

ECONOMIC COMMENTARY

Federal Reserve Bank of Cleveland

Oil, the Economy, and Monetary Policy

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Iraq's invasion of Kuwait on August 2 and the subsequent United Nations embargo on oil exports from both countries have been accompanied by soaring oil prices, declines in stock and bond markets, and renewed speculations about economic recession. Such concerns would seem to be well founded; there is evidence that large oil price increases have been a harbinger of higher inflation and recession many times in the past.

A limitless number of scenarios are possible for future oil supplies and prices, of course. It is uncertain when Iraqi and Kuwaiti crude oil will resume flowing to world markets, to what extent other sources of supply will replace that crude, and whether these additional sources will be interrupted because of military or political action. Therefore, this *Economic Commentary* makes no effort to forecast the path that crude oil production and prices will take. Instead, it examines the theoretical impact of an oil shortage on the U.S. economy, reviews the history of such shocks, and considers some of the limits and risks of monetary policy responses to a supply shock.

■ Oil and the Economy: Theory and Evidence

The U.S. economy has experienced several energy crises over the past 45 years. We can identify at least seven oil price shocks of sizable magnitude between the end of World War II and the start of the current expansion (figure 1). It is provocative to note that all but

one of the last eight recessions were immediately preceded by an oil price shock, leading some economists to conclude that oil market disturbances have been a prominent cause of post-World War II business cycles.¹

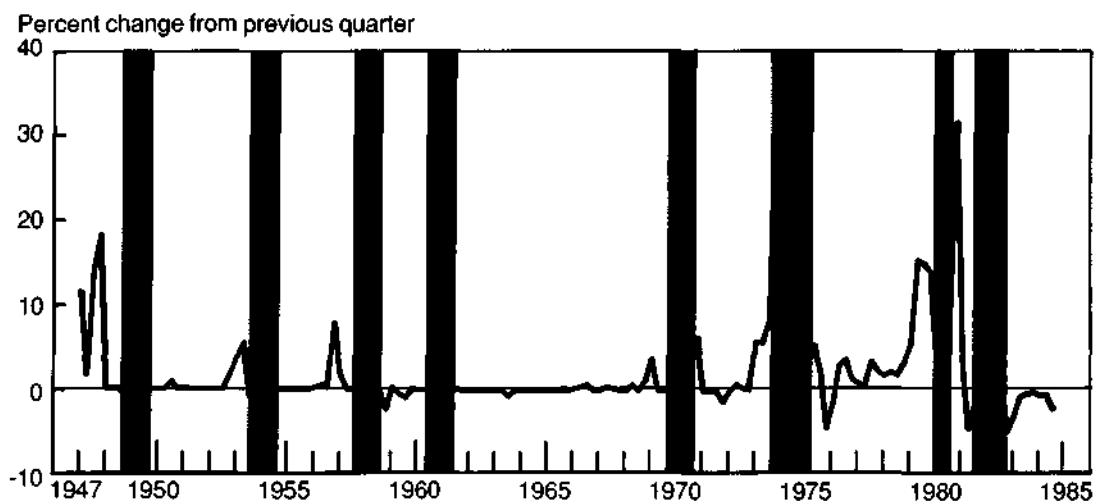
Disturbances that impair an economy's ability to produce goods and services are called "supply shocks," and include such phenomena as natural disasters, labor disputes, and political upheaval.² However, because energy is vital to almost all production processes, its scarcity impacts the economy more broadly than supply shocks that are more or less sector specific, such as those caused by droughts or strikes.

Economic theory offers some insight into the impact of an oil shock on real output and interest rates, labor markets, and the price level.³ At a given level of work effort, output declines because fewer energy resources are flowing into production.⁴ The magnitude of the downturn depends on the importance of oil to the production process and the ease with which alternative energy sources can be substituted. The drop in output reduces wealth, and is felt by households as a decline in the value of assets such as equities and real money balances.

