDP this year is up by about 10% versus 3 years ago. Nonetheless, the evidence is clear, oil is tough to cut back on. Moreover, it is tougher than it used to be, suggesting even greater price movements are required today than in earlier periods to clear markets in response to supply changes.

With respect to oil overall, price responsiveness has declined because consumption of the most readily substitutable oil products, primarily residual fuel oil and non-transport distillate, fell off years ago. A greater share of the oil barrel goes to transport where substitution possibilities. Moreover, certain powerful trends, decentralization, the related limited availability of public transit alternatives outside certain large cities add to the difficulties of cutting back on road fuels. However, what constitutes road fuel is changing as a result of government incentives and outright mandates. In the case of gasoline, policies favoring ethanol are reducing its average petroleum content. More prospectively the petroleum content of diesel will also be reduced via policies favoring biodiesel.

Since the end of oil price controls in 1980 the US has been among the best performers in reducing its energy and oil intensity. Over the past 25 years, the amount of oil required to produce a unit of GDP has nearly halved. However, the price elasticity of demand for petroleum products has also declined so that today, prices need to rise by approximately twice as much to clear a given volume of supply loss. Thus the US economy, in terms of dollar impact, is about as vulnerable today to a given supply disruption as earlier, despite its lower level of oil intensity. "Plus ça change, plus c'est la même chose."

If you have any questions or comments, please contact Larry Goldstein or Ron Gold.

November 2006

Petroleum Industry Research Foundation, Inc.
3 Park Avenue • 26th Floor • New York, NY 10016-5989
Tel.: (212) 686-6470 • Fax: (212) 686-6558

Why Do Oil Prices Jump So High When Supply Glitches Occur?

Summary

In recent years, consumers have seen oil prices move up dramatically in response to supply shortfalls. The supply problems associated with Hurricane Katrina in 2005 saw average gasoline prices rise by nearly 50 cents/gallon within a week. Between mid-March and mid-April, of this year gasoline prices also shot up by nearly 50 cents/gallon, this time as a result of problems associated with the rapid growth in requirements for ethanol (coupled with the rapid phase-out of MTBE) and the more stringently formulated blendstock for reformulated gasoline that could be blended with it. The reason for the sharp increases seems to be that consumer responsiveness to changes in oil prices, or price elasticity, is very low, so that disproportionate increases are required to clear the market when supply problems occur.[1] This indeed appears to be the case for the oil barrel as a whole. After all, the price of crude oil this year to date is more than double its average for 2003---$67/barrel for WTI this year versus $31 in 2003---while overall oil demand appears to be up by about 3%. Of course higher levels of economic activity and income would, other things equal, push up demand and GDP this year is up by about 10% versus 3 years ago. Nonetheless, the evidence is clear, oil is tough to cut back on. Moreover, it is tougher than it used to be, suggesting greater price movements are required today than in earlier periods to clear markets in response to supply changes.

With respect to oil overall, price responsiveness has declined because consumption of the most readily substitutable oil products, primarily residual fuel oil and non-transport distillate, fell off years ago. A greater share of the oil barrel goes to transport where substitution possibilities are limited, at least for the near to medium term. Moreover, certain powerful trends, decentralization, the related limited availability of public transit alternatives outside certain large cities add to the difficulties of cutting back on road fuels. However, what constitutes road fuel is changing as a result of government incentives and outright mandates. In the case of gasoline, policies favoring ethanol are reducing its average petroleum content. More prospectively the petroleum content of diesel will also be reduced via policies favoring biodiesel.

Since the end of oil price controls in 1980 the US has been among the best performers in reducing its energy and oil intensity. Over the past 25 years, the amount of oil required to produce a unit of GDP has nearly halved. However, the price elasticity of demand for petroleum products has also declined so that today, prices need to rise by approximately twice as much to clear a given volume of supply loss. Thus the US economy, in terms of dollar impact, is about as vulnerable today to a given supply disruption as earlier, despite its lower level of oil intensity. "Plus ça change, plus c'est la même chose."

Changes in the Oil Barrel

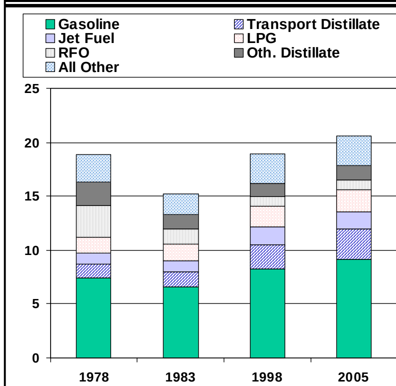
In 1978 the year before the Iranian revolution and the onset of the second oil crisis, US oil consumption reached a peak of 18.8 MMB/D. By 1983, demand had fallen nearly 20%. Demand did not fully recover to its former peak until 1998. Demand has risen further since then,

[1] This issue was previously discussed in the PIRINC report, "Rising Gasoline Prices: Made in the USA," released May 2006 and available on the PIRINC website at: www.pirinc.org/publications.html.

averaging 20.7 MMB/D in 2005. The left panel of the chart looks at total oil demand and its major components for the years, 1978, 1983, 1998, and 2005.

