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Oil and the Macroeconomy Since the 1970s

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Economists have long been intrigued by empirical evidence that suggests that oil price shocks may be closely related to macroeconomic performance. This interest dates back to the 1970s. The 1970s were a period of growing dependence on imported oil, unprecedented disruptions in the global oil market and poor macroeconomic performance in the United States. Thus, it was natural to suspect a causal relationship from oil prices to U.S. macroeconomic aggregates. Since then, a large body of work has accumulated that purports to establish this link on theoretical grounds and to provide empirical evidence in its support. We do not attempt a comprehensive survey of this literature, but rather provide an idiosyncratic synthesis of what we view as the key issues in this debate and the insights gained over the last 30 years.

The timing seems right for such an account. Although the experience of the 1970s continues to play an important role in discussions of the link between oil and the macroeconomy, there have been a number of new "oil price shocks" since the 1970s, notably the 1986 collapse of oil prices and the 2000 boom in oil prices as well as the oil price increases associated with the 1990–1991 Gulf war and the 2003 Iraq war. Given this richer case history, we are arguably in a better position than two decades ago to distinguish the idiosyncratic features of each oil crisis from the systematic effects.

Increases in oil prices have been held responsible for recessions, periods of excessive inflation, reduced productivity and lower economic growth. In this paper, we review the arguments supporting such views. First, we highlight some of the conceptual difficulties in assigning a central role to oil price shocks in explaining

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Table 1
The Coincidence of Oil Dates and Recessions after 1972

Business cycle peak	*Events associated with subsequent major oil price increase*
November 1973	October War and Oil Embargo October 1973–early 1974
January 1980	Iranian Revolution October 1978–February 1979
July 1981	Outbreak of Iran-Iraq War September 1980
July 1990	Invasion of Kuwait August 1990
March 2001	OPEC Meeting March 1999

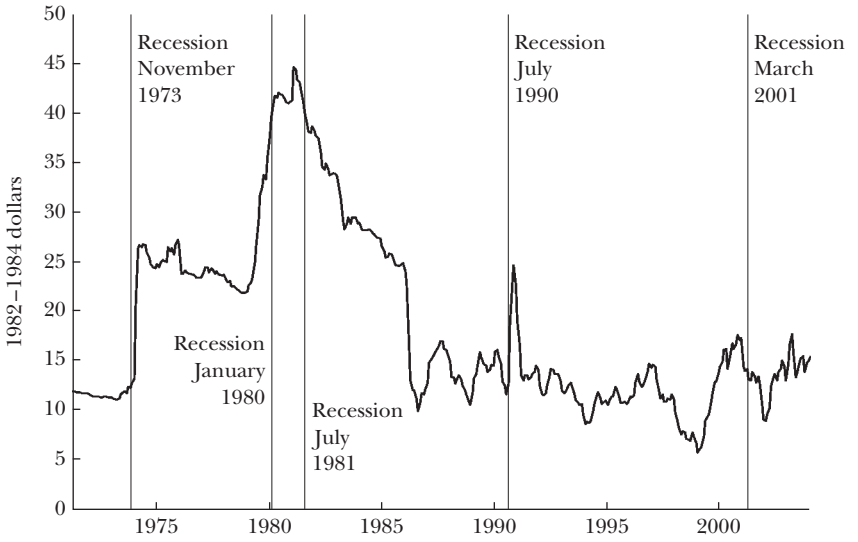
Source: The business cycle dates are from the National Bureau of Economic Research at ⟨http://www.nber.org/cycles⟩.

macroeconomic fluctuations, and we trace how the arguments of proponents of the oil view have evolved in response to these difficulties. Second, we challenge the notion that at least the major oil price movements can be viewed as exogenous with respect to the U.S. macroeconomy. We examine critically the evidence that has led many economists to ascribe a central role to exogenous political events in modeling the oil market, and we provide arguments in favor of reverse causality from macroeconomic variables to oil prices. Third, although none of the more recent oil price shocks has been associated with stagflation in the U.S. economy, a major reason for the continued popularity of the oil shock hypothesis has been the perception that only oil price shocks are able to explain the U.S. stagflation of the 1970s. We show that this is not the case.

Why Oil Seems to Matter for the Macroeconomy

There is a widespread belief that exogenous political events in the Middle East cause recessions in industrialized countries through their effect on the price of oil. This belief is fueled by the close statistical relationship between political events in the Middle East and recessions in the United States. Table 1 provides a list of the starting dates of U.S. recessions since 1972, as dated by the National Bureau of Economic Research. Most of these recessions were preceded by political events in the Middle East that, in some popular readings of events, were responsible for a subsequent increase in the price of oil, which in turn caused the recession. The prima facie evidence for such a linkage is marred by the long and variable delays between oil events and recessions in some cases. For example, the March 1999 OPEC meeting (if it was an exogenous political event) preceded the March 2001 recession by two full years. Similarly, there is a long delay between the Iranian revolution and the January 1980 recession and between the outbreak of the

Figure 1
Real Price of U.S. Crude Oil Imports and Recessions, 1971.3–2003.12



Source: Department of Energy, Federal Reserve Economic Database (FRED), and National Bureau of Economic Research. The oil price data are constructed as in Barsky and Kilian (2002). The oil price has been deflated by the U.S. CPI for urban consumers.

Iran-Iraq war and the July 1981 recession. On the other hand, the November 1973 recession immediately followed the October war and the start of the oil embargo, and the onset of the July 1990 recession even preceded the August 1990 invasion of Kuwait. This irregular pattern argues against a monocausal role for oil, but is still consistent with the view that oil events at least contribute to recessions. Thus, it is easy to see why many observers continue to assign an important role to political events in the Middle East in explaining U.S. recessions.

Even if we do not necessarily accept the view that exogenous political events in the Middle East cause recessions in the United States, it is undoubtedly true that many recessions since 1972 have been associated with major oil price increases, although again the association is less than perfect. Figure 1 plots the real price of oil since 1972 with business cycle peaks imposed as vertical lines. The recessions that started in November 1973 and July 1990 occurred right before major oil price increases. The January 1980 recession followed a sustained oil price increase in 1979. In contrast, the recessions starting in July 1981 and March 2001 actually occurred during declines of the real price of oil, albeit within months of a peak. Thus, it seems difficult to maintain that the two phenomena are unrelated.

In addition to the perceived link between major oil price increases and recessions, oil has been held responsible for the productivity slowdown in the 1970s. Table 2 relates the growth rate of total factor productivity to the real price of oil for selected subperiods. The overall relationship is heavily influenced by a period of unusually low growth in total factor productivity in 1974–1985 that

Table 2
Growth in Total Factor Productivity and the Real Price of Oil Imports

	1950–1959	*1960–1973*	*1974–1985*	*1986–2001*
Real price of oil	20.47	17.72	43.42	20.82
TFP growth (percent)	1.99	1.18	0.31	1.34

Source: FRED. The productivity series is annual multifactor productivity in the private manufacturing sector. The oil price data are constructed as in Barsky and Kilian (2002). The oil price index has been deflated by the U.S. GDP deflator and expressed in 2000 dollars.

coincides with an unusually high real price of oil. This phenomenon has prompted interest in establishing a theoretical link between oil prices and productivity that continues to this day.

