

# ECONOMIC COMMENTARY

Federal Reserve Bank of Cleveland

## The Sectoral and Regional Effects of Oil Shocks: Who's over a Barrel?

by Paul W. Bauer and Susan M. Byrne

Once again the United States has been jolted by an oil price shock. Since Iraq's August 2 invasion of Kuwait, the cost of crude has soared as high as \$41 a barrel. And although prices have since moderated, they continue to exceed the pre-invasion level. The U.S. economy has already begun to register adverse effects, as rising energy costs have contributed to the economic slowdown and a general increase in prices. Furthermore, heightened uncertainty about future oil prices and the prospects for war in the Persian Gulf could weaken the economy even more as some firms reduce, delay, or cancel projects in the face of these added risks.

Although the sluggish economy has touched almost every region and business sector, some have been hit harder than others, while a few have actually benefited. Oil producers in Texas and Alaska, for example, have enjoyed increased revenues from the doubling of crude prices, while New Englanders have had to brace for escalating home heating costs. This *Economic Commentary* provides a framework for analyzing the regional and sectoral effects of higher oil prices, identifying those areas most likely to be hurt and those that might benefit. It also presents evidence that the impact of the current oil shock will not be as severe as that of previous ones.

### ■ A General Framework

Oil is essential to industrialized economies, both as an input in many produc-

tion processes and as a major source of energy. Three factors determine the influence that an oil price shock will have on firms and, ultimately, on sectors and regions: 1) oil's share of firms' total costs, 2) the ease with which firms can substitute other inputs for oil (for example, by purchasing more fuel-efficient capital equipment or by altering production techniques), and 3) consumers' ability to switch to other products if a firm attempts to raise its prices.

The importance of these factors is illustrated by current difficulties facing the airline industry. Oil price shocks tend to hit the airlines faster and harder than many other industries because airlines buy oil on the spot market, and oil comprises one-fifth of the industry's total costs. Also, there are few opportunities to substitute other inputs for jet fuel.<sup>1</sup> Compounding the injury is the fact that oil shocks tend to be followed by a generally weakened economy and a consequent drop-off in the demand for air travel, making it difficult for airlines to recoup their higher costs through increased fares.

### ■ Oil Usage by Sector

In order to examine the differences in oil consumption across industries, we divide the economy into five sectors: transportation, industrial, residential, commercial, and electric utilities. Of these, transportation will probably be hit most severely by the current oil shock, because the industry accounted for al-

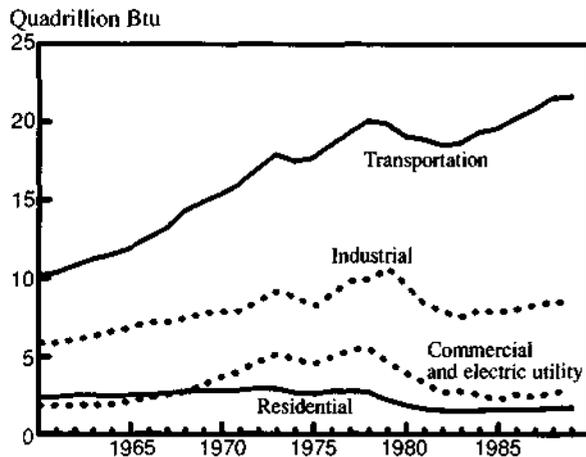
Although rising oil prices have a net negative impact on the U.S. economy, certain regions and business sectors suffer disproportionately, while others actually benefit. This article examines the regional and sectoral effects of higher-priced oil, citing evidence that the current shock will have less of an impact on overall economic performance than previous shocks have had.

most 63 percent of all oil consumed in the United States in 1989 — more than that of the other three sectors combined — and because the short-run opportunities for switching to alternative fuels are so limited (see figure 1).

