Oil, Oil, Toil and Trouble? *

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We have all re-familiarized ourselves to the price of oil. Amid concerns about a summer "soft-patch" in U.S. economic activity, the rise in oil prices this Fall has created concern that it could place further hurdles in the path of our economic future. Now, we have had these ups and downs in the price of oil before so you would think that economists would agree to how changes in the price of oil affect the U.S. economy. But you would be wrong.

The reason for the disagreement among economists on the question of the relationship between the price of oil and macroeconomic activity is that it turns out to be more complicated than you think. So before turning to some of the empirical issues in this debate, let's talk about the economic issues first. Let's start with demand and supply and let's also keep in mind that the U.S. is an oil-importing country. Now we all know from our Economic Principle's class that a price can rise for one of two reasons: the first is a rise in demand and the second is a fall in supply. So if the price of oil is rising because of rising world-wide demand for oil (U.S., Europe, China, India, etc…) then we should see a rise in prices and in the volume of oil being produced. And a rise in the world-demand for oil is likely to go hand-in-hand with a rise in the world-demand for all goods and services which is likely to help the U.S. economy, not hurt it. So suffice it to

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say that a demand induced rise in oil prices is unlikely to be a significant adverse development for the U.S. economy.

Alternatively, the price of oil could rise because of a reduction in supply. In the 1970's we had several experiences with abrupt, negative developments on the supply-side of oil. Twice during this decade the U.S. was hit with embargoes that created situations of rationing and long lines at the gas pump that seriously impaired our ability to produce goods as well as threatened our economic sense of well-being. And during these episodes, unlike our current experience, declines in the volume of oil in the U.S. were associated with higher prices, sure signs of a supply-induced rise in oil prices.

Of course, the actual current volume of oil consumed in the U.S. does not need to fall for the supply side of the oil market to make the price of oil rise. Indeed, anticipated supply disruptions can also raise the price of oil even if the actual disruptions never materialize. For example, recent political turmoil in the Middle East, Venezuela and Nigeria has led to uncertainty over the likelihood of future supplies of oil, which has contributed to the rise in the current and futures price of oil. In the end, however, actually adverse shifts in the supply of oil have more deleterious effects on U.S. economic activity than anticipated ones.

As the above discussion indicates, the inability to distinguish between demand and supply developments is an important reason for why there is not a straightforward link between high oil prices and economic activity. But there are additional complications as well. For instance, another issue that can affect how oil prices relate to economic activity is whether the development is temporary or permanent. Obviously, a permanent supply disruption would affect the U.S. economy more than a temporary one. Second, the

ease with which producers and consumers can vary their usage of alternative energy inputs will also affect the extent to which oil price increases negatively impact producers and consumers. In particular, it is viewed by many that the reason why the U.S. economy has become relatively more immune from oil price shocks is that producers have become more flexible in their use of energy inputs and consumers have a wider variety of vehicles and appliances to chose among. Finally, oil prices may rise just because the U.S. economy is performing extraordinarily well, an issue that is referred to as "reverse-causality".

Sorting out the empirical evidence, however, is never easy. While economists such as Professor James Hamilton of the University of California, San Diego argue that oil price increases consistently lead to economic slowdowns in the U.S., there are others such as former Federal Reserve Economist Mark Hooker that argue that this empirical relationship disappears after the early 1980's.[1] Moreover, Economists also argue over additional issues such as whether the economy is affected by positive oil price shocks but not negative oil price shocks (so called `asymmetry') , and whether volatile oil markets also have an independent and negative influence on economic activity.

Of course, statistical analysis cannot resolve all of these issues with certainty. It cannot, for example, unequivocally identify supply issues from demand ones. Also, statistical analysis may not be very good at recognizing when an empirical relationship has changed or broken down. What empirical work can do, however, is to estimate average responses of variables to movements in other variables. And such analysis can

[1] For example, see the following papers: Mark A. Hooker (1996), "What Happened to the Oil Price-Macroeconomy Relationship?, Journal of Monetary Economics, vol. 38, pp.195-213. James D. Hamilton, "This is What Happened to the Oil Price-Macroeconomy Relationship," Journal of Monetary Economics, volume 38, pp. 215-220.

provide a reasonable benchmark for understanding the risks the U.S. economy faces going forward.