Oil price shocks have also been said to cause inflation. Figure 2 plots the Consumer Price Index (CPI) inflation rates for the United States with major oil dates indicated as vertical lines. Figure 2 shows that indeed events such as the invasion of Kuwait in 1990, the collapse of OPEC in 1986 or the 1999 OPEC meeting were followed by sharp, if short-lived, spikes in CPI inflation. On the other hand, the relationship between oil price shocks and CPI inflation is not as apparent as one might have expected. Some oil dates, such as the outbreak of the Iran-Iraq war in 1980, seem to have had little impact on CPI inflation, and others such as the outbreak of the war in Afghanistan in 2001 and of the Iraq war of 2003 were followed by a fall in consumer prices.[1]

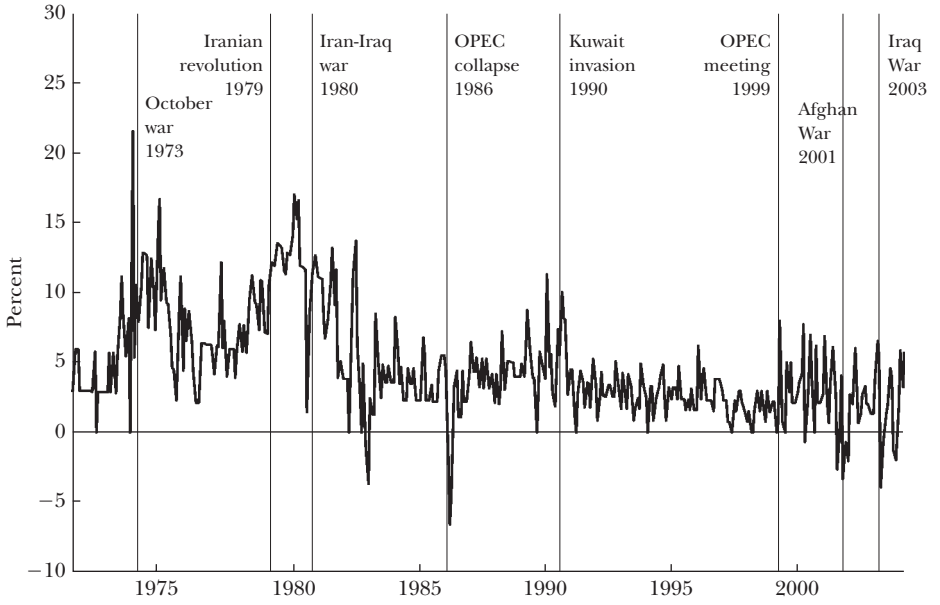
Conversely, several large spikes in the CPI inflation rate are clearly unrelated to oil events. Indeed, the largest spike in monthly CPI inflation occurred in August 1973, well before the October 1973 war, which by most accounts was unanticipated. The strongest case for a relationship emerges from focusing on medium-term trends in inflation. In particular, the period of sustained high inflation in the 1970s included two major oil events, which has given credence to the notion that both the economic stagnation and the high inflation rates of the 1970s were related to oil price shocks. The next section will review the explanations that have been proposed for such a relationship.

How Oil Price Shocks May Affect the Macroeconomy

To the extent that disturbances in the oil market do have a causal effect on output, prices and productivity, through what channels do they operate? Below we will discuss a number of mechanisms that might provide a causal link from oil prices to recessions, inflation and economic growth.

[1] In the case of the Iraq war of 2003, it may be argued that the war was well anticipated, causing the price of oil and hence the inflation rate to spike before the outbreak of hostilities. The observed spike in CPI inflation is not large, however, by historical standards.

Figure 2
Monthly CPI Inflation Rates and Oil Dates, 1971.3–2004.3



Source: Federal Reserve Economic Database (FRED).

How Oil Price Shocks May Cause Recessions

Suppose gross output Y is given by the production function $Y = Q[K, L, O]$, where O, L and K denote the quantities of imported oil, labor and capital services. A key insight that recurs in the literature on oil and macroeconomics is that the magnitude of the effect of an oil price shock on gross output—holding L and K constant—must be small. A 1 percent reduction in oil usage reduces gross output—to a first-order approximation—by a percentage amount corresponding to the cost share of oil. This share of oil in output is thought to be no larger than 4 percent and may be much smaller. With a unit elasticity of substitution between oil and value added, a 10 percent increase in oil prices, for example, will result in a less than 0.5 percent reduction in gross output (Rotemberg and Woodford, 1996). Empirically, increases in oil prices appear to raise the share of oil in output. This implies that the elasticity of substitution must be less than unity, suggesting that the actual drop in gross output is even smaller.

The corresponding effect of an oil price shock on value added, in contrast, is less clear. Suppose, for example, that $Y = Q[V(K, L), O]$, where $V(K, L)$ is domestic value-added (which may be thought of as real GDP). Then under perfect competition, there will not be a direct effect of an oil price shock on value added at all, because changes in the quantity of oil do not shift the demand curve for labor and capital services as a function of the wage and rental rates measured in terms of value added. This benchmark result is weakened somewhat if we drop the assumption of perfect competition and allow for a fixed mark-up. Under mark-up pricing,

an oil price increase does lower factor demand because firms apply the mark-up to all cost components, including imported oil, not just to capital services and labor (Rotemberg and Woodford, 1996). The magnitude of this effect on value added, however, is likely to be small for reasonable mark-up ratios, unless we allow in addition for substantial changes in the mark-up over time. The latter possibility is discussed by Rotemberg and Woodford (1996) who present a model involving implicit collusion between oligopolists in the goods market that can yield output responses to an oil price shock that are quantitatively important, though highly dependent on the particular setup.

Another way of undermining the benchmark result is to allow for capital-energy complementarities in production. In the presence of capital-energy complementarities, one would expect an oil price increase to lower real GDP by lowering the demand for capital services. For example, it is sometimes claimed that the rise in energy prices during the 1970s made part of the existing energy-intensive capital stock obsolete, causing a reduction in output without any apparent change in measured capital inputs. If true, this economic depreciation of capital should be reflected in lower prices for used equipment. There is, however, no real empirical support for this notion. For example, Hulten, Robertson and Wykoff (1989) found that the price of used equipment did not change much after the 1973 oil shock and that the price of energy-intensive equipment actually increased in some cases. The obsolescence hypothesis was also rejected by Bohi (1991), who found no relationship between the energy intensity of industries and their output and employment changes following the oil price shocks of the 1970s. Moreover, to the extent that old energy-inefficient capital depreciates, one would expect increased investment in new energy-saving equipment that will offset at least in part the recessionary effects of the oil price shock.

Another potential channel of transmission is the transfer of wealth involved in paying higher oil import bills. The total wealth transfer from the industrialized countries to the oil-producing countries, however, will tend to be small, given the small expenditure on foreign oil relative to GDP. Olson (1988) computes estimates of the extra import costs of about 1 percent of GDP for 1974–1978 and for 1982–1985 and of about 2–3 percent for 1979–1981. Further, the reduction in aggregate demand due to the wealth transfer occurs only to the extent that oil producers have a lower propensity to purchase industrial countries' output than domestic consumers.

