Energy markets and the Midwest economy

Richard H. Mattoon

Introduction and summary

The price and availability of energy has long been a critical concern to industrialized nations. In 2002, the industrialized nations as represented by the Organization for Economic Cooperation and Development (OECD) were responsible for consuming 61 percent of the world's petroleum and 51 percent of the world's natural gas.[1] Higher prices have lead to concerns about the potential drag that energy costs might have on economic growth since the first oil embargo of the 1970s. For energy-intensive industries, high energy prices can be particularly destructive. Yet the recent disruptive impact of high energy prices appears to be muted as the U.S. economy has shifted to a service base and gains have been made in reducing the reliance on energy to produce U.S. output. Twenty-five years ago it took 15,000 Btu (British thermal units) to produce $1 gross domestic product (GDP). By 2003, this had fallen to 9,500 Btu, a decline of nearly 37 percent.

For much of 2004–05, a significant economic story was the rising price of virtually all types of energy. While crude oil prices grabbed the headlines as nominal spot prices hit record highs approaching $60 a barrel,[2] less attention has been paid to the rise in natural gas and coal prices. The spot price for natural gas has risen from $4/MMBtu (per thousand Btu) in November 2003 to better than $6.25 by early November 2004.[3] In late October 2004, spot prices peaked at nearly $8.[4] Coal prices have seen an even more dramatic run up in the last several years. The spot price of Central Appalachian coal has risen from roughly $28 per ton in the first part of 2002 to a record nominal price of $66.50 a ton by late October 2004.[5]

More than the rest of the U.S., the Midwest, with its industrial legacy and seasonal weather pattern of cold winters and hot summers, is more energy reliant than the rest of the nation. In this article I will examine in greater detail how the Midwest economy (Seventh Federal Reserve District—7G) is exposed to energy prices and how this exposure has changed over time. In particular, I will look at two sources of change. First I will examine systematic improvements in energy efficiency and/or conservation. Second, I will examine changes in the structure of the economy away from energy-intensive industries toward services industries, focusing on how economic structure differs from state to state within the District and in comparison to the U.S. as a whole. I find that the Midwest has followed a similar path as the rest of the nation in reducing the amount of energy input needed to produce $1 of GDP. However, I also find that the region has, on a relative basis, increased its national share of seven energy-intensive industries, suggesting that the region will feel the effects of rising energy prices slightly more than the nation as a whole. In particular, the region is highly reliant on natural gas, so volatility and price increases in this fuel bear our particular attention.

The remainder of this article is organized as follows. The second section will provide a brief literature review regarding the importance of energy markets and energy prices to the macroeconomy and to state and regional economies. The third section will briefly describe the recent evolution of energy prices and volatility that shows that volatility may be the more difficult issue for economic performance. Energy markets have historically had a boom and bust cycle that has discouraged both consumers and producers from changing their behavior. The fourth section describes the economies of the 7-G states and how their similarities and/or differences from other parts of the

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country with respect to energy prices. The evidence suggests that the region is still relatively more exposed to energy costs than the rest of the nation as a whole. The final section offers some concluding observations.

Related literature

Since the mid-1970s economists have been examining the effect of energy and, in particular, oil price shocks on the macroeconomy. Early empirical studies tended to measure the effect by regressing GDP on oil prices and other selected variables (Rasche and Tatom, 1977a, 1977b). However isolating the effect of oil prices has always been a difficult econometric task providing very little in the way of "clean experiments" where oil prices alone cause declines in economic output. Darby (1982) makes the case that the 1973 oil price shock was the closest to a clean experiment in as much as the world was just emerging from the international monetary arrangements established at Bretton Woods and the U.S. was emerging from a period of generalized price controls, reducing the confounding effect of other factors on economic performance. In a landmark article, Hamilton (1983) found that an oil price increase has preceded every recession in the U.S. since World War II with the exception of 1960. This finding focused research attention on the importance of oil in the economy throughout the post-World War II era rather than just on the economic effect from the two oil embargoes of the 1970s.

Other work examined the effect of price volatility on adjustment mechanism in the economy. Gilbert and Mork (1986) and Mork (1989) were interested in explaining the weaker-oil-price–GDP relationship that Hamilton had found during the late 1970s by examining whether the economy had somehow adjusted to mitigate the impact of oil price shocks. These studies examined whether price movements have symmetric effects on production possibilities. They found that any change in direction triggers resource reallocation; however, increases in prices tend to have a more significant effect on the economy than decreases.

More recently, oil and energy price research has focused on its relationship to business cycle theory. In particular research has focused on the relationship between monetary policy adjustment and oil price changes (Bernake, Gertler, and Watson, 1997). This research builds on the work of Tobin (1980) that questioned whether a resource that accounts for such a small share of U.S. GDP (oil is roughly 3 percent) could cause large losses in GDP in ensuing recessions. These authors suggest that it has been monetary policy adjustments in response to an oil price spike that may have played a larger role in triggering economic decline than the oil price spike in the first place.

A recent review article (Jones, Leiby, and Paik, 2004) suggested some interesting conclusions about what is known about the current relationship between oil prices and GDP. Their review of the literature found that when price movements have been large compared with recent volatility, the effects of oil prices on the economy have been greatest. Sharp volatility is more important because a sustained higher price causes consumers and producers to alter their behavior in response to the higher price. Further they suggest that the effect is mostly seen in the reallocation of labor within specific industries. Reallocation of labor is particularly intense for manufacturing. Davis and Haltiwanger (2001) found that the oil price shock of 1973 was related to a job reallocation of 11 percent of total manufacturing employment over the next 15 quarters. However, they note in particular that this reallocation occurs within industry classifications and even at the plant level. Sector-specific and plant-specific factors are at work, suggesting that the real distributional effect of an energy price shock needs to be examined at the sector or plant level.