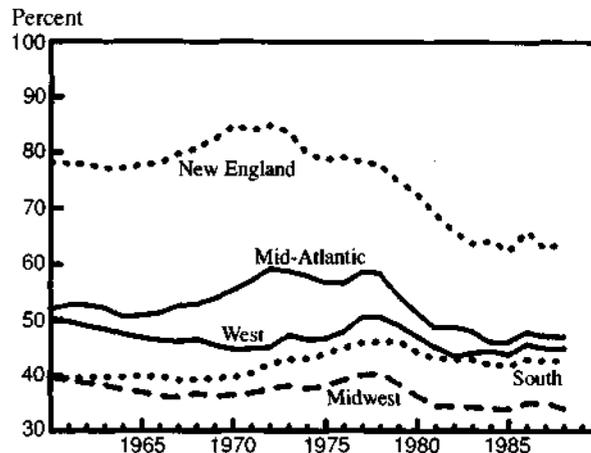
Higher oil prices may also induce significant movements of cargo and passengers from less-fuel-efficient to more-fuel-efficient modes of transportation, such as from truck to rail and from private automobiles to public transportation. Because most industries and consumers depend on transportation services, the price increases in this sector also affect other areas of the economy.

Although the industrial sector accounts directly for about 25 percent of all U.S. oil consumption, a price shock should have less impact there than on transportation, since oil accounts for no more than 7 percent of total industrial costs

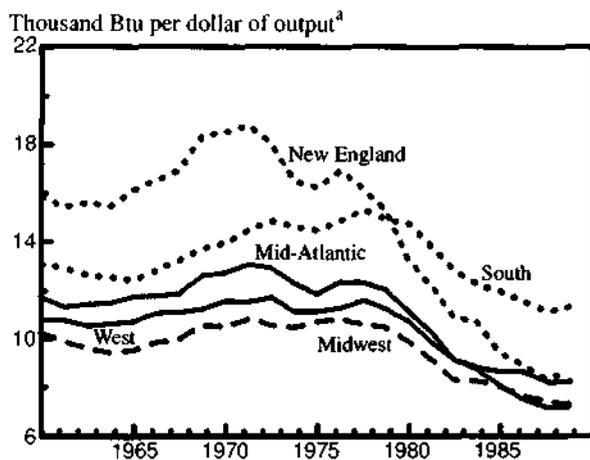
**FIGURE 1 OIL CONSUMPTION BY SECTOR**



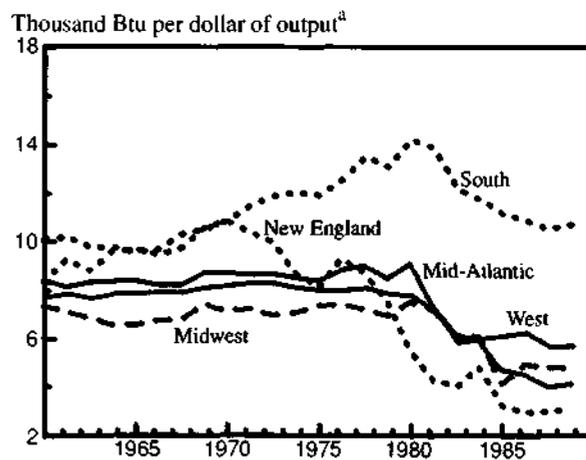
**FIGURE 2 OIL USAGE RELATIVE TO TOTAL ENERGY USAGE**



**FIGURE 3 REGIONAL OIL EFFICIENCY**



**FIGURE 4 INDUSTRIAL OIL EFFICIENCY**



a. Measured in 1982 dollars using real gross state product data.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis; and Energy Information Administration, State Energy Data Report.

(excluding petroleum refining). However, industry's indirect use of oil (through purchases of transportation services, for example) could compound the effects of a price hike.

The residential sector represents only 4.7 percent of all oil consumed in the United States, primarily for home heating. But because price increases are paid directly by consumers, the psychological impact may be greater than the share of consumption would suggest. In those regions where oil is the predominant home heating fuel, residents have few short-run alternatives. However, over the long run they can switch to propane or electricity, or even add insulation. And although the installation

of natural gas lines is expensive and disruptive, some communities are moving in this direction.