In response to the difficulties with the preceding theoretical arguments, the literature has shifted toward indirect effects set in motion by the response of economic agents to the higher price of oil. We already mentioned models with time-varying mark-ups (Rotemberg and Woodford, 1996). Another model that explains how an oil price shock may lower real GDP is the sectoral shifts model of Hamilton (1988). The principal propagation mechanism in this model is that an oil price increase will depress purchases of energy-using goods such as automobiles. The dollar value of such purchases may be large relative to the cost of gasoline. The shift in demand causes reallocation of labor across sectors. If the movement of labor is costly, potentially large reductions in value added may result. One impor-

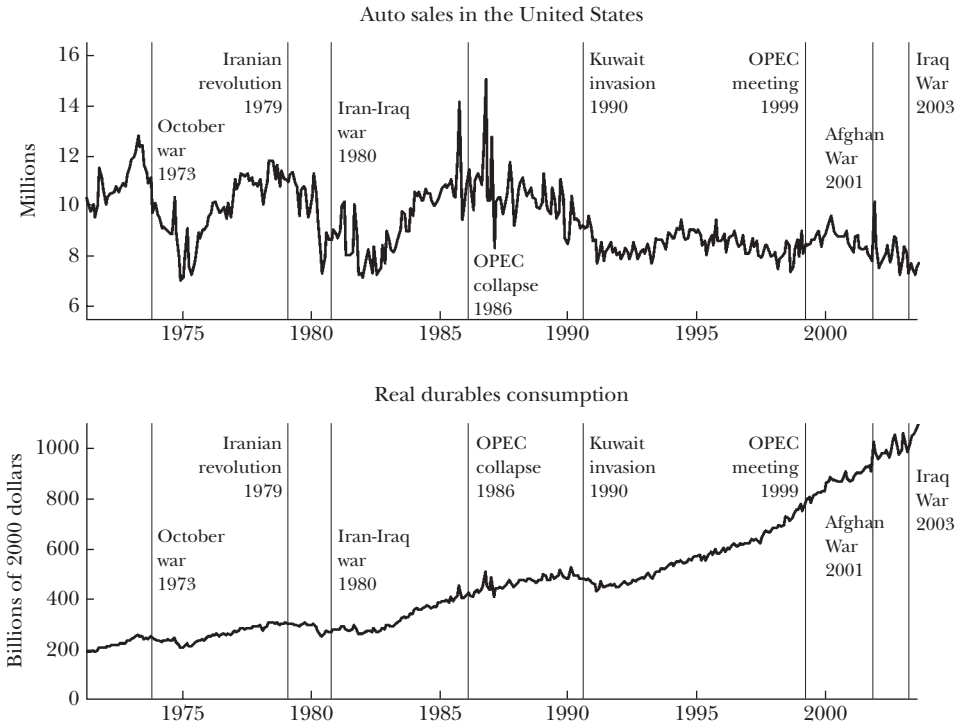
tant implication of this model is that the response of output should be symmetric, whether the price of oil increases or decreases. For example, the predicted rise in unemployment following the oil price increase of 1979–1980 and that following the collapse of OPEC prices in 1986 should have been about the same, given the similarity of the overall magnitude of these oil price shocks. Clearly, however, there was no increase in unemployment in 1986, casting doubt on the realism of this model.

A related channel has been discussed by Bernanke (1983), who shows in a partial equilibrium model that oil price shocks will tend to lower value added, because firms will postpone investment as they attempt to find out whether the increase in the price of oil is transitory or permanent. Gauging the importance of such indirect effects of oil on output is far less straightforward than the corresponding exercise for the direct effects. Yet there is evidence that the "waiting" effect discussed by Bernanke (1983)—if it exists—is small relative to the apparent magnitudes that need explanation.

The upper panel of Figure 3 plots monthly auto sales (millions of units sold) in the United States. The oil dates are imposed as vertical lines and indicate periods of large increases in uncertainty about the price of oil. If uncertainty is an important channel by which oil price shocks cause recessions, we would expect to see a sharp drop in sales of energy-using durables such as cars after each major oil price change. Although there is some evidence that car sales fell after the shocks of 1974, 1979 and 1990, the drops are rather small by historical standards and occur only gradually. Moreover, in each case they merely represent the continuation of a decline that started well before the oil date. For example, car sales in the United States had peaked nearly a year before the October 1973 war. They also peaked well before the Iranian revolution and the invasion of Kuwait. In some cases there is no evidence at all of a decline in car sales, notably in the year following the 1980 and 1999 oil dates. Nor was there a change in trend after the 2001 and 2003 oil dates. Finally, in the year following the collapse of OPEC in 1986, car sales on average increased. This finding suggests that the negative effect on car sales of the increased uncertainty about oil prices in 1986 must have been small relative to the direct positive effect of lower oil prices. Thus, the evidence that oil price shocks operate via a reduction in demand for durables such as cars is weak. The data cast doubt both on the importance of the Bernanke (1983) uncertainty effect and on the Hamilton (1988) model that relied on reductions in the demand for consumer durables such as cars.[2]

[2] An alternative approach is to use the volatility of oil prices as a proxy for uncertainty. A more formal analysis shows that there typically is an increase in oil price volatility following the oil dates, but often with a substantial delay. The formal volatility measure that we used is the conditional variance of the percentage change of the nominal oil price. It was computed based on the fitted values of a generalized autoregressive conditional heteroskedasticity model. There is some evidence that increases in oil price volatility in 1973–1974, 1979–1980 and 1990–1991 may have been associated with subsequent declines in car sales, but the lags are long and variable. There are no sudden and sharp drops, as one might have expected based on the Bernanke (1983) model. Moreover, it is not clear to what extent these declines are a cause of the recession or an effect.