If consumers believe that the energy shortage will be short-lived, they will hold closely to their current spending level and offset the temporary income loss by borrowing, producing upward pressure

Soaring oil prices have caused speculation about the prospects for a national recession this winter. These concerns seem to be well grounded; all but one of the eight post-World War II recessions in the United States were preceded by an oil price shock. However, there is also evidence that the influence of oil prices on economic performance has diminished. This article examines the impact of an oil shortage on the U.S. economy from a theoretical perspective, reviews the effects that such shocks have had in the past, and discusses the problems that these crises present for monetary policy.

FIGURE 1 DOMESTIC CRUDE OIL PRICES AND RECESSIONS, 1947-85



NOTE: Shaded areas indicate recessions.

SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; and National Bureau of Economic Research.

on real interest rates. However, if consumers expect a prolonged income and wealth loss, they will reduce their spending to correspond with their diminished budget, leaving borrowing and the real interest rate unaffected.

Economic theory is ambiguous about the net impact of an oil shortage on employment. Higher real interest rates and reduced wealth encourage an increase in work effort. However, if the oil shock reduces the marginal productivity of labor and real hourly earnings fall accordingly, workers will be inclined to work less.

Finally, an oil shortage tends to exert upward pressure on the price level. This occurs because the decline in real output produces an increase in the "money" value of all goods if the supply of money remains constant. To paraphrase an old saying, the same amount of money is now chasing fewer goods.

The chronicle of oil shocks and their effects on the U.S. economy is generally consistent with the scenario outlined above (table 1). In each of the last three major oil crises (the OPEC embargo of 1974, the Iranian revolution of 1979, and the outbreak of the Iran/Iraq war in

TABLE 1 OIL PRICE SHOCKS AND THE ECONOMY
(Percent change, annual rates)

Shock description	Oil prices	Deviation from trend ^a		Change in rate of	
		Output	Hours	CPI ^b	Expected real interest ^c
OPEC embargo (1974)	65	-5.2	-1.5	0.9	-0.7
Iranian revolution (1979)	47	-1.4	2.0	2.9	1.5
Iran/Iraq war (1980-81)	31	-3.1	-1.5	2.0	3.8

a. Average, 1950-80.

b. Consumer Price Index.

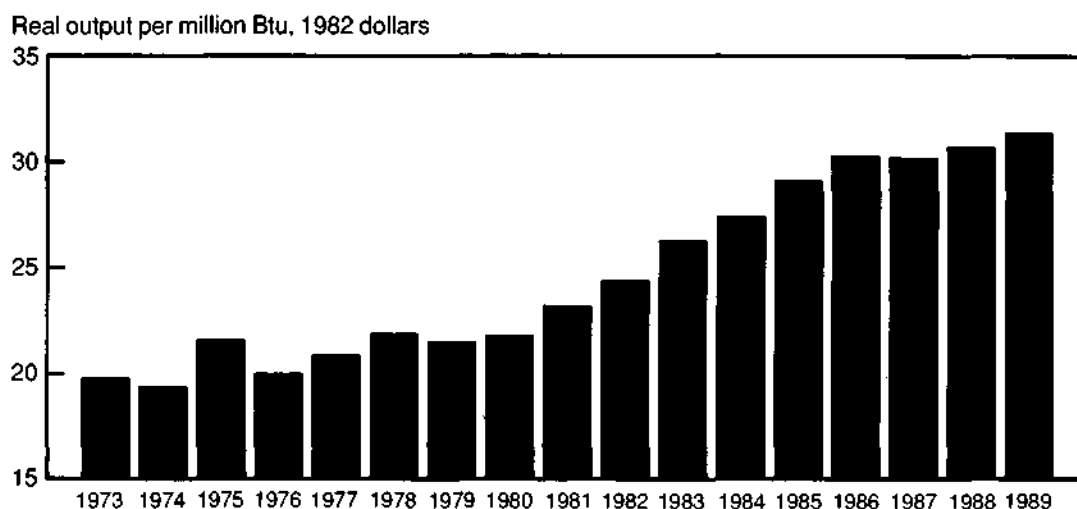
c. Treasury bill rate less Livingston Survey inflation forecast.

SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; Board of Governors of the Federal Reserve System; and the *Philadelphia Inquirer*.

1980-81), upward pressure on the price level coincided with a decline in output relative to its trend rate of growth. Clearly, these periods can be characterized as supply shocks. Moreover, evidence suggests that only the OPEC embargo was perceived as "permanent": Despite a 65 percent increase in oil prices, the expected real interest rate did not rise during this crisis. The latter two instances, the Iranian revolution and the onset of the Iran/Iraq war, seem to have been perceived as temporary shocks; while oil prices rose at annualized rates of roughly 47 percent and 31 percent, respectively, expected real interest rates also increased.⁵

Iraq's invasion of Kuwait sent oil prices skyrocketing 85 percent between mid-July and mid-September, altering the economic outlook in a predictable way. According to the September 10 (post-invasion) consensus forecast compiled by *Blue Chip Economic Indicators*, real economic growth has been revised downward 1.3 percent and inflation has been revised upward 1 percent through 1991:IIQ (table 2).⁶ However, the predictions for output growth and inflation beyond 1991:IIQ have been virtually unaffected by the energy price shock, an indication that forecasters expect the full effects of the shock to be felt fairly quickly. The revised forecast does show

FIGURE 2 ENERGY EFFICIENCY IN THE INDUSTRIAL SECTOR



SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis; U.S. Department of Energy, Energy Information Agency; Board of Governors of the Federal Reserve System; and the Federal Reserve Bank of Cleveland.

TABLE 2 IMPACT OF THE CURRENT OIL CRISIS ON THE ECONOMIC OUTLOOK^a
(Percent, annual rates)

	1990		1991			
	IIIQ	IVQ	IQ	IIQ	IIIQ	IVQ
Real GNP						
Pre-invasion	2.1	1.9	2.2	2.3	2.4	2.5
Post-invasion	1.0	0.0	0.5	1.6	2.3	2.7
Change	-1.1	-1.9	-1.7	-0.7	-0.1	+0.2
Consumer prices						
Pre-invasion	3.8	4.1	4.5	4.3	4.3	4.3
Post-invasion	5.8	6.0	4.7	4.2	4.2	4.2
Change	+2.0	+1.9	+0.2	-0.1	-0.1	-0.1
Real interest^b						
Pre-invasion	3.8	3.4	3.0	3.1	3.1	3.1
Post-invasion	1.7	1.3	2.4	2.8	2.8	2.9
Change	-2.1	-2.1	-0.6	-0.3	-0.3	-0.2

a. Based on the *Blue Chip Economic Indicators* consensus forecasts of July 10, 1990 (pre-invasion) and September 10, 1990 (post-invasion).

b. Treasury bill rate less Consumer Price Index.

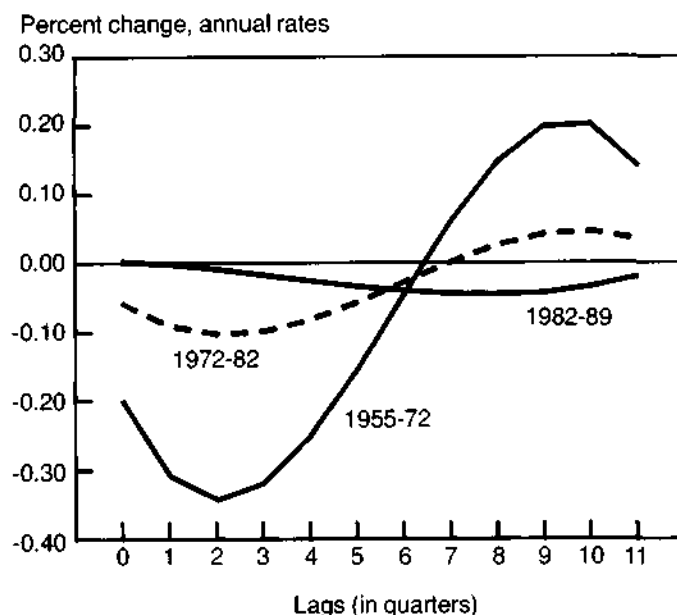
SOURCE: *Blue Chip Economic Indicators*, Sedona, Arizona.