On the eve of the second oil crisis, and even more so now, gasoline was the most important petroleum product, accounting for nearly 40% of total product demand. Second in importance was residual fuel oil (RFO). In 1983, recession, the aftereffects of the second oil crisis, and the ongoing effects of rising CAFÉ standards combined to push down overall demand by 3.6 MMB/D, a decline of nearly 20%.[2] Although gasoline use declined by about 0.8 MMB/D or about 10%, its share of total demand actually went up to 43% of total demand. Gasoline's growth in relative importance resulted from the sharp declines in demand for RFO and non-transport distillate. Demand for each of the two fell by more than 50%. Their combined volumetric decline amounted to nearly 2.5 MMB/D, about triple the volumetric decline for gasoline.

Trends in US Oil Consumption by Product
Selected Years: MMB/D



Changes – MMB/D	78-98	98-05
Gasoline	+0.8	+0.9
Trans. Dist	+1.0	+0.6
Jet Fuel	+0.6	+0.0
Subtotal	+2.4	+1.4
LPG	+0.5	+0.1
RFO	-2.1	+0.0
Oth. Dist	-1.0	+0.1
Subtotal	-3.1	+0.1
All Other	+0.2	+0.1
Total	+0.1	+1.7

The sharp declines in residual fuel oil and non-transport distillate reflect particularly the improved availability of an alternative, natural gas. The improvement in gas supplies in turn resulted from the unwinding of the price controls on interstate gas that had been discouraging exploration and development and constraining shipments. Gas backed out large volumes of residual fuel oil from the power sector as well as lesser volumes of distillate. Gas also replaced distillate for residential and commercial heating as new and replacement heating systems were installed.

Share of Transport Fuels in the Oil Barrel

	1978	1983	1998	2005
Gasoline	39%	43%	44%	44%
Transport Distillate	7%	9%	12%	14%
Jet Fuel	6%	7%	9%	8%
Total	52%	59%	64%	66%

It took twenty years but in 1998, overall oil demand returned to its 1978 peak. However, its composition was very different, with transport fuels far more important than before. As illustrated in the table, gasoline's share of the barrel was up to 44%, significantly above its 1978 share of 39% and slightly above its 1983 share. The two other fuels, distillate for transport, mainly road diesel, and jet fuel grew significantly in importance, rising together from about 13% of the barrel in 1978 to 21% in 1998. Together with gasoline, the three accounted for 64% of total

[2] The Energy Policy Conservation Act of 1975 established CAFÉ standards for passenger cars and light trucks with the goal of doubling average new car fuel economy by model year 1985. The new car standards established by the Act started at 18 MPG for model year 1978, rising to 19 in 1979, 20 in 1980 and rising to 27.5 for model year 1985. The Act did not set a specific standard for light trucks.

demand and, as shown in the right panel of the chart above, total demand for these three transport fuels in 1998 was up by 2.4 MMB/D versus 1978. Demand for RFO and non-transport distillate was down versus 1978 by 3.1 MMB/D. Moreover, their 1998 levels were below their 1983 levels by a combined total of nearly 0.7 MMB/D, indicating ongoing competitive losses to gas. The chart also shows growth in another product category, LPG. While some is used in residential/commercial heating in areas where natural gas is not available, most is used as chemical feedstock. A minimal amount is also used as an alternative road transport fuel.

Between 1998 and 2005, oil consumption rose by about 1.7 MMB/D, with most coming in gasoline and transport distillate. The latest figures suggest that most of the easier substitution possibilities, namely gas for oil in power generation and heating have already taken place. Moreover, residual fuel oil and to a certain extent distillate have taken on a critical backstop role in US electricity production by their availability for use when gas supply problems and price spikes develop. This role was demonstrated most recently in the aftermath of hurricane Katrina in 2005. At such moments, with gas supplies curtailed, price elasticity becomes for all practical purposes virtually zero.

With oil demand concentrated in the transport fuels where substitution possibilities are far more limited, the net result is a secular decline in overall price elasticity of demand for the oil barrel as a whole. In this regard, accepted estimates of overall short-term price elasticity for the 1980s ranged between -0.15 to -0.2. Estimates for the current period range between -0.08 and -0.1, or roughly half the earlier estimates. Although the US has about halved its use of oil relative to the overall size of the economy since the second oil crisis, the lower current price elasticity is offsetting much of the reduction in the economy's vulnerability, in terms of immediate dollar impact, to supply problems. For example, a 5% reduction in oil supplies (about 1 MMB/D) would require an overall price increase of about 30% to balance demand with supply assuming a price elasticity of -0.2, but a price increase of about 67% if the price elasticity is -0.1.