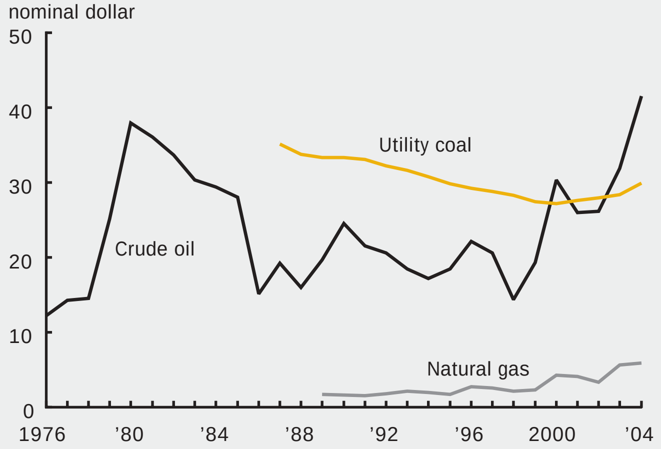
Literature on regional adjustment to energy prices

Brown and Yucel (2004) have documented the effect of higher oil prices on the Texas economy noting that the region's industries have become less energy reliant tending to mute the impact of sudden increases in oil prices. However, they have also noted that, as the oil producing and refining industries have declined in importance, the Texas economy has not received the same boost as in the past when oil companies were major beneficiaries of higher prices. Using a vector autoregression (VAR) model, they found that rising oil prices only raised Texas gross state product (GSP) by one-fifth as much during the period 1988 to 2002 as they had during the period 1970–87.[6]

In another regional study, Bradbury (2005) looked at the effect of higher energy prices on households by census region over the winter of 2003–04 in comparison to the winter of 2004–05. During this period the U.S. Department of Energy forecasted that fuel oil prices would increase by 39 percent, gasoline by 24 percent, and natural gas by 13 percent. This study recognized that the relative fuel mix used by a given region largely determines what the effect of increased energy prices will be on the average household. From the household's perspective, energy consumption falls into two broad baskets—home heating and residential needs and transportation. Each region of the country has specific energy needs determined by weather, driving patterns, and region-specific preferences for certain fuel types. Bradbury finds that the short-run impact of higher energy prices will be most felt in New England due largely to a preference for heating oil. For the Midwest, reliance on natural gas and higher than national average transportation needs drives energy costs. The projected energy cost increase as a share of consumer spending from the winter of 2003–04 to the winter of 2004–05 is estimated at 1.26 percent for New England and 1.11 percent for the East North Central region.[7]

FIGURE 1

Average annual energy prices



Notes: Crude oil is measured in dollars per barrel, natural gas is measured in dollars per million Btu, and utility coal is measured in dollars per ton.
Source: BP, 2005, *Statistical Review of World Energy 2005*, report, available at www.bp.com/genericsection.do?categoryId=92&contentId=7005893.

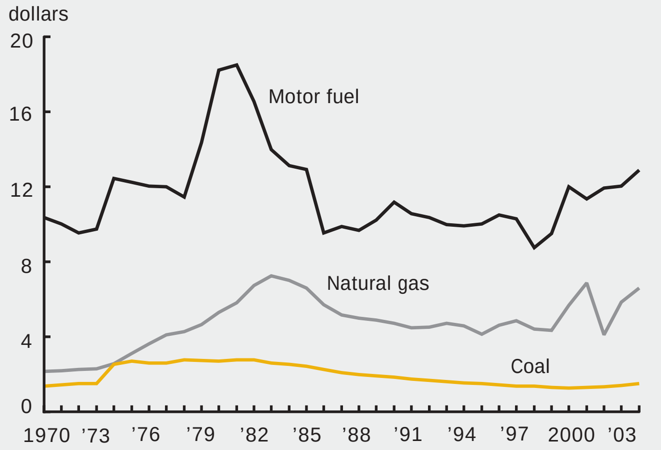
A brief history of fuel prices and volatility

In this section I provide an overview of fuel price behavior and measures of price volatility. As figure 1 demonstrates, the price movements of the three major energy fuels used in the U.S. have not moved in synch.[8] This should not be of any real surprise given that each fuel is governed by its own set of market dynamics. For example, oil prices reflect supply and demand conditions in a world market. Oil prices were clearly affected by the disruption in supply from the Arab oil boycotts of the 1970s and more recently by the growing world demand (particularly from China and India) and concerns over potential supply disruptions. In contrast, natural gas and coal prices reflect regional conditions and certain idiosyncracies specific to each fuel. In the case of natural gas, the U.S. market is highly integrated with Canada, creating a regional North American market.[9] Natural gas prices reflect the infrastructure used to deliver the product, and prices are set at regional trading hubs. The recent increase in natural gas prices reflects limitations in the pipeline infrastructure to deliver the product and growing concern that North American gas fields are maturing leading to more expensive extraction and lower well productivity. In addition the relative inability to increase liquefied natural gas (LNG) imports by the U.S. (LNG accounts for 2 percent of U.S. energy consumption) means that no ready substitute for North American production exists. Finally, in the case of coal, the market has been shaped by continued concern over the environmental attributes of the fuel. While coal is still the preferred fuel for baseload electricity generation, years of environmental regulation and potential concern over options such as carbon taxes has limited coal consumption. The recent increase in coal prices reflects a renewed desire by utilities to burn coal to offset the sharp increases in costs of alternative fuels, particularly natural gas.

Figure 2 provides a slightly different look at fuel prices. In it, the prices for inflation have been adjusted and normalized by relating the price to the price per million Btu.[10] Then, to more closely reflect U.S. fuel consumption patterns, motor fuel is substituted

