

# Chicago Fed Letter

## Oil and competition in world markets

Turmoil in the Middle East once again confronts the economies of the U.S. and other oil importing countries with concerns about disruption in oil markets. Although supplies are not drastically lower, oil prices have jumped from \$20 per barrel at the end of July to around \$40. The price hikes reflect not only the current tightness in supplies but also uncertainty about the prospects for war, which would seriously disrupt oil supplies.

How will the U.S. economy respond to the last oil price shock? How will it affect U.S. living standards? How will it affect U.S. international competitiveness? To address these questions, we examine some of the changes in energy/oil use and efficiency in the U.S. economy since the oil price shocks of 1973-74 and 1979-80. On the international side we examine similar developments in France, West Germany and Japan.

### Background

This third oil price shock (four, counting the rapid decline in oil prices in 1986) in less than two decades comes at a difficult time for many of the world's economies. It puts at risk the already slowing economic expansion in several of the industrial nations and the economic recovery in the developing countries that depend on imported oil. It also threatens to impede the successful adjustment of the Central and Eastern European economies to the rigors of free market forces as they face paying for oil imports at much higher market prices in dollars in-

stead of below market prices in Soviet rubles.

Government policy makers and monetary authorities face a dilemma. On the one hand, they are pressed to follow restrictive policies to check inflationary pressures that are exacerbated by higher oil prices. On the other hand they are pressed to relax economic policy in order to prop up slowing economic expansion. This dichotomy is especially sharp in the U.S. environment, where a weak domestic economy is relying heavily on its competitiveness in world markets to shore up overall economic activity.

### Measuring energy use and efficiency

Oil price shocks do not hit all economic sectors or all economies equally. The intensity of the impact depends upon at least three factors:

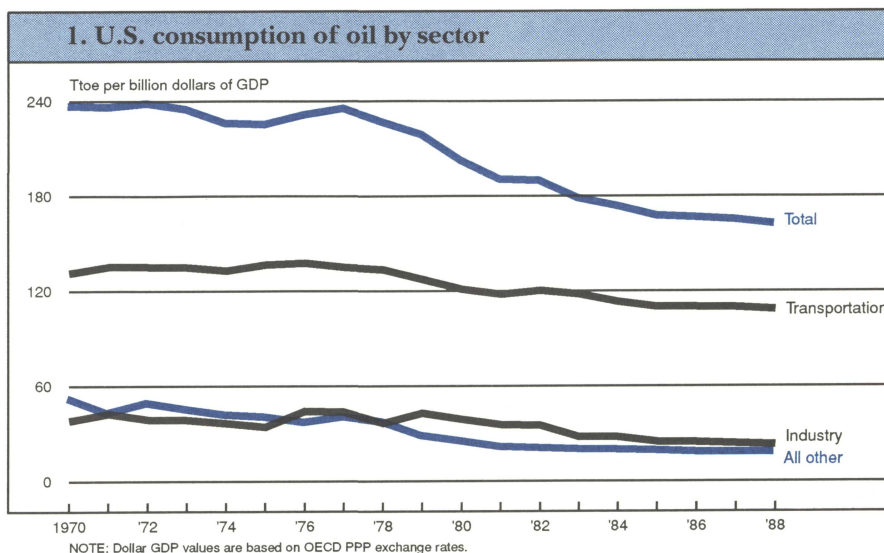
1. A sector's or economy's relative energy dependence compared with other sectors or economies

2. The availability of alternative energy sources and the relative ease of change by a sector or economy to those alternatives

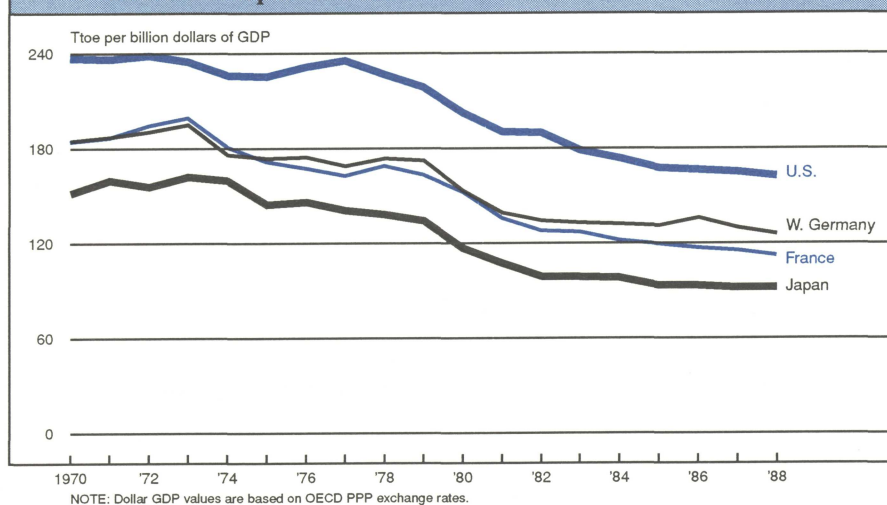
3. The relative ability of a sector or economy to increase its energy/oil efficiency