The commercial and electric utility sectors combined comprise just 7.7 percent of U.S. petroleum consumption. Higher oil prices are likely to have only a small direct effect on these industries, because oil's share of total costs is minimal. During the 1970s, electric utilities were the third-largest consumers of oil, representing almost 12 percent of total U.S. consumption. Since 1978, however, that figure has plummeted to 4.6 percent, and electric companies now typically use oil-fired generators only during high peak-load periods.

■ **Regional Variations in Oil Usage**  
Relative to total energy usage, New England consumes the most oil, followed by the Mid-Atlantic, the West, the South, and the Midwest (figure 2). These regional variations stem from differing industrial compositions and oil efficiencies within sectors. These same factors also lead to regional differences in the effects of higher oil prices.

The regional variation in industrial composition is substantial. For example, with respect to states, manufacturing employment as a share of total employment ranges from a low of 4.4 percent for Nevada to a high of 28.3 percent for North Carolina. With respect to specific industries, the midwestern states have a

**TABLE 1 RANKING OF STATES BY THE EFFECT OF HIGHER OIL PRICES ON THE GROWTH RATE OF GSP<sup>a</sup>**

State	Initial effect	After 1 year	After 2 years	Net effect
<b>Top Ten</b>				
Alaska	0.20	0.92	-0.33	0.79
Wyoming	0.41	0.05	-0.02	0.43
Louisiana	0.16	0.10	0.07	0.32
Oklahoma	0.07	0.07	0.10	0.24
New Mexico	0.09	0.04	0.04	0.17
Texas	0.04	0.08	0.05	0.16
West Virginia	-0.04	0.03	0.02	0.01
North Dakota	-0.04	0.07	-0.04	-0.02
Montana	-0.09	0.12	-0.05	-0.02
Utah	-0.06	-0.01	0.05	-0.02
<b>Bottom Ten</b>				
Oregon	-0.13	-0.07	-0.01	-0.21
Georgia	-0.24	0.01	0.02	-0.21
Florida	-0.15	-0.03	-0.04	-0.21
Massachusetts	-0.25	0.07	-0.03	-0.22
Hawaii	-0.06	-0.07	-0.10	-0.22
South Dakota	-0.10	-0.15	0.03	-0.22
Maryland	-0.23	0.07	-0.06	-0.22
Rhode Island	-0.29	0.11	-0.06	-0.23
Michigan	-0.33	0.04	0.02	-0.28
Arizona	-0.13	-0.11	-0.07	-0.30

a. Numbers reflect the impact of a 1 percent increase in oil prices on real GSP growth. For example, a 1 percent increase in oil prices initially leads to a 0.20 percent increase in Alaska's GSP growth rate.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis and Bureau of Labor Statistics; and Federal Reserve Bank of Cleveland.

much heavier concentration of transportation equipment firms than do other regions.

The relative efficiencies in the use of oil also vary across the nation. The impact of these variations in industrial composition and oil efficiencies can be seen in regional differences in oil usage per dollar of output (figure 3). The southern states rely most heavily on oil to produce a dollar's worth of output, because many of their industries use significant amounts of oil in the production process (petroleum refineries, for example). Other regions tend to be much more alike in this respect.

Oil usage within individual sectors also differs across regions. Within the industrial sector, for example, oil usage

per dollar of output ranged from a high of 11,000 Btu in the South to a low of 3,100 Btu in New England in 1986. The Mid-Atlantic, Midwest, and West have been reducing their industrial oil consumption since the late 1970s (figure 4). Note, however, that New England's industries began to lessen their dependence on oil much earlier, possibly reflecting that region's shift away from petroleum-intensive manufacturing and toward industries such as electronics and telecommunications. The South's pattern again deviates from that of the rest of the country, mainly due to the heavy concentration of oil refineries in Texas and Louisiana and the in-migration of manufacturing from New England and the Midwest.