FIGURE 2

Real fuel prices, dollars per million Btu, 1970–2004

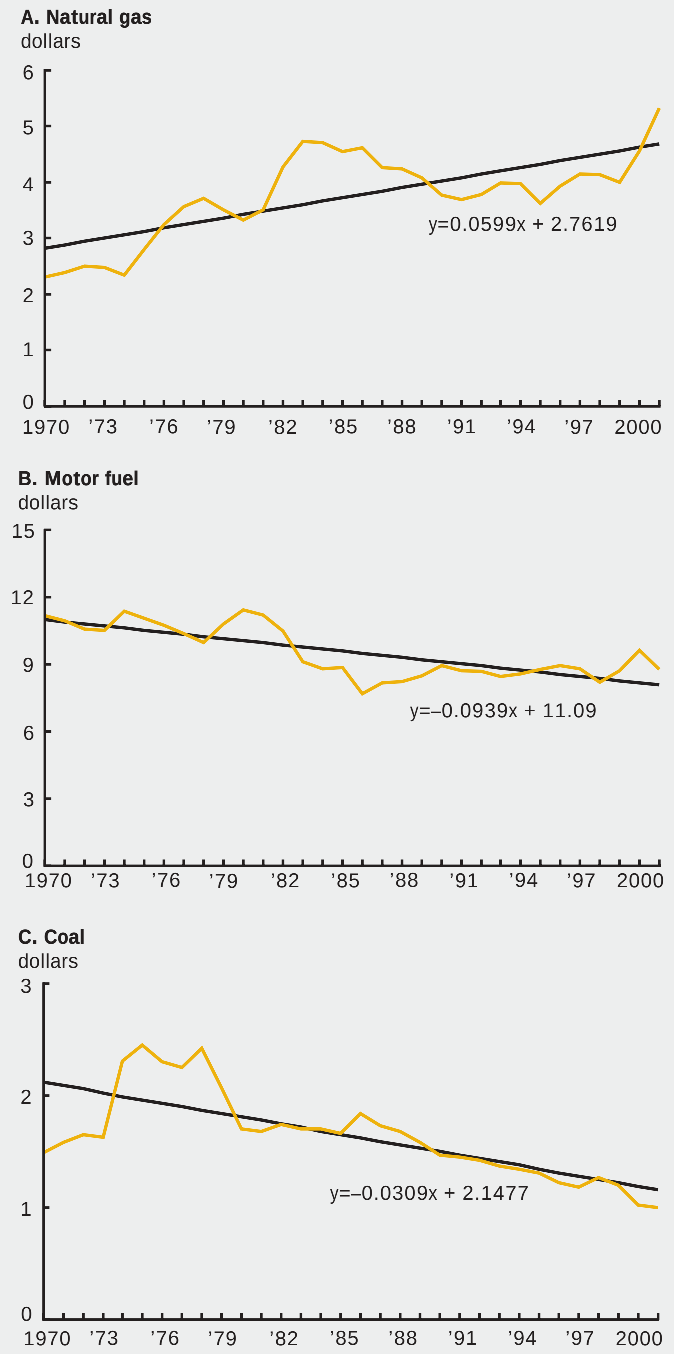


Sources: Author's calculation for 2002–04; and U.S. Energy Information Agency, 2002, "State energy data," chart, available at www.eia.doe.gov/emeu/states/_states.html, for 1970–2001.

for oil since nearly 70 percent of U.S. oil consumption comes in the form of motor fuel. Perhaps most notable in this figure is the relatively long period of time in which all three fuels experienced flat or declining real prices—from the mid 1980s to the late 1990s. Not until 2000 do you begin to see a sharp upturn in both motor fuel and natural gas prices, a harbinger of things to come.

FIGURE 3

Annual deviation from trend



Sources: Author's calculation; and U.S. Energy Information Agency, 2002, "State energy data," chart, at www.eia.doe.gov/emeu/states/_states.html, for fuel prices.

Measuring volatility

It is not just price that has a major impact on energy markets. As was noted in the literature review, economists have found that the relative volatility of fuel prices has a significant effect on the response of the economy, households, and firms to sudden changes in energy prices. Casual evidence would suggest that greater relative volatility slows the process of adaptation since neither consumers nor producers know whether to make fundamental behavioral changes in the face of uncertain prices. For consumers, if the price increase is seen as temporary, they are likely to maintain their energy consumption habits by reducing expenditures on other items or reducing savings rather than making significant changes such as installing fuel-efficient appliances or buying a more fuel-efficient car. Producers fearing a boom and bust cycle in energy prices are likely to be wary of making investments in long-lived physical assets based on prices that may be short-lived. Even today in the era of oil at well above $60 a barrel, major oil companies are determining their investment decisions based on a long-run price of oil in the high $20 a barrel range.[11] Figure 3 shows the volatility of the three major fuels measured by the annual standard deviation. Of the three fuels, natural gas has exhibited the largest volatility for more than 30 years.

Sources of volatility

For all fuels, the recent increase in volatility is most closely related to increased world demand and shrinking surplus capacity. In general, the fuel system is operating at a higher capacity, and this can make supplies tight when demand increases since there is little surplus capacity. In the U.S. oil refineries have been operating above 90 percent capacity utilization since the early 1990s leaving little room to compensate for an unplanned shutdown of a refinery. In addition, the increased requirements for reformulated gasoline, now 30 percent of the U.S. motor fuel market, further reduces the flexibility of refineries by requiring the production of specialty motor fuels to meet environmental standards for specific parts of the country. In the natural gas field, it can take up to a year for significant new gas production to come online even in the face of higher prices. Constraints in pipeline capacity also can limit the ability to get gas to the market even if it is available. In the case of LNG, it can take up to ten years to site and build a terminal due to siting restrictions and construction expense. Finally, there is the general reluctance to bring new energy resources online given the long time frame over which the investment must pay out. Energy assets often have useful lives of 20 years to 30 years. The decision to invest in a production asset is determined by the cash flow expected from the asset based on the estimated price of the fuel over the life of the facility. This tends to make energy companies somewhat conservative even when prices are high. Having seen prior booms and busts in prices, these companies' conservatism is understandable. Energy industry analysts believe that market volatility slows investment by oil and gas companies.[12] The bottom line is that with lower reserves, tighter production, and an inability to rapidly respond to increased demand, price becomes the mechanism for balancing the market in the short run.

Turning attention to Midwest energy and the changing structure of the 7-G economy

Much of the concern over higher energy prices in the Midwest has to do with the region's economic structure. The region has long been known as the nation's manufacturing belt. Manufacturing is significantly more energy intensive, so it bears to reason that higher energy costs will disproportionately affect the region's economy.

Figure 4, panel A–F illustrates the changing structure of the 7-G economy based on the composition of GSP for the individual states and for the District as a whole. What is most striking is that while the share of GSP derived from manufacturing in the District has declined significantly since 1980, it is still well above the U.S. average. In contrast, the District is slightly below the U.S. average in its share of GSP from less energy-intensive industry sectors such as services and finance, insurance, and real estate. Perhaps more interesting is the contrasting structure of each state's economy. Illinois has dramatically reduced GSP from manufacturing from 25 percent in 1980 to only 13 percent by 2003. The Illinois economy has departed from many of its industrial neighbors and now has a structure that essentially mirrors that of the U.S. In large measure this can be attributed to the restructuring of the Chicago metropolitan economy where manufacturing has declined dramatically and been replaced by growth in business services, retail trade, and convention and tourism. In contrast, Indiana and Wisconsin continue to have significantly higher shares of GSP from manufacturing. In both states, manufacturing is still the largest share of GSP at 27 percent and 22 percent, respectively, in 2003. Over this period, these states have seen less systemic restructuring by industry sector as measured by output. Indiana in particular has maintained a heavy concentration of durable manufacturing in sectors such as recreational vehicles and automotive parts. Iowa and Michigan fall somewhere in the middle. Both have had significant declines in GSP attributed to manufacturing (Iowa fell from 26 percent to 20 percent and Michigan from 31 percent to 21 percent) but they still have manufacturing shares well above the national average. Michigan manufacturing is still highly related to the auto sector.