Figure 3
Oil Price Uncertainty and Real Consumption of Durables, 1971.3–2003.7



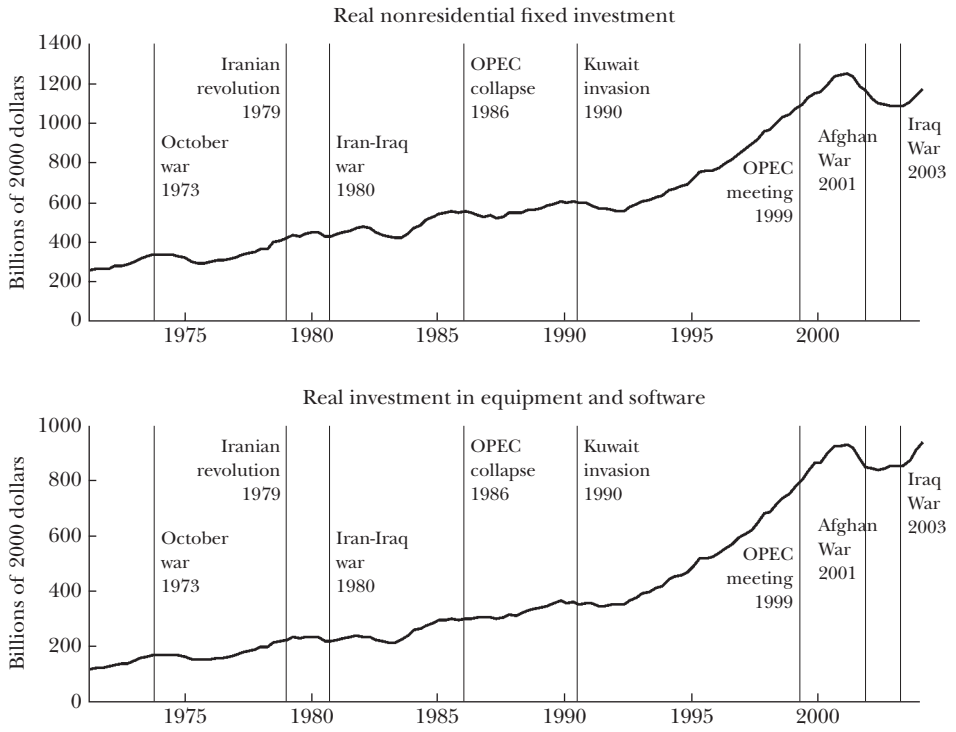
Source: Federal Reserve Economic Database (FRED), Department of Energy and BEA.
Notes: Oil dates have been imposed as vertical lines.

Other evidence paints a similar picture. The bottom panel of Figure 3 focuses on a broader measure of monthly real consumption of durables. The qualitative conclusions are the same as for car sales. There is no evidence of sharp drops in consumer spending after oil dates. In fact, durables consumption appears largely stable after the 1973 and 1979 oil dates. It actually increases after the 1980, 1986, 1999, 2001 and 2003 dates. Only in 1990 is there evidence of a slight decline after the oil date.

Similar results hold if we focus on the investment decisions of firms. Figure 4 shows the corresponding data for real fixed nonresidential investment and real investment in equipment and software. Neither series shows a sharp drop after oil dates, as one might have expected in response to an increase in uncertainty. Even accounting for the long-run trend in investment, these aggregate data provide no support for the notion that increased uncertainty leads to a sharp fall in investment that in turn contributes to a recession.

Yet another line of reasoning as to why oil price shocks may have indirect effects has focused on the monetary policy response to oil price shocks. For instance, Bohi (1989) and Bernanke, Gertler and Watson (1997) have investigated the possibility that the 1974 recession may be understood as a consequence of the

Figure 4
Oil Price Uncertainty and Real Investment, Quarterly 1971.I–2003.IV



Source: Federal Reserve Economic Database (FRED).
Notes: Oil dates have been imposed as vertical lines.

Federal Reserve's policy response to the inflation triggered by an oil price shock. The output effect arises, in this view, because the Fed responds to evidence of rising inflation with a monetary tightening, thereby inducing a recession. Whether monetary policy actually did respond to oil price shocks in this way continues to be a matter of debate. For example, in the 1973–1974 episode, the monetary tightening started eight months prior to the 1973 oil date (for example, Bernanke and Mihov, 1998).

A second indirect monetary effect on output is due to the "wage-price spiral," which occurs if nominal wages are set in line with past price increases, while prices are set in line with past wage increases. In this setting, an initial inflationary shock due to oil may be propagated, if wage increases are accommodated by the central bank. To the extent that the real wage is prevented from falling, a decline in value added will be required in response to an oil shock (Bruno and Sachs, 1985). Although this explanation is popular, empirical studies suggest that U.S. real wages actually did fall in response to higher oil prices (Bohi, 1989, 1991; Keane and Prasad, 1996; Rotemberg and Woodford, 1996). Even for Europe and Japan, there is at best limited support for this explanation. Thus, again the case that oil price shocks create recessions is weak.

How Oil Price Shocks May Affect Inflation

Theories that can explain how oil might cause a recession still do not in general generate *stagflation,* a phenomenon especially important for understanding the historical experience of the 1970s. Thus, it is important to address the additional role of oil price shocks, if any, in explaining inflation. Interestingly, the existing literature has focused on the effect of oil price shocks on aggregate output and left unchallenged the common notion that oil price shocks are by necessity inflationary. Recently, Barsky and Kilian (2002), using an illustrative example that builds on Gordon (1984) and Rotemberg and Woodford (1996), have verified that an oil price shock indeed is unambiguously inflationary for the price of gross output. Hence, following an oil price shock, one would expect stagflation in the form of a decline in industrial production and increased inflation in the CPI. The same model, however, also implies that there is no theoretical presumption that the GDP deflator would increase in response to an oil price shock, although it might under certain conditions. This analysis is important because it explains important differences between the observed response of CPI inflation and of inflation in the GDP deflator to oil price shocks.

Of course, in principle a more complicated theoretical model—involving, say, mark-ups and wage-price interactions—could deliver an unambiguous increase in the GDP deflator in response to an oil price shock. It is important, however, not to lose sight of the fact that there is no convincing empirical evidence that oil price shocks are associated with higher inflation rates in the GDP deflator. There is strong evidence only of sharp changes in the CPI inflation rate following major oil price changes (Barsky and Kilian, 2002).

How Oil Price Shocks May Affect Economic Growth

Oil price shocks may also have long-term consequences for economic growth. Notably, the rise in the price of oil in 1974 has been blamed for the productivity slowdown, which is often dated as beginning in 1973 (although there is a case that it began earlier, perhaps in the late 1960s, as discussed in Hansen, 2001). The relationship between oil price increases and changes in total factor productivity was explored extensively in the Fall 1988 "Symposium on the Productivity Slowdown" in this journal. Olson (1988) in that issue concluded that "the evidence has not been kind" to oil-based explanations of the productivity slowdown. The fundamental problem is that the cost of energy is too small a part of GDP to explain the productivity slowdown. Olson quantified the U.S. productivity losses that may be attributed to substitution away from oil and concluded that they were much too small to explain the productivity slowdown. He also noted that the opportunities for substitution were sharply limited during the initial years following the 1973 oil price shock. This view is now widely accepted.

In response, some economists have focused on alternative channels of transmission that operate through some other variable with important effects on productivity. One possibility is that energy-inefficient capital was made obsolete by higher oil prices, resulting in an unmeasured decline in the capital stock, which would look like a decline in productivity in the data. As we have discussed earlier,

there is no empirical support for that notion. Although a number of additional and more elaborate arguments have been advanced that in principle might establish a link from oil prices to productivity changes, none of these models can claim solid empirical support.

Where Do Oil Price Shocks Come From?