Addressing these issues to make both domestic and international comparison raises three problems: correctly measuring oil and energy consumption; establishing meaningful measures of energy efficiency; and, the bane of international comparisons, selecting the appropriate "numeraire," that is, a uniform measure of GDP of the different countries.

This analysis uses a standard unit to measure energy use—"tons of oil equivalent" (toe).<sup>1</sup> Efficiency is treated as units of energy input-per-unit of output (thousands of toe per billion units of real gross domestic product—Ttoe/bilGDP).<sup>2</sup> Thus, as Ttoe/bilGDP declines, energy efficiency increases.



## 2. Total consumption of oil



Cross-country comparisons pose a more difficult issue—that of an appropriate numeraire. This is necessary for efficiency measures. Adapting the Ttoe/bilGDP measure of efficiency across countries by converting GDP values to a common currency, for example dollars, is an appealing approach. But what foreign-currency/dollar exchange rate reflects some “normal” international economic environment?

In an attempt to take a “neutral” approach to this problem, we define the exchange rate between foreign currencies and the dollar as that based on a measure of “purchasing power parity” (PPP)—the exchange rate that identifies an equivalent bundle of goods and services between two countries.<sup>3</sup>

### Our standard of living takes a hit...

...but the hit won't be as bad as in past oil shocks. Substantial progress in energy efficiency has been made in the U.S. since 1970. Not only have various sectors of the economy become more efficient in their use of energy, but there also has been a reorientation of the industrial mix within the economy, resulting in the development of new industries that are less energy-intensive. Overall, total energy consumption relative to real GDP declined 32% between 1970 and 1988. The decline in oil

consumption relative to GDP was essentially the same at 31%. Comparing U.S. sectors, we examine “industry,” “transportation,” and “all other” (see Figure 1).

Energy consumption by the “industry” sector declined 43% relative to GDP. On a share basis, industry's proportion of all fuel consumption in the U.S. dropped from 35% of the total in 1970 to 30% in 1988. Industry also reduced its share of oil consumption—from 16% to 14%. This share reduction for oil wasn't simply a switch to alternative fuels: Natural gas consumption by industry also declined as a share of total gas consumption—from 48% to 43%.

Large efficiency gains also accrued to the “all other” sector of the economy, of which residential and commercial establishments are important components. Relative to GDP, total energy use by this sector declined one-third between 1970 and 1988. Oil use declined two-thirds, and natural gas use was down two-fifths. Electricity, on the other hand, an important component of energy use in this sector, increased 22% relative to GDP (oil is not a large component of electrical generation).

Energy efficiency in “transportation” also increased during this period, but less so than for the “industry” or for “all other” sectors—the de-

cline in energy use relative to GDP was 17%. For this sector energy use is largely equivalent to oil use.

In terms of overall energy use, or the share of total energy consumption accounted for by transportation, this sector became a relatively larger user of energy during the past 20 years. In 1988 transport's share rose to 35% of total final consumption of all fuels in the U.S. compared with 29% of the total in 1970.

The relatively poorer performance by transportation should not come as a big surprise. The U.S. is a heavy consumer of individual transportation services as compared with mass transportation services. U.S. population distribution and infrastructure strongly support the expansion of individual transportation services, which require a comparatively high energy content. Thus, transportation in support of industry, households and commercial establishments, and agriculture has more than grown apace with the growth in these other sectors.