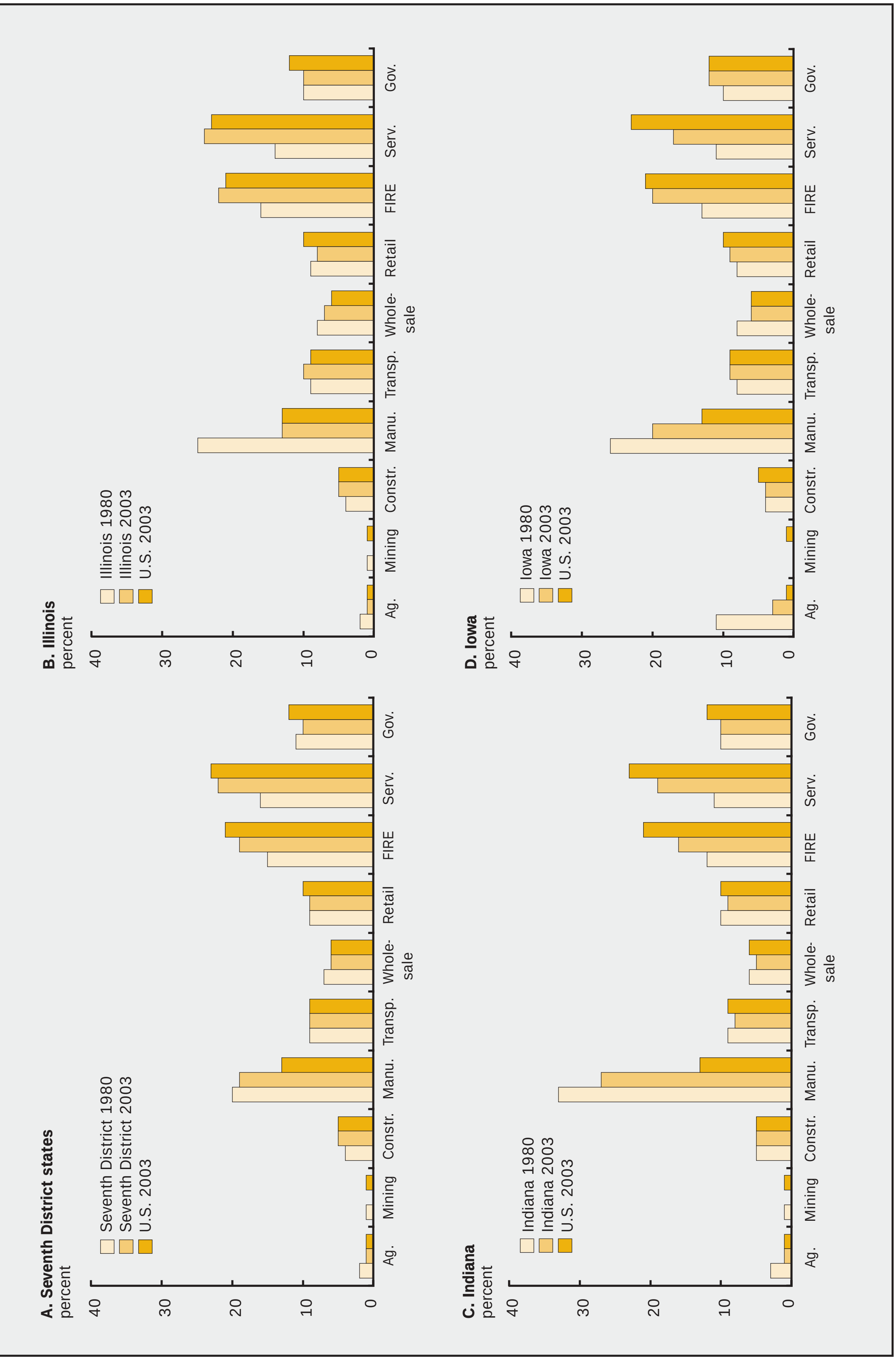
Another factor increasing the energy dependence of the region is climate. Being a region characterized by cold winters and hot summers, energy demand for heating and cooling in the Midwest is relatively high. One of the easiest ways to document the relatively harsher climate of the 7-G states is through the use of heating and cooling degree days.[13] Heating degree days calculate the daily variation in temperature at a location below 65 degrees Fahrenheit, while cooling degree days calculate the variation above 65 degrees. States with high heating degree totals require significant energy for space heating and usually are marked by high consumption of natural gas and fuel oil. States with high cooling degree totals are usually large consumers of electricity needed to run air conditioners.[14] Table 1 (p. 26) shows the average annual heating and cooling degree totals from 1971–2000 weighted by each state's population in the 7-G, and for the U.S. population as a whole.

The significant variation in heating days above the U.S. average places a special emphasis on the use of natural gas in the region. As table 2 (p. 26) demonstrates, natural gas is overwhelmingly the preferred heating fuel in the District states, and the region's cold winters make the Midwest more reliant on natural gas than any other region.

When it comes to energy consumption the five states that compose the Seventh District have differing patterns that tend to reflect the underlying structure of their economies. Table 2 compares energy utilization in each state compared with the U.S.

FIGURE 4

Percent of total gross state product by industry and comparison to the U.S.