a negative impact on expected real interest rates, however. This downward adjustment seems to indicate that borrowing demands will ease in response to the crisis; that is, the oil price increase will not soon be reversed.⁷

There is reason to believe that the capacity of the U.S. economy to ride out a long-lived energy price shock has improved substantially since the oil crisis of 1974: Industrial output has grown roughly 50 percent since 1973, and yet petroleum usage has fallen 9 percent and total energy usage is off 6 percent in that sector. Stated simply, the overall energy efficiency of the economy is 37 percent greater today than it was in 1973, and in the industrial sector, energy efficiency has improved 55 percent (figure 2).

To illustrate the diminished influence of oil on real economic activity, we estimated the lagged impact of changes in the price of crude oil on real GNP growth for three periods: 1955-72, 1972-82, and 1982-89 (figure 3).⁸ In the 1955-72 era, a 10 percent rise in petroleum prices was followed by a net real GNP loss of 0.7 percent per year over a span of three years. During the 1972-82 period, an oil price increase of similar magnitude caused a much smaller reduction in

FIGURE 3 IMPACT OF LAGGED OIL PRICE INCREASES ON REAL GNP GROWTH, 1955-89



SOURCE: Authors' calculations.

output—0.3 percent annually over a three-year interval. For the 1982-89 period, the effect of oil price changes on the economy was minimal: Over the three years following a 10 percent oil price increase, real GNP tended to fall by only about 0.2 percent per year. Moreover, the estimates from the 1982-89 period were not statistically significant.⁹

■ The Supply of Oil and the Supply of Money

Can monetary policymakers do anything to offset the negative effects of an oil shock? Clearly, higher oil prices reduce output and exert upward pressure on the price level. It would seem, then, that supply shocks present a dilemma; if the Federal Reserve is inclined to repress the rise in prices, it should seek to reduce bank reserves, but if it intends to support output, then it may be tempted to ease.

First, consider the correspondence between relative oil price increases and the inflation rate in the United States (figure 4A). Historically, as oil prices have soared, so too have non-oil, non-food consumer prices. By what process do higher oil prices produce a rise in the general price level? Virtually

all goods (and services) can, to varying degrees, be linked to oil, and the ability of firms to pass these higher costs on to consumers depends on the degree to which consumers can find substitutes. Yet higher oil prices cannot be automatically transmitted across all goods and services—there simply is not a sufficient stock of money in circulation to allow for a general rise in the price level. Without monetary accommodation, the prices of some goods will rise only if the prices of other goods fall.

However, the decline in national output caused by an oil shortage creates a surplus of money relative to output. These excess money balances push up the prices of all goods and services; hence, it is the surplus of money that ultimately allows the oil price increase to be transmitted as a general inflation. Figure 4B shows that soaring oil prices correspond with a surge in base money relative to national output.¹⁰

It would be consoling to know that the Federal Reserve could forestall the slowdown in business activity that stems from an oil shock. So many uncomfortable adjustments to higher oil prices

could then be avoided. But unfortunately, the decline in real output reflects the fact that an important raw material is now scarcer. No increase or decrease in money supply or interest rates will make foreign oil more readily available to the United States.