Wide variations in oil usage across regions are also apparent in other sectors. For example, New England's residential and electric utility sectors combined comprise the largest share of that region's total oil consumption. The residents of New England depend more than other Americans on heating oil, with a per-capita consumption rate more than two and one-half times that of the Midwest. New England's electric utilities also are quite dependent on oil. Like its homes, the region's electric generating plants were constructed before the relative shift in fuel prices, when oil could compete successfully with other energy sources.

The residential and electric utilities sectors of the Mid-Atlantic are also relatively heavy users of oil, but because of a more moderate climate, the demand for heating and cooling is not as great. The South differs from the rest of the nation in that a much higher share of its oil is consumed by the industrial sector. One reason for this is that some southern states produce oil, so petroleum-intensive industries have found it advantageous to locate there. In the West, the transportation sector comprises a greater share of total oil usage than in the nation as a whole, reflecting that region's lower population density and greater mileage between cities. In the Midwest, oil consumption patterns generally mirror those of the nation, with one exception. Virtually no oil is used to generate electricity here, since coal was the cheapest fuel when most of this region's electric power plants were constructed.

Note that to this point we have addressed the issue of higher oil prices only by examining consumption patterns. However, the United States is also one of the world's largest petroleum producers. Furthermore, three-fourths of the country's total production is concentrated in only four states: Alaska, Texas, Louisiana, and California. Higher-priced oil obviously benefits these states' oil producers. And in states such as Alaska, where oil revenues comprise a large share of the gross state product (GSP), the entire state may emerge as a net gainer.

### ■ Putting It All Together

What, then, is the net effect of rising oil prices on various regions of the country? To answer this question, we estimate how changes in oil prices over the last several decades have affected the growth rate of GSP. Our results are presented in table 1.

As expected, higher-priced oil boosts GSP for the largest oil-producing states by the end of the first year following an initial shock. Alaska's and Wyoming's economies seem to benefit from a price increase in the short run, but long-run adjustments within their oil-consuming industries eventually offset these gains to some degree. Higher oil prices even appear to benefit West Virginia, a leading coal producer. The initial negative effect of an oil shock on the state's economy indicates that consumers need time to switch from oil to coal.

The states most adversely affected by higher oil prices are those with a large manufacturing base (Michigan and Maryland) and those that rely heavily on agriculture and forestry (South Dakota, Arizona, Georgia, and Oregon). In every case, oil shocks had an immediate negative impact on these states' GSP.

### ■ The Future Impact of Higher Oil Prices

This analysis has examined the average impact of oil price shocks on states over the last several decades. Obviously, the structure of state economies has changed since the early 1970s, both in the composition of economic activity and in patterns of oil consumption. One of the most striking transformations has been the significant reduction in oil usage across all regions. As shown in figure 3, oil consumption per GSP has fallen nationwide since the oil shocks of the 1970s. The greatest decline has occurred in New England, where textile manufacturing has given way to less oil-intensive concerns such as the semiconductor and aerospace industries. The South, on the other hand, has experienced the least conservation in oil usage, as agriculture has become more dependent on petroleum-based products and manufacturing has migrated in from the North.

Overall, oil price shocks have less of an effect today than they did in the 1970s. And if present trends in energy conservation continue, we can expect future price shocks of similar magnitude to have even less of an impact. A recent study suggests that the United States is better shielded against an oil shock now than it has been in the past, particularly in the industrial sector, where oil efficiency has improved

substantially since 1974.<sup>2</sup> Nonetheless, it is apparent that the regional and sectoral effects of oil price shocks vary significantly, contributing to deviations in the timing and intensity of regional business cycles.

### ■ Footnotes

1. In the short run, fuel efficiency can be boosted by flying slower, but this requires greater usage of other inputs, such as pilot hours. In the longer term, worn-out jet engines can be replaced with more fuel-efficient models. However, because of the expense and longevity of these engines, early replacement is undesirable even for relatively large increases in fuel prices.

2. See Anderson, Gerald H., Michael F. Bryan, and Christopher J. Pike, "Oil, the Economy, and Monetary Policy," Federal Reserve Bank of Cleveland, *Economic Commentary*, November 1, 1990.

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