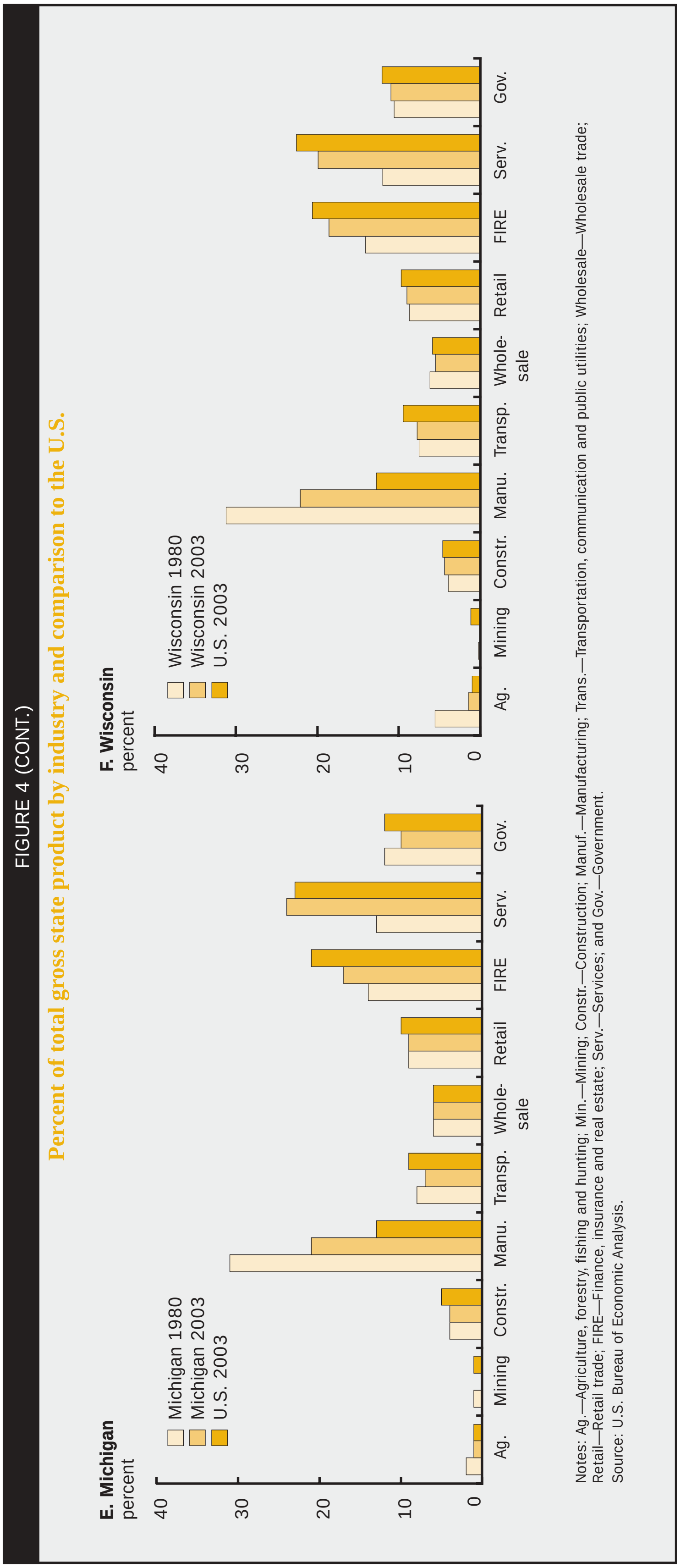


FIGURE 4 (CONT.)

Percent of total gross state product by industry and comparison to the U.S.

Notes: Ag.—Agriculture, forestry, fishing and hunting; Min.—Mining; Constr.—Construction; Manuf.—Manufacturing; Trans.—Transportation, communication and public utilities; Wholesale—Wholesale trade; Retail—Retail trade; FIRE—Finance, insurance and real estate; Serv.—Services; and Gov.—Government.

Source: U.S. Bureau of Economic Analysis.

Total energy consumption is above the national average for all states except Iowa and much of this has been attributed to the above national average concentration of energy-intensive manufacturing industries and midwestern climate. However, on a per capita consumption basis, the region appears more moderate in its consumption patterns with the exception of Indiana.

The changing role of energy related to economic output

From an economic perspective, an important trend has been the declining role of energy as an input to producing gross product in the U.S. This trend has been mirrored in the 7-G, as well as played a significant role in reducing the importance of energy as a basic input to production. Figure 5 displays the change in the number of Btus needed to produce $1 of gross product. For all three fuel types, Btu equivalents are used to allow for more accurate comparisons. The declines have been dramatic with the amount of energy needed to produce $1 of gross product dropping by 77 percent for natural gas, 76 percent for motor fuel, and 67 percent for coal. In the case of natural gas, 7-G states followed this pattern for the most part although Indiana, Michigan, and Iowa required higher levels of usage on natural gas to produce GSP. As for coal, it is worth noting the significantly higher utilization of coal to produce GSP. Indiana uses coal as a primary fuel for 80 percent of its electricity generation and is more dependent on coal as a fuel than the rest of the region.

Jones, Leiby, and Paik (2004) found that the largest economic effect of energy price spikes was demonstrated through changes in employment in specific industries. They suggest that reallocation related to an energy price shock is often determined at the plant level making estimates of economic impact at even the broad industry level potentially misleading. In order to test this idea, I have selected

TABLE 1

Annual average heating and cooling degree days in 7-G states and U.S., weighted by population

State	Annual average heating degree days	Annual average cooling degree days
Illinois	6,355	876
Indiana	5,894	894
Iowa	7,058	837
Michigan	6,950	568
Wisconsin	7,791	500
Contiguous U.S.	4,524	1,215

Source: National Oceanic and Atmospheric Administration, “State, regional, and national monthly heating degree days,” Historical Climatography, Series No. 5-1 and “State, regional, and national cooling degree days,” Historical Climatography, Series No. 5-2.

As this table demonstrates, Indiana in particular has a concentration of energy-intensive industries. In total, Indiana had nearly $37 billion in shipments from these industries, with total employment of 83,000. In all, these industries made up more than 7 percent of GSP. Individual industries played important roles in specific states. The forest products industry in Wisconsin is responsible for almost 4 percent of that state’s GSP and employs 71,000. In Illinois, chemicals account for almost 2 percent of GSP and employ 58,000. However to assess the impact that high energy prices might have on these industries, it is important to examine what their long-term growth trends have been.

the seven industries (aluminum, chemicals, forest products, glass, metal casting, petroleum, and steel) identified by the U.S Energy Information Agency as the most energy intensive and examine how employment has changed in these industries following oil shocks. I will do this for the five District states and for the U.S. as a whole. In addition, I will look at the effect of the relative concentration of these industries on the District states over time. Using location quotients (LQ) based on employment shares, I will demonstrate which states in the District have the largest concentration of these energy-intensive industries and how this has changed over time. This will shed light on the question of whether the employment in region has in a relative sense become more or less exposed to energy dependent industries over time.

In evaluating the structure of the Seventh District economy, there is clearly a lack of many energy-producing industries, with the exception of coal; however there is a reasonable concentration of employment in energy-intensive industries. Table 3 (p. 28) shows some basic properties of these industries and their relative concentration in the Seventh District.