Apparent Price Elasticity for Transport Fuels

The price spikes associated with the first and second oil crisis, as well as the Iraqi invasion of Kuwait in 1990 were each followed by recession, which in turn helped pull down oil demand in the transport as well as other sectors. The two oil crises also came at a time when price controls were still in effect, holding down retail prices somewhat but at the cost of outright shortages at the pump. In 1990, lingering memories of previous shortages still impacted the demand response at the onset of that crisis. A cursory look at price changes and volumes consumed, without allowing for these other factors would thus overstate significantly consumer responsiveness to price change. The working through of the rising CAFÉ standards through 1985, would, unless specifically allowed for, also tend to bias apparent price elasticity upward.

Certain secular tendencies, the overwhelming reliance of the country's population on private as opposed to public transport options, the continued shift of freight transport other than bulk commodities in favor of trucks and air as opposed to rail and ship limit near-term substitution options among transport modes.

The past few years has seen sharp spikes in gasoline prices over and beyond what was happening to crude prices. Yet gasoline consumption has at most flattened as opposed to declining outright as happened in previous decades. Part of the answer is continued positive economic growth, offsetting part of the negative effects of higher prices on consumer incomes. Another is that with free-market pricing, there have been no outright shortages to scare consumers away from the pumps (apart from some very limited spot shortages right after hurricane Katrina).[3] Both factors however mean that a given supply problem will produce a sharper gasoline price increase since consumer responsiveness will not be magnified by these considerations.

A recent working paper released by the National Bureau of Economic Research presented estimates of price and income elasticity for gasoline for two periods 1975 to 1980 and 2001 to 2006.[4] The paper reported significant differences in price elasticity for the two periods. For the first period, estimates ranged from –0.21 to –0.34, while for the second, estimates were much lower, ranging from –0.034 to –0.077. Estimates of income elasticity for both periods, ranging from 0.21 to 0.75, were not significantly different. These recent estimates provide further evidence of the very limited short-term responsiveness of consumers to higher gasoline prices and of a significant decline in apparent price elasticity versus earlier periods.[5]

In one area however, the composition of road fuels, substitution possibilities are being generated by government policy. The Energy Policy Act of 2005 established a national (48 state) Renewable Fuels Standard that requires the gasoline pool to contain minimum volumes of renewable fuel rising from 4 billion gallons this year, or nearly 3% of the gasoline pool to 7.5 billion in 201, about 5% of the expected pool and to maintain that share into the future. The new Congress is almost certain to accelerate the process and raise the ultimate limit. In effect gasoline (including E85) will become less oil-intensive. If renewable sources, mainly ethanol, become sufficiently plentiful, there could be possibilities for substitution beyond the mandated levels. To date however, ethanol has had price spikes of its own. Moreover, as it grows in importance, its supply would become vulnerable to variations in the corn crop and corn prices,

---

[3] The share of GDP devoted to energy has gone down over time but "Globalization" may also get some credit here for the limited impacts on economic growth. With greater competition, the secondary inflation effects of higher energy prices have become more muted, lessening the prospects for a restrictive policy response. The potential negative impacts on international trade have been reduced by the enormous build-up of reserves by previously vulnerable countries. At the end of 1997, the eve of the developing country financial crisis, India' reserves ex gold stood at $27,billion at the end of 2005 they stood at $132 billion. For Thailand, the comparable figures are $26 billion and 51 billion, and for Korea, $20 billion and $210 billion.

[4] Jonathan E. Hughes, Christopher R. Knittel, Daniel Sperling, **Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand**, National Bureau of Economic Research Working Paper 12530, September 2006.

[5] The word "apparent" is used deliberately here since the methodology for estimating price elasticity for the two periods has problems. The use of average retail prices works well during the free-market period, 2001-06 but not 1975-80 when under price controls average prices understated marginal costs of gasoline, especially following the Iranian revolution and subsequent supply losses. Moreover, while the authors try to allow for special supply considerations in 2001-06---curtailments of Venezuelan, Iraqi, and US hurricane-related supply---they do not include the sudden loss of Iranian supplies that took place during the first estimation period. Between September 1978 and early 1979, Iranian crude production fell from 6.1 MMB/D to 0.7 MMB/D before recovering somewhat. Iranian production for all of 1979 averaged about 60% of its 1978 average while1980 production averaged about 30% of the 1978 level. Beginning in October 1980, the onset of the Iran-Iraq war there was an abrupt decline in Iraqi production and a fall-back in Iranian production.

and therefore subject to price fluctuations independent of developments in the world crude oil market.