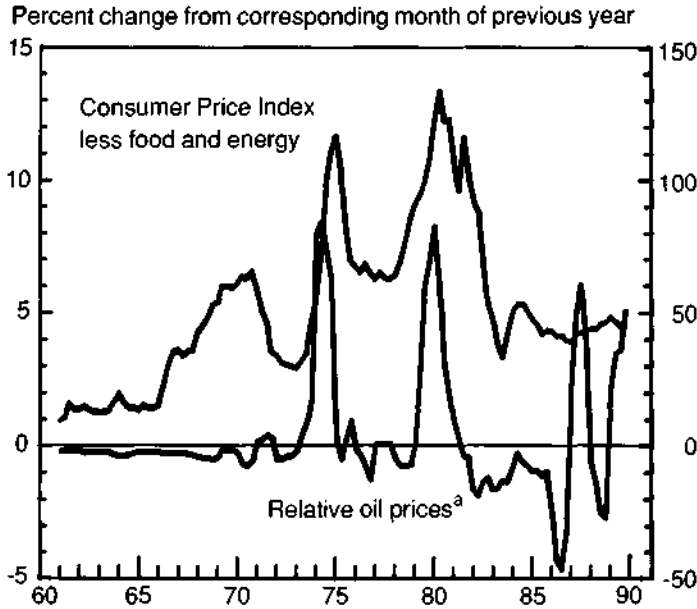
Still, monetary policy might attempt to offset certain secondary effects of an oil price shock. Major economic adjustments are rarely smooth; a temporary lull in aggregate demand and a rise in *involuntary* unemployment may occur as a nation adjusts to higher energy prices.¹¹

Involuntary unemployment arises as a result of various impediments to the market adjustment process, such as institutional or governmental restrictions and imperfect information. At the heart of these impediments are erroneous expectations—that is, contracts and other temporarily fixed agreements that were negotiated prior to the oil shock. For example, the oil shock may cause a drop in labor productivity, producing downward pressure on real wages that exceeds the real wage decline that would result from rising prices alone. Employees may resist wage adjustments if they have previously established labor agreements. If they do resist, unemployment will rise, since firms will now find real wage levels incompatible with the deteriorating business climate. The rise in involuntary unemployment also implies that output will fall by more than what the supply shock alone would indicate.

We can further presume that the change in oil prices redistributes income from energy users to energy producers. This prompts offsetting spending decreases by consumers and spending increases by producers. However, there is no guarantee that the two events will occur simultaneously.¹² These adjustments may play out over a period of time, and as they do, aggregate demand could be temporarily reduced and real wages may need to temporarily fall.¹³

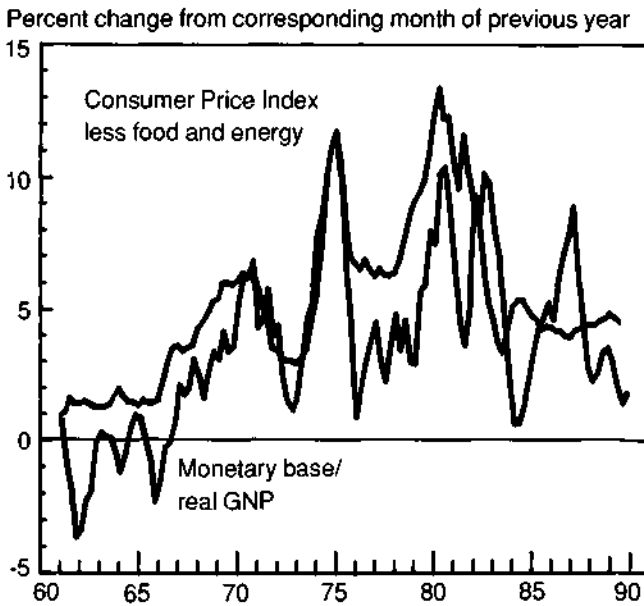
If a monetary policy easing could lower real interest rates and encourage a rise in spending, the Federal Reserve might try to offset temporary reductions in aggregate

FIGURE 4A INFLATION AND RELATIVE OIL PRICES



a. Oil prices divided by Consumer Price Index less food and energy.
SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; Board of Governors of the Federal Reserve System; and the Federal Reserve Bank of Cleveland.

FIGURE 4B INFLATION AND THE MONETARY BASE/REAL GNP RATIO



SOURCES: U.S. Department of Labor, Bureau of Labor Statistics; Board of Governors of the Federal Reserve System; and the Federal Reserve Bank of Cleveland.

gate demand that stem from the supply shock, then institute a period of tightening in order to avoid an environment of "excess spending" as markets adjust.