Conventional wisdom suggests that major increases in the price of oil tend to be driven by exogenous political events in the Middle East. Even if we accept the notion that turmoil in the Middle East may cause sharp increases in the price of oil, however, recent history demonstrates that Middle East disturbances do not necessarily raise the price of oil and that major oil price increases may occur even in the absence of such shocks. For example, the increase in the real price of oil between March 1999 and November 2000 was certainly a major one, but during that period military conflicts in the Middle East were conspicuously absent. Even more difficult to explain for adherents of the conventional view is the fact that after November 2000 the oil price fell, despite Middle East turmoil and the high likelihood that most of Iraq's oil exports would remain off global markets, on top of low inventories that were further strained by one of the coldest winters in recent memory. Neither the terrorist attacks of September 11, 2001, nor the outbreak of the war in Afghanistan and the stocking up of the U.S. Strategic Petroleum Reserve could stem the decline in crude oil prices in 2001.

Many observers would be willing to concede that major movements in oil prices are possible even in the absence of exogenous political shocks, but would argue that the 1999–2000 oil price increase must have been engineered by the OPEC oil cartel. This interpretation begs the question of how this cartel suddenly acquired new powers in March 1999, having been unable to force a sustained increase in oil prices since 1986, and how the same cartel just two years later seemed to be on the verge of collapse. It seems implausible that the Mexican oil minister by his eloquence alone in 1998 managed to unify a cartel that had steadily lost influence since 1986. Nor is it obvious why those rhetorical powers failed the oil minister in 2001. There have been many OPEC meetings since 1986, but only the March 1999 decision was followed by a sustained increase in oil prices. Clearly, it takes more than a cartel meeting to drive up prices. What then was different about 1999–2000? One plausible answer is that OPEC decisions are far from exogenous and in fact respond to global macroeconomic conditions.

The Role of Cartels

The view that worldwide demand for oil is essential in understanding oil prices does not imply that OPEC was inconsequential. A key channel that links the stability of oil cartels to macroeconomic forces is described in standard theoretical models of cartels such as Rotemberg and Saloner (1986) and Green and Porter (1984). Producers trade off the immediate gains from abandoning the cartel against the present value of the future cartel rents foregone. This logic suggests that, all else

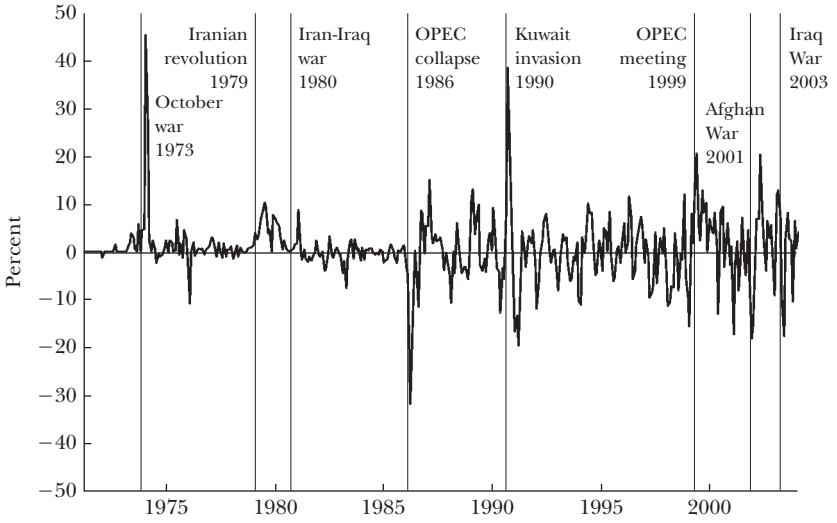
equal, unusually low real interest rates as in the 1970s should be conducive to the formation of cartels and that high real interest rates should be detrimental. Furthermore, the work of Green and Porter implies that the ability of cartels to keep prices high will be procyclical if producers are unable to tell whether other cartel members are cheating by exceeding their production quota. More specifically, in times of unexpectedly low demand, when prices fall below a trigger point, cartel members will choose to flood the market with their output. The assumption of imperfectly observable output is particularly appealing for crude oil producers. The actual production level of crude oil can only be estimated in many cases, and reliable output statistics become available at best after a long lag. Thus, strong economic expansions, all else equal, should strengthen oil cartels and major recessions weaken them.[3]

This model helps to explain the surplus production of oil following the Asian crisis of 1997–1998 as well as the apparent success of OPEC during 1999–2000. Although real interest rates were not unusually low by historical standards over the latter period, cumulative GDP growth in the United States was extraordinarily high—high enough to offset the less-than-stellar growth performance of Europe and Japan. The same economic theory suggests that (all else equal) a pending recession should undermine the stability of OPEC. As Figure 1 shows, the turning point for oil prices indeed occurred as the first signs of a possible U.S. recession emerged in late 2000. Within weeks the oil price began to slip, and its fall accelerated throughout 2001. Shortly thereafter, the *New York Times* referred to the prospect of a devastating price war (Banerjee, 2001), as OPEC was unable to enforce its goal of a major cut in oil production in the face of falling demand. This analysis does not deny the importance of political efforts aimed at strengthening or sustaining the oil cartel; rather, the point is that such activities—unlike wars—are not exogenous and that the sustainability of cartels will be determined to an important extent by the macroeconomic environment.

The above discussion abstracts from international features of the oil market. A further element in OPEC's price decisions is likely to be the exchange rate of the dollar vis-à-vis other major currencies. Indeed, the depreciation of the dollar was an important element in OPEC's justification for higher oil prices in the 1970s (for example, Terzian, 1985). To the extent that the dollar depreciates with respect to European or Japanese currencies, goods denominated in those currencies become more expensive, and there will be an incentive to make up for the loss in OPEC purchasing power by increasing the price of oil in dollar terms. At the same time, a weaker dollar also will tend to stimulate demand for oil in the rest of the world, thereby strengthening the cartel and driving up the price of oil.

[3] Rotemberg and Saloner (1986), in sharp contrast to Green and Porter, argue that cartels should break up in booms. That conclusion is not empirically supported for the oil market, however, and indeed driven by the counterfactual assumption of perfectly observable output.

Figure 5
Percentage Change in the Nominal Price of Crude Oil Imports, 1971.3–2003.12



Source: See Figure 1.

The Role of Major Political Events in the Middle East: An Overview

Once one accepts that the 1999–2000 tripling of oil prices was not caused by exogenous political events in the Middle East, the question arises naturally to what extent previous oil price increases were perhaps driven by the same endogenous forces. It is useful to start with the anatomy of major oil price increases. It is widely believed that sudden and large changes in the price of oil tend to be caused by unpredictable exogenous political events in the Middle East that represent shifts of the supply curve for oil. Often these "shocks" are associated with military events such as the outbreak of wars. Figure 5 shows the percentage change in the nominal price of oil since March 1971, when U.S. oil production reached full capacity and the United States became dependent on foreign oil. Episodes of major wars or major civil unrest are indicated by vertical bars and include the October war of 1973, the Iranian revolution in late 1978, the outbreak of the Iran-Iraq war in late 1980, the invasion of Kuwait in 1990, the start of the war in Afghanistan in October 2001 and of the war in Iraq in March 2003. We also included the collapse of OPEC in 1986 and the period of possible OPEC price management since March 1999 for comparison.