The relatively slower adjustment by transportation to higher oil prices suggests that this sector is likely to be more vulnerable to oil price shocks than are the industry and all other sectors. It is virtually totally dependent on oil as an energy source and to date has no viable alternatives. Apart from gains in technical efficiency, which all sectors must rely on, any immediate gains in efficiency, relative to GDP, for this sector will likely have to come from reduced use of transportation services—in effect, a reduction in the standard of living, particularly for those who make extensive use of such services. To some degree this latter consequence also applies to short-term efficiency gains by the residential component of the “all other” sector of the economy.

### International energy use comparison: We fare poorly but are doing better

1. What has happened to the relative efficiency of U.S. oil consumption during the period 1970-88, as com-



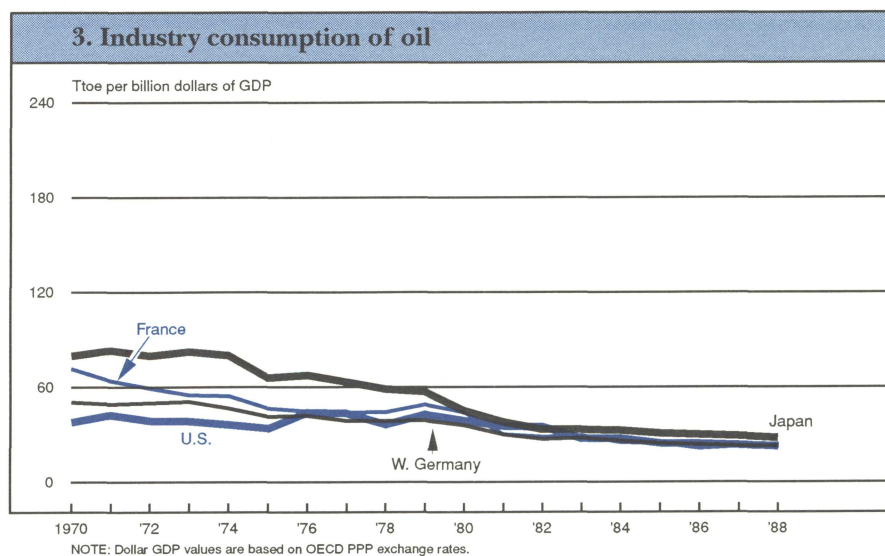
pared with three other major industrial economies—France, West Germany, and Japan?

2. What does the relative change in efficiency imply for U.S. international competitiveness?

A clear conclusion to be drawn from examining comparative energy use data is that the U.S. is a relatively heavy user of oil in comparison with West Germany, France, and Japan (see Figure 2). In 1988, for example, the U.S.'s total final consumption of oil stood at 163 Ttoe/bil\$GDP, well above the equivalent measures for West Germany (126), France (113), and Japan (92). Importantly, each of these countries became substantially more oil efficient following the first oil price shock in 1973-1974. Oil consumption relative to GDP declined 39% in France and in Japan, 32% in West Germany, and 31% in the U.S. However, the composition of the gains in efficiency by sector differed markedly across countries.

Examination of oil consumption data by the industry sector provides a somewhat mixed picture. In 1970 the U.S. was the lowest user of oil in industrial applications relative to GDP (see Figure 3). Between 1970 and 1988 the U.S. halved its oil use in industrial applications—from 39 to 23 Ttoe/bil\$GDP. During that period, however, Japan, France, and West Germany made even greater strides. In Japan, oil usage relative to GDP declined from 80 to 28 Ttoe/bil\$GDP; in France from 72 to 22; and in West Germany from 51 to 23. Thus, oil efficiency in industry for these competitors moved into line with that of the U.S.<sup>4</sup> The U.S. remained competitive but over the period became relatively less so.

As noted earlier, the U.S. has improved its oil use efficiency in transportation (see Figure 4). However, the U.S. is a transportation-intensive country and that sector's use of oil relative to GDP is high—109 Ttoe/bil\$GDP in 1988, as compared with 56 for West Germany, 57 for France, and 36 for Japan. It is interesting to



note, however, that transportation's oil efficiency in Japan was essentially stable during the 1970-88 period. In West Germany and France transportation's oil efficiency deteriorated.

In the "all other" sector, which includes households, commercial establishments, and agriculture, U.S. oil efficiency compares favorably, in terms of absolute values and in the rate of improvement. In 1988 U.S. oil consumption by this sector stood at 18 Ttoe/bil\$GDP, one-third its 1970 level, which compared well with levels ranging from 23 for Japan to 42 for West Germany.