Using monetary policy to "fine tune" aggregate demand is, of course, a controversial matter among economists. First, the Federal Reserve's ability to determine real interest rates is open to question. Moreover, if a channel from monetary policy to aggregate demand does exist, both the strength and the timing of this linkage are unclear. Furthermore, data may be neither timely nor accurate enough to reveal the development of a shortfall in aggregate demand. It is possible that a monetary policy aimed at stabilizing aggregate demand may actually destabilize the economy as the uncertainties caused by the supply shock are compounded by fluctuations in money, inflation expectations, and interest rates. Efforts to fine tune the economy may, in the end, simply impede the adjustment to a new set of relative prices and resource usage patterns, both of which are necessary responses to higher-priced oil.

■ **Conclusion**

Theory offers some insight into how the supply shock associated with Iraq's invasion of Kuwait will impact the U.S. economy. Unfortunately, monetary policy cannot change the reality that oil prices are now higher and therefore output will be lower than it would otherwise have been. However, it is necessary to weigh any benefit of using monetary policy to smooth the adjustment process against the risk of enabling the oil price increase to be transmitted as an increase in the inflation rate.

■ Footnotes

1. James D. Hamilton is a leading proponent of this view. See James D. Hamilton, "Oil and the Macroeconomy since World War II," *Journal of Political Economy*, vol. 91, no. 2 (April 1983), pp. 228-48.
2. Supply shocks can also have a positive impact on the economy. Two examples are the discovery of a natural resource (Alaskan oil reserves) and a technical innovation (computers).
3. This discussion assumes efficient, rational, and instantaneous market adjustments to the shock. For a textbook discussion of supply shocks and macroeconomic activity from this neoclassical perspective, see Robert J. Barro, *Macroeconomics*, 2d ed. New York: John Wiley & Sons, Inc., 1987.
4. Work effort is defined as total hours worked in the economy, and reflects the level of employment and the average number of hours worked per person.
5. These expectations seem to have been largely borne out. Real oil prices remained above their pre-1974 level for a period of 12 years following the 1974 shock. In contrast, the real oil price increases of 1979 and 1980-81 held for relatively brief periods.
6. As compared with the July 10, 1990 (pre-invasion) forecast.
7. This seems to be contrary to the oil price expectations implied in futures markets, which indicate that crude oil prices are expected to fall back to near their pre-invasion level over the next 12 months.
8. These estimates were made using an Almon-type distributed lag regression. Our results were quite similar to the response functions reported by Hamilton (see footnote 1).

9. Because the impact of oil on the economy may not be symmetric, the 1982-89 period could have been influenced by the large decline in energy prices that occurred during these years. For a detailed explanation of this possibility, see Knut Anton Mork, "Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results," *Journal of Political Economy*, vol. 97, no. 3 (June 1989), pp. 740-44.

10. Money is measured by the monetary base—currency held by the public plus bank deposits at the Federal Reserve.

11. There is ample evidence that the rate of unemployment rises following energy shocks. For example, Hamilton identifies a strong linkage between oil price shocks and the rate of unemployment (see footnote 1), while Loungani shows that structural shifts previously claimed to impact unemployment rates may actually have been responses to changing oil prices. In both instances, however, the increase in unemployment caused by a reallocation of resources may be the result of a rise in the full-employment rate of unemployment, or natural unemployment. This is distinctly different from the involuntary unemployment caused by nominal wage rigidity. See Prakash Loungani, "Oil Price Shocks and the Dispersion Hypothesis," *Review of Economics and Statistics*, vol. 68, no. 3 (August 1986), pp. 536-39.

12. For example, domestic energy producers' propensity to consume and invest may be less than that of domestic users. In the case of foreign energy producers, it may be that export demands increase less rapidly than domestic consumer spending declines.

13. The Council of Economic Advisors estimated that the 1979 oil price shock reduced aggregate demand by \$53 billion that year. (See *Economic Report of the President*, Washington, D.C.: U.S. Government Printing Office, January 1980, p. 65.) To the extent that the income redistribution is believed to be temporary, the aggregate demand/unemployment rate effects will be smaller.

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