Clearly, not all so-called oil shocks follow the same pattern. For example, the period after the October war of 1973, the period after the collapse of OPEC in late 1985 and the period immediately after the invasion of Kuwait in 1990 are characterized by sharp spikes in oil prices. The period following the Iranian revolution of 1978–1979 and that following the 1999 OPEC meeting are, in contrast, characterized by relatively small, but persistent positive rates of change. Nor are the 2001 and 2003 wars associated with sharp spikes in oil prices. These differences suggest

important differences in the genesis of these oil events. For example, the casual observer would be led to conclude that the 1999–2000 increase in oil prices is much more akin to the 1979–1980 increase than to the 1973–1974 or the 1990 episode.

We conclude that there may have been many plausibly exogenous political events in the Middle East, but the magnitude and pattern of the subsequent changes in the price of crude oil varies greatly. Thus, it is far from obvious what the precise channel is by which exogenous events affect the price of oil and whether there is a link at all. This is the question we turn to next.

The Role of Wars

It may seem that wars in the Middle East are natural candidates for inducing major changes in oil prices, but this link is far from obvious. A perhaps simplistic view is that oil price shocks reflect shocks to the supply of oil in the form of interruptions of the production (or shipments) of crude oil from the Middle East. As we will show, this interpretation is difficult to sustain. A more sophisticated view is that in response to wars or the threat of war in the Middle East, there will be an increase in precautionary demand for oil, which may cause sharp increases in the price of oil when the supply of oil is inelastic, as is especially likely in times of capacity constraints. In this latter interpretation, wars shift the demand for oil, rather than the supply of oil. Demand for oil shifts because oil consumers attempt to stockpile oil when they feel that the likelihood of a major oil supply interruption has increased. This second explanation may help explain seeming discrepancies in the timing and in the magnitude of the oil price shock. Its main limitation is that the effect depends on largely unobserved shifts in expectations.

A first way of seeing that the oil supply shock view must be missing something important is to note that supply cuts of similar magnitude seem to have had very different effects on the price of oil. For example, although the case for an exogenous production cut following the outbreak of the Iran-Iraq war in late 1980 is strong, the data in Figures 1 and 5 reveal that the apparent effect on the price of oil was quite small compared to the effect of the invasion of Kuwait. This seems rather curious, given that the magnitudes of the production cuts were almost the same with a 7.2 percent and 8.8 percent drop relative to pre-war levels, respectively (Hamilton, 2003).

A second reason to doubt the oil supply shock view is the timing of some major oil price increases and commonly cited political events. For example, most of the 1979 increase in the price of oil occurred more than half a year after the Iranian revolution broke out (but before the outbreak of the Iran-Iraq war in late 1980). Thus, the exogeneity of the production cut during the revolution is not in doubt, but the extent to which the observed temporary production cut after October 1978 is actually related to the rapid oil price increases after May 1979 is not clear.

Even more curious is the fact that this particular oil price increase in 1979–1980, very much unlike the sharp oil price spike following the 1990 war, occurred in the form of small, but persistent price increases extending over a period of almost two years. It is unclear why the typical response of oil prices to a production cut should look so qualitatively different when the nature of the shock is presum-

ably identical and why these increases only occurred when Iran had resumed oil exports.

This evidence argues against the existence of a mechanical link between war-induced cuts in oil supplies and the price of oil. Instead, the effect of a supply cut will depend very much on the response of other suppliers of oil (including Saudi Arabia as the country with the most spare capacity) and on demand conditions in the oil market, reflecting both the overall macroeconomic environment in the world and the degree of anxiety of oil consumers about future supplies. Moreover, increased uncertainty about future oil supplies may shift the price of oil even in the absence of a war-induced production cut. A case in point is the 2003 Iraq war. The 2003 Iraq war, unlike many of the other events in Figure 5, was clearly anticipated. By definition, at the time of the oil price increase, no war-related production cutbacks had occurred (nor was there significant damage to oil facilities during the war). Thus, all of the observed oil price increase may be attributed to uncertainty. Comparing oil price data in the summer of 2002 (when the possibility of a war was first openly discussed) to the price in March 2003, right before hostilities broke out, suggests an uncertainty premium of about $5 or $6 per barrel. This is roughly the same amount by which the price fell after the war had ended.

Of course, increased fears about future oil supplies may arise from events other than the threat of war in major oil producing countries in the Middle East—any event with adverse effects on the political stability of these countries could generate such fears. Arguably, conflicts such as the terrorist attacks of September 11, 2001, the war in Afghanistan, the 1982 invasion of Lebanon by Israel and subsequent clashes with Syria or the Palestinian uprising in Israel and its occupied territories all have repercussions for the political stability of major oil-producing nations and hence would be expected to raise the price of oil. If such increases do not seem large, as the evidence suggests, this fact only reinforces our point that no automatic link exists between political events and fears of supply interruptions. As noted by Mabro (1998), in the absence of taut demand conditions in the oil market, political flare-ups are unlikely to cause dramatic shifts in the price of oil.[4]

The Role of Embargoes

The 1973 oil price shock took the form of a sharp spike, similar to that of 1990 in magnitude. At first sight, this fact is suggestive of a war-based explanation, but the observed increase in the price of oil in late 1973 and early 1974 occurs only after a delay. It does not appear to be directly related to the October 1973 war nor to damaged oil facilities in that conflict. In fact, most countries involved in military

[4] A case in point is the rise in oil prices in early May 2004 following terrorist attacks on oil facilities in Saudi Arabia. As the *New York Times* (Sachs, 2004) notes, "it is the combination of fears of what might happen and the fundamental tightness of the market that has sent prices higher." The article elaborates that "while recent attacks on oil facilities did not do much damage, traders worry that a more serious disruption of Middle East oil production remains possible and that it would shake the fragile stability of the already strained oil market."

action—Egypt, Jordan, Syria, Iraq—were not even major oil producers at the time.[5] Rather, the fall in oil supplies is mainly related to the tightening of the oil embargo imposed by Arab OPEC countries in late 1973. An embargo, unlike a war, is likely to be endogenous with respect to macroeconomic conditions.

The key question then is to what extent that embargo decision was driven by political as opposed to economic considerations. Hamilton (2003) rightly points out that political considerations did play *some* role in the embargo decision. Barsky and Kilian (2002) instead stress historical and institutional evidence in support of the endogeneity of the 1973 embargo decision to macroeconomic conditions. In the latter view, there was no trade-off between political and economic objectives at the time when the embargo and the associated production cuts were instituted.[6] Once the economic objective of a higher price of oil had been achieved in early 1974, however, the political objectives of the embargo were quietly discarded along with the embargo itself.

Moreover, the observed price increases for oil over that 1973–1974 period were not much different from those of some industrial commodities for which political considerations can be ruled out, casting doubt on the importance of the oil embargo. This fact is consistent with the view that the observed spike in the price of oil in late 1973 can be explained as the result of unique institutional features in the oil market, which led to a delayed adjustment of the price of oil to a preceding demand boom (Barsky and Kilian, 2002). If there was a component of the 1973–1974 oil price increase that can be attributed to the war, it is likely to have been fears about future oil supplies in late 1973, but as noted earlier, those fears must also be viewed against the macroeconomic background of a world economy that was booming at that time.