Employment trend

Figure 6 (p. 28) shows total employment in these seven industries over 3 decades. In the case of the 7-G states employment decline was more pronounced than the U.S. from 1972 to 1982, however employment turned around in the early 1980s and these industries showed job gains up until 2000. During this period, District employment outperformed the U.S. as a whole. This pattern is more clearly reflected in figure 7 (p. 29) showing the annual percentage change in employment. It is also worth noting the behavior of employment in light of major oil shocks. The first and second oil embargoes of the 1970s and the related price shocks created significant job loss in these seven industries, more so in the District than for the nation as a whole. Interestingly, the change in employment is significantly less volatile following the 1990 Persian Gulf crisis. Some analysts suggest that this reflects a reallocation

TABLE 2

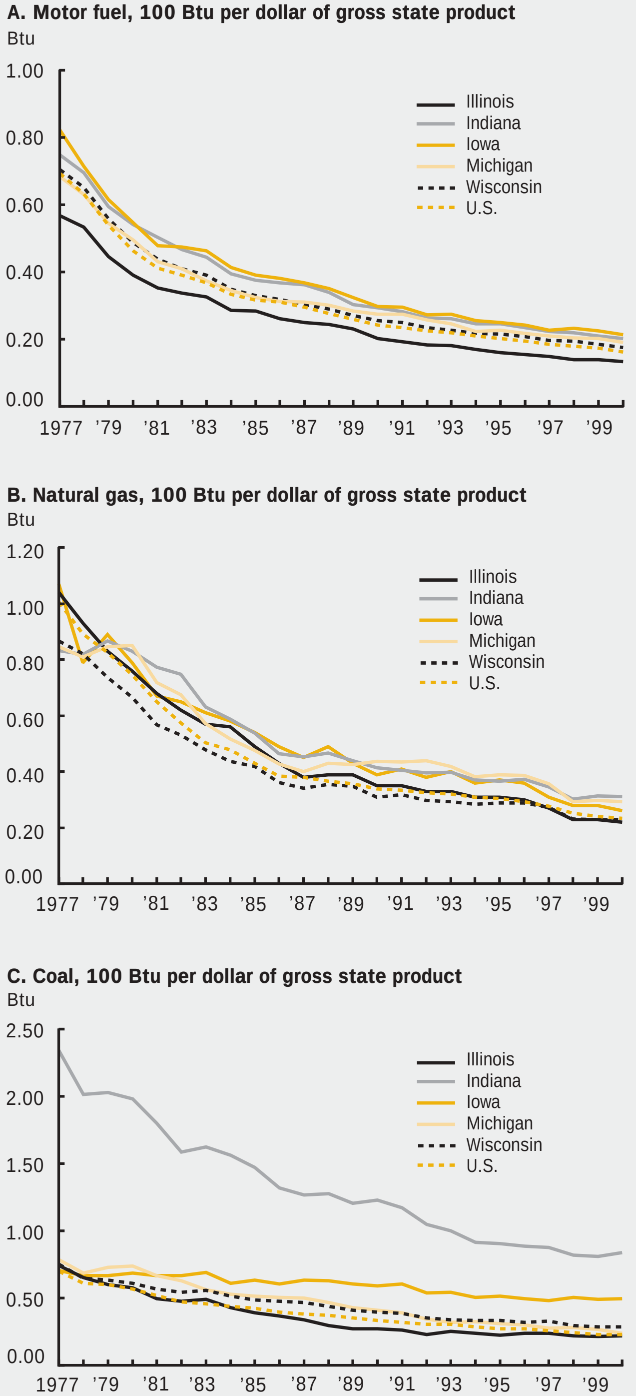
Energy consumption patterns in 7-G and U.S.

	Energy consumption / per capita	U.S. Rank	Total energy consumption	Primary heating fuel
Illinois	356 million Btu	22	4.4 quadrillion Btu (rank 5)	Natural gas (81 percent)
Indiana	457 million Btu	13	2.8 quadrillion Btu (rank 10)	Natural gas (65 percent)
Iowa	372 million Btu	19	1.1 quadrillion Btu (rank 29)	Natural gas (66 percent)
Michigan	314 million Btu	36	3.1 quadrillion Btu (rank 9)	Natural gas (78 percent)
Wisconsin	333 million Btu	29	1.8 quadrillion Btu (rank 19)	Natural gas (66 percent)
U.S.	349 million Btu	N/A	98.9 quadrillion Btu (rank 1 in world)	Natural gas (61 percent)

Source: U.S. Energy Information Agency, 2000, “Petroleum profiles: Illinois, Indiana, Iowa, Michigan, Wisconsin,” available at www.eia.doe.gov/emeu/states/_states.html

FIGURE 5

Energy use intensity



Sources: U.S. Energy Information Agency, 2000, "State energy data," chart, available at www.eia.doe.gov/emeu/states/_states.html, for fuel prices; and U.S. Bureau of Economic Analysis, "Regional economic accounts," available at www.bea.gov/bea/regional/data.htm.

of labor in these industries where production has moved off shore. However it is worth noting that the sharper employment decline of these industries in the District states beginning in 2000 may reflect that these industries are still relatively more concentrated in the District than they are in the nation as a whole, and therefore are more likely to respond to higher energy prices.

Evaluating the relative concentration of energy-intensive industries in the 7-G

I have decided to use location quotients (LQ) to examine how the relative concentration of these seven industries has changed in the District based on employment. An LQ is a common measure in economic geography that identifies the relative significance of a phenomenon (in this case employment in energy-intensive industries) in a region or state compared with a benchmark region (in this case the U.S.). In interpreting the results from LQs, any number above 1 indicates an employment share in that industry that is above the national average. For example, the forest products industry in Wisconsin has increased its importance to that state's economy. Forest products are represented by two Standard Industrial Classifications, (SIC), 2400 and 2600. In Wisconsin the location quotient for employment in SIC 2400 rose from 1.16 in 1972 to 1.96 in 2002. This means that Wisconsin has nearly double the national average of employment in this sector. Likewise, employment rose from 18,500 in 1972 to 32,100 in 2002. SIC 2600 experienced even larger growth with its LQ rising from 2.99 to 3.82. Employment rose from 43,000 to 50,000. Chemicals in Indiana have also grown in importance to that state's economy. In 1972, chemicals had employment of 26,000 and an LQ of 1. By 2002, employment had risen to 33,000 and the LQ to 1.46.