#### Pulling it all together

Similar conclusions emerge from both the international and domestic comparisons of energy efficiency. The U.S. has made progress in improving oil efficiency since 1970. But so have its industrial competitors.

The oil-use efficiency of U.S. industry is on a par with industry of the major competitors, but it has not adjusted to higher oil costs with the same rapidity as other countries. Thus, in a relative sense, the U.S. has lost competitive position in terms of oil efficiency in industry. Progress in oil consumption efficiency by the "other" sector of the U.S. economy has been favorable—absolutely and relative to the other countries.

The transportation sector in the U.S., and those who rely heavily on it, take it on the chin in the domestic as well as the international comparison, largely because it is a relatively heavy user of energy. Major price movements can be expected to influence this sector adversely. On the positive side, however, in the international comparisons U.S. transportation has gained in relative oil efficiency although it has a long way to go in an absolute sense to reach parity.

Of course, energy consumption and efficiency are part of a larger framework in determining the competitive stance of the U.S. during an oil crunch. Another element in the framework is the behavior of the dollar in foreign exchange markets.

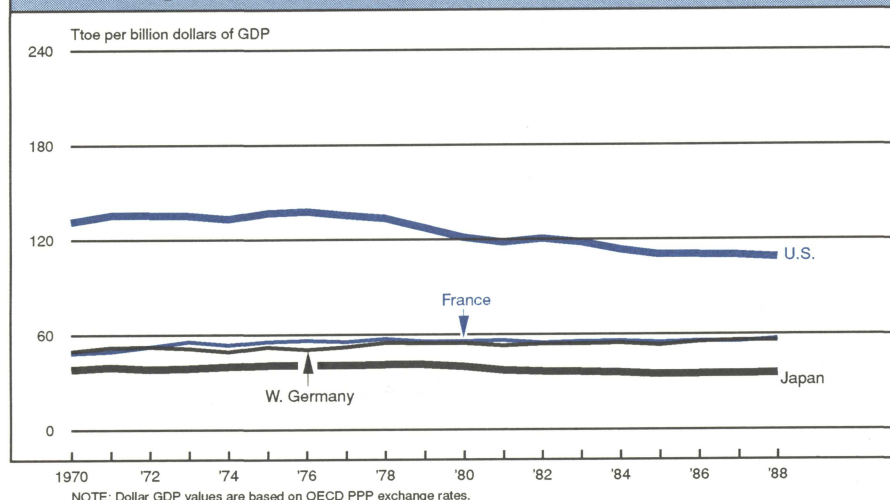
Karl A. Scheld, Senior Vice President and Director of Research; David R. Allardice, Vice President and Assistant Director of Research; Judith Goff, Editor.

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#### 4. Transportation consumption of oil



In the late 1980s, like the 1970s, the depreciation of the dollar tended to increase U.S. competitiveness in world markets, although it also made oil (denominated in dollars on world markets) cheaper for foreign producers. In contrast, the appreciation of the dollar in the early 1980s produced the opposite effect. U.S. competitiveness was depressed, but the foreign-currency cost of oil rose.

In sum, the recent increase in oil prices will have a detrimental impact

on the U.S. economy, and on its international competitive position. But, the substantial decline in the exchange value of the dollar in recent months and its resultant positive contribution to U.S. competitiveness in world markets can be expected to more than offset the deleterious effects of the oil price increase.

—Jack L. Hervey

<sup>1</sup>"Tons of oil equivalent" (toe) data are based on data developed by the Organization for Economic Cooperation and Development (OECD).

<sup>2</sup>This is the inverse of the normal efficiency measure, that is, units of output per unit of input.

<sup>3</sup>The OECD's estimates of PPP are used to adjust real GDP values by country to a dollar numeraire.

<sup>4</sup>The gains in oil-use efficiency by industry, in particular in West Germany and France, came about in part as a result of industry's switching from oil to natural gas as an energy source. In these countries natural gas use rose both in absolute terms and relative to GDP during the 1970-88 period. By comparison, U.S. industry also increased its natural gas use, but it recorded a dramatic increase in natural gas efficiency, cutting use relative to GDP in half. Even so, U.S. industry continued to record higher gas use relative to GDP (lower efficiency) than the other three countries. In sum, U.S. industry's total energy efficiency remained below that of the other three countries.

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FEDERAL RESERVE BANK OF CHICAGO  
Public Information Center  
P.O. Box 834  
Chicago, Illinois 60690  
(312) 322-5111