The Role of Global Macroeconomic Conditions

As shown earlier, neither cartel decisions nor the imposition of oil embargoes nor the effects of political uncertainty on the price of oil are independent of global macroeconomic conditions. Apart from their indirect effects through institutions, macroeconomic conditions also affect the price of oil directly by shifting the demand for oil. This view has long been recognized by oil economists. For example, the survey by Mabro (1998), "OPEC Behavior 1960–1998: A Review of the Literature," in the *Journal of Energy Literature* gives considerable (favorable) attention to the endogenous elements of oil price determination. Curiously, mainstream economists have often been slow to embrace the notion that oil prices respond to economic forces, as one would expect of other industrial commodity prices.

The importance of shocks to the demand for oil was strikingly illustrated by the

[5] Egypt, Jordan and Syria were not even members of OPEC. Iraq's oil output amounted to about 3.8 percent of world oil production in September of 1973 (U.S. Energy Information Administration, 1994). Its share fell to 3.3 percent in October 1973 (covering the period during and after the war).

[6] This situation is not unlike that of the Spanish conquistadores who aimed to procure ships from the Spanish king to serve the double objective of finding gold and converting heathens across the Atlantic. Is it reasonable to presume that the Spanish would have sailed just for the latter objective?

drop in the price of oil following the Asian crisis of 1997–1998. It also is essential in understanding the upswing in oil prices in 1999–2001, as discussed earlier. Barsky and Kilian (2002) suggest that some of the same forces that help us understand oil price movements in 1997–2001 also help explain the sustained increases in oil prices in the 1970s. Unlike in the late 1990s, the upward pressure on oil prices in the 1970s, in this view, was caused not by a shift in productivity, but by worldwide monetary expansions that drove output levels above potential for sustained periods and were followed by periods of unusually low real interest rates. As these booms gave way to recessions and increases in real interest rates, oil prices started falling in the early 1980s and ultimately collapsed in early 1986, despite the best efforts of the OPEC cartel to sustain them at higher levels.

Central to this demand-driven account of oil price movements is that in the short run, the effective supply curve for oil—which depends on pipelines and tanker capacity at least as much as on oil reserves in the ground—can be very steep. That view is consistent with oil industry sources that suggest that the industry tended to be at capacity in times of high world economic activity. In the long run, high oil prices due to strong demand for oil stimulate an expansion of capacity. It stands to reason that the collapse of oil prices in the 1980s would not have happened as fast as it did if the high oil price in 1974 had not induced many countries to increase oil production. Given the considerable delays in expanding oil production, however, the shift in the long-run supply curve did not have material effects on the price of oil until more than half a decade later.

Are Oil Price Shocks Essential in Explaining Stagflation?

We have shown that the evidence for the alleged link from oil price changes to macroeconomic performance may have been overstated. Some of our points are new, but many of the arguments have been known for years. Despite the mounting evidence to the contrary, the oil shock view has proved surprisingly resilient because of another piece of evidence that—at first sight—appears as the "smoking gun" in this controversy: the appearance of stagflation during the 1970s. Stagflation has been defined as a period of high unemployment in combination with rising inflation or, alternatively, a high level of inflation. The choice of definition matters. Until the 1970s, it was commonly accepted that inflation is caused by excess demand. In its modern guise, this view has been embedded in the so-called accelerationist Phillips curve, which implies that inflation increases when the economy is overheated and declines when there is slack in the economy.

The perception that the early 1970s, unlike earlier periods, were characterized by *increasing* inflation in combination with unemployment in excess of the natural rate (as is sometimes claimed even today, as in Blanchard, 2002, p. 185), cast doubt on the accelerationist model. Evidence that the economy remains below potential, while inflation continues to rise, is inconsistent with the standard accelerationist model of the macroeconomy and thus would seem to require a different explanation, presumably one based on supply shocks that shift the Phillips curve. This fact

helps explain the increased focus on oil price increases as supply shifters in the early 1970s. However, there never was a significant period of rising inflation along with excess unemployment in 1973–1975. Rather, stagflation in the data occurred in the form of periods of slow or negative economic growth alongside high levels of inflation. Thus, the data are consistent with the accelerationist model, making it unnecessary to appeal to special factors such as oil shocks.

Figure 6 shows quarterly data (at annual rates) for 1973:I to 1975:IV on unemployment, the deviation of log real GDP from trend, inflation in the CPI and inflation in the GDP deflator.[7] The unemployment rate is presented relative to the rate of 5.5 percent, which roughly corresponds to zero deviation of output from the trend, and is a plausible estimate of the natural rate of unemployment. Over the period 1973:I to 1974:III, the economy was in decline but unemployment was still below the natural rate. Inflation tended to *rise* over this period.[8] In contrast, inflation tended to *fall* from late 1974 through the end of 1975—the part of the recession in which unemployment exceeded the natural rate. This behavior is strikingly consistent with the accelerationist Phillips curve with—of course—some disturbance, but not one larger than is found in other historical periods.[9]

Once it is clear that *rising* deflator inflation in combination with abnormally high unemployment is not a strong feature of the data, a definition of stagflation based on such a pattern becomes largely irrelevant, as does the demonstration that an accelerationist model cannot account for this hypothetical pattern. Our analysis also helps us to understand the conspicuous absence of stagflationary patterns following subsequent oil price shocks. In fact, none of the major oil price increases since the 1980s have been associated with stagflation.

Conclusion

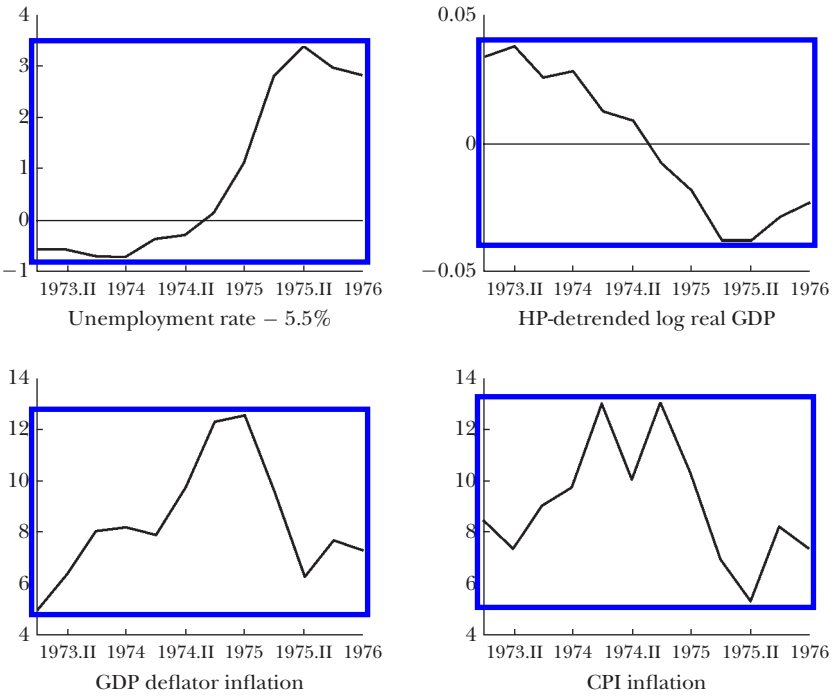
It is commonly believed that there is a close link from political events in the Middle East to changes in the price of oil, and in turn from oil price changes to macroeconomic performance in the United States. As to the first belief, we stressed that exogenous political events in the Middle East are but one of several factors driving oil prices, and that the effect of seemingly similar political events may differ greatly from one episode to the next, in accordance with variations in demand conditions in the oil market and global macroeconomic conditions. As to the

[7] The deviations of output from trend were computed using the Hodrick-Prescott (HP) filter. Hodrick and Prescott (1997) proposed that we view the time series for log real GDP as the sum of a cyclical component and a growth component. The latter may be removed by a statistical filter that leaves an estimate of the business cycle component in the form of deviations from a smooth time trend. The degree of smoothness may be regulated by choosing a constraint parameter λ. We estimated the growth component over 1960 to 2003 with the conventional parameter choice of $\lambda = 1600$.