To provide a benchmark, a standard empirical approach for examining whether changes in oil prices affect real GDP is using a statistical technique called a vector autoregression (VAR). In a VAR, the dynamic empirical relationships between a set of variables is estimated in the data, and the dynamic response of all the variables to a movement in one of the variables can be traced out over time. For the case of oil, typically researchers look at a VAR with four variables: real GDP, overall prices, the price of oil and the federal funds rate (as a measure of monetary policy).[2]

I have estimated a VAR using data from the Greenspan era, 1987:3 to 2004:2. To isolate the impact of oil prices on the data, Figure 1 presents the impact of a one standard deviation shock to the price of oil on output, prices and the federal funds rate. Note that the movements in all the variables are reported in annualized percentage point changes. The top left graph present the dynamics of a one standard deviation to oil prices (approximately a change of 60%) which would be like the short term price of oil moving from a baseline of $30 per barrel to $48 per barrel. This experiment is roughly consistent with the recent run-up in oil prices. The dark line is the average dynamic response although the dashed lines are the 95% confidence interval around that average response. The bottom left graph is the dynamic response of real GDP in percentage points to the change in oil prices. The top right graph is the dynamic response of prices in percentage

[2] The first three variables are reported in natural log levels so that changes in the variables can be thought of as percent changes. The measure of overall prices is the GDP price deflator and the federal funds rate is the value of the federal funds rate on the last day of the quarter. The price of oil is the value of a barrel of West Texas Intermediate on the last day of the quarter. The model is estimated using data during the Greenspan era: 1987:Q3 – 2002:Q3 and a constant and two lags of each variable is included in the VAR. I have also ordered the variables from most exogenous to least exogenous as follows: real GDP, prices, oil prices and the federal funds rate.

points to the change in oil prices. The final graph is the dynamic response of the federal funds rate to the oil price shock.

The estimated "impulse responses" to the variables from a 60 percentage point shock to oil prices demonstrate three main facts. First, the impulse response indicates that the effect of the oil price change on real GDP output is a fall in output of approximately 1 percentage point from the second to sixth quarter. Second, there is a significant rise in prices on the order of approximately 0.5 percentage points on an annual basis that feeds through the economy from the second to sixth quarter. Third, consistent with recent Federal Reserve behavior, the Federal Funds rate is suppressed approximately 0.375 percentage points in response to the rise in oil prices. This result is consistent with my earlier SOMC memo on the FOMC's reaction to oil price changes.

In summary, the estimated empirical effects from the oil price change are as follows: a small temporary decline in output and the federal funds rate, and a small temporary rise in prices.

As a final note, I benchmark this empirical evidence to recent survey evidence of the effect of oil price changes on output forecasts. In the Wall Street Journal's October 8th-12th 2004 survey of economists, they asked the following question:

> ***Oil recently climbed above $50 a barrel for the first time. If crude-oil prices remained in the following ranges for an entire quarter, by what amount would you reduce or increase your forecast for real GDP (annualized rate) for that quarter:***

The response was that if oil remained in the $40-49 a barrel range, they would lower their forecast of real GDP by -0.09 percentage points at an annual rate. These numbers rise to

a fall of -0.45 percentage points if the price is in the $50-59 range and -0.93 percentage points if the price of oil is in the $60-69 range.

Summary

The evidence I provide suggests that the typical effect from the current 60% rise in oil prices should lead us to shave our estimates of recent and future growth by approximately 1 percentage point on an annual basis. Trouble, but certainly not big trouble for the U.S. economy. In addition, current circumstances suggest that the actual impact should be less than this. The primary reason for the muted impact on the U.S. economy is that a large part of the current rise in oil prices likely stems from an increase in the world demand for oil, rather than from a sharp decline in its availability. While the latter poses difficulties for the U.S. economy, the former is likely to be associated with a rise in world demand which should keep U.S. economic activity buoyant.

Figure 1: Impulse Responses for Variables: 1987:Q3 to 2004:Q2

Shock to The Price of Oil (with 95% Confidence Intervals)