On an industry-specific basis, all of the industries have seen gains in their LQ since 1972 in the 7-G. Specifically,

- Metal casting, 2.0 in 1972, 2.5 in 2002,
- Steel, 1.6 in 1972, 2.1 in 2002,
- Aluminum, 1.7 in 1972, 2.0 in 2002,
- Glass, 0.9 in 1972, 1.11 in 2002,

TABLE 3

Energy consumption patterns in 7-G and U.S.

Industry	Energy intensity (energy purchased as a % of value of product shipped, 2001)	Primary energy / fuel type used in production	Industry percentage of GSP in top 7-G states	Employment in thousands in top 7-G states (national rank)	Value of shipments in billions of $, 2000 (national rank)
Aluminum	6.9	Electricity 76% Natural gas 20%	Indiana .43% Illinois .05%	Indiana 6.1 (1) Illinois 2.5 (6)	Indiana $2.5 (2) Illinois $0.9 (6)
Chemicals	3.7	Natural gas 37%	Indiana 4.6% Illinois 1.8%	Illinois 58.1 (5) Indiana 22.4 (10)	Illinois $22.2 (8) Indiana $18 (10)
Forest products	Wood–4.7 Paper–2.0	Wood residues 50%	Wisconsin 3.9%	Wisconsin 71.3 (2)	Wisconsin $18.1 (1)
Glass	6.5	Natural gas 54%	Indiana .05% Michigan .02%	Indiana 7.2 (9) Michigan 7.2 (9)	Indiana $1.2 (9) Michigan 1.6 (8)
Metal casting	4.7	Natural gas 37%	Wisconsin .72% Indiana .56% Michigan .50% Illinois .17%	Wisconsin 22 (2) Michigan 19.1 (3) Indiana 17.7 (4) Illinois 13.6 (5)	Wisconsin $3.2 (2) Michigan $3.0 (3) Indiana $2.9 (4) Illinois $1.8 (5)
Petroleum	3.9	Refined products—refinery gas, coal, coke, and other 94%	Illinois .4%	Illinois 5.6 (5)	Illinois $14.6 (4)
Steel	7.7	Natural gas 42% Coal 31%	Indiana 1.75% Michigan .39% Illinois .27%	Indiana 32.0 (2) Illinois 14.9 (4) Michigan 11.2 (5)	Indiana $12 (2) Illinois $ 5 (4) Michigan $3.7 (5)

- Chemicals, 0.7 in 1972, 1.3 in 2002,
- Forest products 1.25 in 1972 to 1.4 in 2002, and
- Petroleum 0.6 in 1972, 0.7 in 2002.

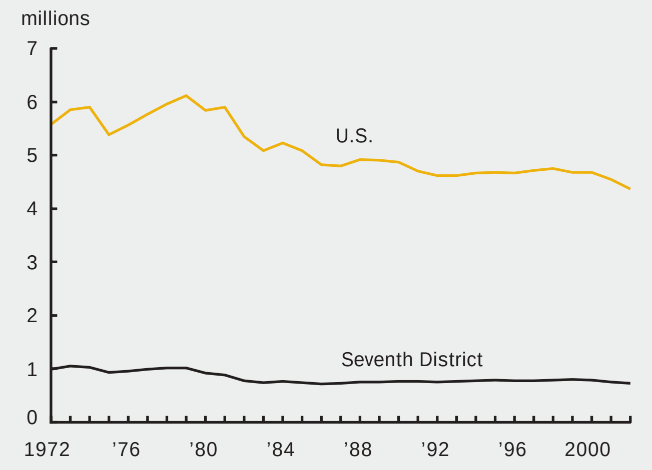
Only petroleum has a relative employment concentration below the U.S. average and three industries have concentrations that are double the U.S. average.

For the District as a whole, while the relative concentration of energy-intensive industries has increased over this period total employment has declined. In 1972 the LQ for all seven industries district-wide was 1.11 and by 2002 it was 1.24. Employment however fell from 998,600 to 731,000 (26.9 percent). On a national level employment in these seven industries fell from 5.580 million to 4.036 million over the same period—a decline of 27.7 percent.

There is also significant variation by state (see figure 8). For the entire Seventh District, employment in these highly energy-intensive industries was a little better than 13 percent above the nation. However, the LQ for the District has been on the rise since hitting its trough in 1981 and has been consistently above the nation since 1988. On an individual state basis, the story is quite different. Illinois and Michigan have consistently lowered their employment LQs in these industries. Iowa while still

FIGURE 6

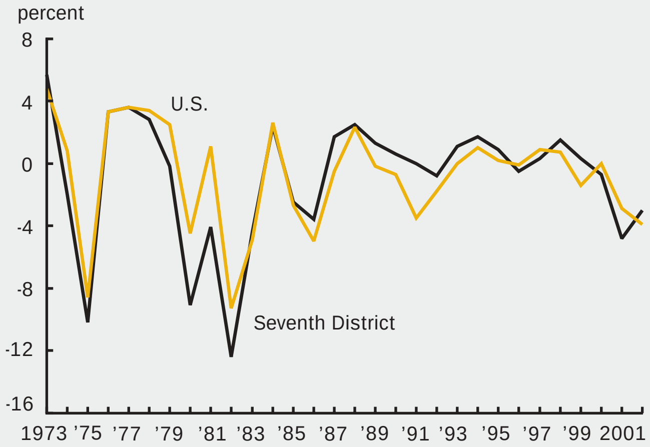
Employment in seven energy-intensive industries



Source: Data from Haver Analytics.

FIGURE 7

Percentage change in employment in the U.S. and Seventh District



Source: Data from Haver Analytics.

and Wisconsin) will be more significantly impacted by higher fuel prices.