[8] The spike in CPI inflation in 1974.I reflects the temporary effect of the OPEC oil price increase. The differential effect of the oil price increase on CPI and deflator inflation data is consistent with the theory on the price of gross output and value added discussed previously.

[9] For example, although the increase in the deflator inflation rate slowed down considerably in 1974.IV, deflator inflation started declining only in 1975.I.

Figure 6
CPI Inflation, Inflation in the GDP Deflator, Detrended Log Real GDP and the Unemployment Rate in Excess of 5.5 Percent
(quarterly 1973:I to 1975:IV)



Source: Federal Reserve Economic Database (FRED).

second belief, we showed that the timing of oil price increases and recessions is consistent with the notion that oil price shocks may contribute to recessions without necessarily being pivotal. We investigated several leading theoretical explanations for a contractionary effect of oil price increases, but found little empirical support for any one explanation, either because the magnitude of the predicted effect can be shown to be small a priori or because the theory has implications that are not supported by U.S. macroeconomic data. We also showed that oil price shocks are neither necessary nor sufficient to explain stagflation in real GDP and in the implicit GDP deflator. Thus, we conclude that disturbances in the oil market are likely to matter less for U.S. macroeconomic performance than has commonly been thought.

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References

Ball, Laurence and N. Gregory Mankiw. 2002. "The NAIRU in Theory and Practice." *Journal of Economic Perspectives.* Fall, 16:4, pp. 115–36.

Banerjee, Neela. 2001. "Oil Prices in Flux as OPEC Decides Against Cut in Output." *New York Times.* November 15, C1.

Barsky, Robert B. and Lutz Kilian. 2002. "Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative," in *NBER Macroeconomics Annual 2001.* B. S. Bernanke and K. Rogoff, eds. Cambridge, Mass.: MIT Press, pp. 137–83.

Bernanke, Ben S. 1983. "Irreversibility, Uncertainty, and Cyclical Investment." *Quarterly Journal of Economics.* February, 98:1, pp. 85–106.

Bernanke, Ben S. and Ilian Mihov. 1998. "Measuring Monetary Policy." *Quarterly Journal of Economics.* 113:3, pp. 869–902.

Bernanke, Ben S., Mark Gertler and Mark W. Watson. 1997. "Systematic Monetary Policy and the Effects of Oil Price Shocks." *Brookings Papers on Economic Activity.* 1, pp. 91–148.

Blanchard, Olivier. 2002. "Comments on 'Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative' by Robert Barsky and Lutz Kilian," in *NBER Macroeconomics Annual 2001.* B. S. Bernanke and K. Rogoff, eds. Cambridge, Mass.: MIT Press, pp. 183–92.

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

Bohi, Douglas R. 1991. "On the Macroeconomic Effects of Energy Price Shocks." *Resources and Energy.* June, 13:2, pp. 145–62.

Bruno, Michael and Jeffrey D. Sachs. 1985. *Economics of Worldwide Stagflation.* Cambridge, Mass.: Harvard University Press.

Friedman, Milton. 1968. "The Role of Monetary Policy." *American Economic Review.* March, 58:1, pp. 1–17.

Green, Edward J. and Robert H. Porter. 1984. "Noncooperative Collusion under Imperfect Price Information." *Econometrica.* January, 52:1, pp. 87–100.

Gordon, Robert J. 1984. "Supply Shocks and Monetary Policy Revisited." *American Economic Review.* May, 74:2, pp. 38–43.

Hamilton, James D. 1988. "A Neoclassical Model of Unemployment and the Business Cycle." *Journal of Political Economy.* June, 96:3, pp. 593–617.

Hamilton, James D. 2003. "What is an Oil Shock?" *Journal of Econometrics.* April, 113:2, pp. 363–98.

Hansen, Bruce E. 2001. "The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity." *Journal of Economic Perspectives.* 15:4, pp. 117–28.

Hodrick, Robert J. and Edward C. Prescott. 1997. "Postwar U.S. Business Cycles: An Empirical Investigation." *Journal of Money, Credit and Banking.* February, 29:1, pp. 1–16.

Hulten, Charles R., James W. Robertson and Frank C. Wykoff. 1989. "Energy Obsolescence and the Productivity Slowdown," in *Technology and Capital Formation.* Dale W. Jorgenson and Ralph Landau, eds. Cambridge, Mass.: MIT Press, pp. 225–58.

Keane, Michael P. and Eswar S. Prasad. 1996. "The Employment and Wage Effects of Oil Price Changes: A Sectoral Analysis." *Review of Economics and Statistics.* 78:3, pp. 389–400.

Mabro, Robert. 1998. "OPEC Behavior 1960–1998: A Review of the Literature." *Journal of Energy Literature.* June, 4:1, pp. 3–27.

Olson, Mancur. 1988. "The Productivity Slowdown, the Oil Shocks, and the Real Cycle." *Journal of Economic Perspectives.* Fall, 2:4, pp. 43–69.

Phelps, Edmund S. 1968. "Money-Wage Dynamics and Labor Market Equilibrium." *Journal of Political Economy.* Part 2, 76:4, pp. 678–711.

Roberts, John M. 1995. "New Keynesian Economics and the Phillips Curve." *Journal of Money, Credit and Banking.* Part 1, November, 27:4, pp. 975–84.

Rotemberg, Julio J. and Garth Saloner. 1986. "A Supergame-Theoretic Model of Business Cycles and Price Wars During Booms." *American Economic Review.* June, 76:3, pp. 390–407.

Rotemberg, Julio J. and Michael Woodford. 1996. "Imperfect Competition and the Effects of Energy Price Increases on Economic Activity." *Journal of Money, Credit, and Banking.* Part 1, November, 28:4, pp. 550–77.

Sachs, Susan. 2004. "Attacks in Mideast Raise Fear of More at Oil Installations." *New York Times.* May 8, C1.

Terzian, P. 1985. *OPEC. The Inside Story.* London: Zed books.

United States Energy Information Administration. 1994. *Historical Monthly Energy Review: 1973–1992.* Washington, D.C.: U.S. Government Printing Office.