Many extensions to this line of research are possible. Ultimately to properly assess the impact of energy costs or energy spikes on the region's economy it is necessary to identify the relative importance of energy as a cost of business to individual firms. An old maxim in economics is that high energy prices act like a tax on consumers. If this is true the interesting questions need to focus on the incidence (or distribution) of that tax based on specific attributes of consumers/industries. Further, it must be recognized that the price paid for fuel and energy varies depending on company-specific purchasing agreements. Some companies buy fuel on long-term contracts and some at spot market prices. The impact of reported higher spot market prices may be negligible on a well-hedged fund. In addition more research needs to be done to examine the affect of energy prices on secondary markets for industries. For example, the Midwest is still home to the Big Three auto producers. Reports from Detroit blame high gas prices for reducing demand for large sport utility vehicles. How will this affect the regions economy? Finally, more needs to be done to understand the impact of energy as it applies to the reallocation of resources globally. Manufacturers increasingly see

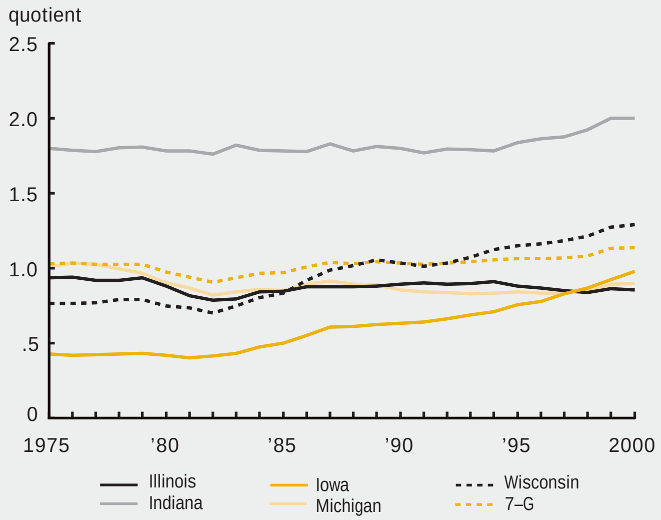
below the national average for employment at 98, has shown rapid gains with its LQ doubling since 1975. The two states that have the largest concentration of employment in these energy sensitive industries are Indiana and Wisconsin. Indiana's LQ was double the U.S. by 2000 while Wisconsin had seen its LQ rise to 129 from a low of 70 in 1982.

Conclusion

This article makes three basic observations about energy markets trends and behavior. First, the market dynamics for individual fuel types are quite different. While oil prices are largely set in a world market, natural gas and coal are influenced by regional dynamics. Issues of fuel security, infrastructure for delivering the fuel, government regulation, and the development of spot markets and trading centers all have varying influences on the behavior of each fuel. However, recently energy prices appear to have become more closely linked. Demand for all fuel types has been on the rise, and fuel substitution has been limited leading to similar levels of increases in all fuels. Second, price volatility appears to influence investment decisions and may discourage investment in costly energy infrastructure. Finally, the Midwest's economic composition suggests that certain industries (metal casting, steel, and aluminum) and states (Indiana

FIGURE 8

Location quotients for energy-intensive industries



Source: Data from Haver Analytics.

their competition arising off shore. Is the energy picture different for industries located in key competitor nations? By answering these questions, we can ultimately develop a far clearer understanding of the impact of energy prices on regional economies.

NOTES

[1]U.S. Energy Information Agency (2002), excel table.

[2]U.S. Energy Information Agency (2005b). West Texas Intermediate rose above $55 a barrel in August of 2004, it has since risen over $60 in July of 2005.

[3]U.S. Energy Information Agency (2005a).

[4]Natural Gas Spot Price, Henry Hub, November 3, 2003 to November 5, 2004 are available at from WTRG Economics (2005).

[5]U.S. Energy Information Agency (2004). Percent increase reflects the change in the price per ton for central Appalachian coal from May 31, 2002 to October 29, 2004. The October 29 price was a record high of $66.50 per ton.

[6]Specifically the study found that a 10 percent increase in oil prices increased Texas gross state product 2.6 percent during the period 1970–87 while only increasing gross state product by 0.4 percent in the period 1988–2002. In addition the authors found that a 10 percent increase in oil prices in the first period increased Texas employment by 1 percent. In the 1988–2002 period a ten percent rise in oil prices lead to a 0.4 percent decline in employment.

[7]These estimates are based on forecasted prices in the U.S. Energy Information Agency (EIA) Short-term Energy Outlook for November 2004. The EIA estimated that from the winter of 2004 to the winter of 2005 that the price of no. 2 heating oil would rise by 38.7 percent, residential natural gas by 12.6 percent, propane by 22.4 percent, residential electricity 1.6 percent, and gasoline by 23.9 percent. For the U.S. as a whole, energy is 7.1 percent of the CPI-U. In the case of the Midwest, energy is a slightly higher share of the consumer market basket at 7.4 percent. Residential fuel is responsible for 4.1 percent of the energy cost and motor fuel for the remaining 3.3 percent. Within the residential fuel category, 52 percent of the estimates for the 2003 fuel mix was represented by electricity, 43.3 percent by natural gas, 3.5 percent by propane, and the remaining small shares from fuel oil and kerosene. The Midwest reliance on natural gas in its fuel mix is the highest in the nation. The next closest region is the Mid-Atlantic at 34.1 percent. Clearly changes in natural gas prices will have a larger influence on household budgets in the Midwest. As Bradbury points out, in the short run, there is little evidence that the household sector reacts to higher fuel prices by dramatically reducing consumption or switching to less expensive fuels. This can occur in the long run if higher energy prices appeared to be sustained. Instead the household sector is likely to either use savings to pay for higher fuel prices or reduce other types of purchases in order to meet their budget. The magnitude of the increase over the last winter is large enough to be noticed by consumers but is unlikely to cause radical changes in consumer behavior. Of course if energy is a larger portion of any individual household's budget, the effect will be more pronounced.

[8]The prices used for coal are based on the delivered utility price per ton and not the price for central Appalachian coal used in the introduction. Given that coal is used almost exclusively for electricity generation, this represents a fair estimate of the cost paid by utilities.

[9]North America has only 4.2 percent of the proved natural gas reserves in the world, it produces 21 percent of the world's supply and accounts for 30 percent of the world's demand. In contrast the Middle East has nearly 41 percent of the world's proved supply and Europe and Eurasia has 35 percent.

[10]A Btu is defined as the amount of heat required to raise the temperature of one pound avoirdupois of water by one degree Fahrenheit. Normalizing the price by Btu allows a comparison of the resources needed to create this amount of heat and can be used as a rough proxy for the heating price of a particular fuel stock.

[11]Briefing by Finley (2005).

[12]A report by the consulting firm Accenture and Cambridge Energy Research Associates issued in 2003 analyzed the impact of market volatility on 16 energy companies and found that volatility was preventing increased investment in energy assets. (See Accenture and Cambridge Energy Research Associates, 2003.) However economists have been more ambivalent about the impact of volatility on investment. The key determining factor influencing the relationship between volatility and investment include the life of the investment, whether the investment is reversible, the nature of competition that firms in the industry are facing, and the relative risk aversion of firms in the industry. Given these factors, both empirical work and theoretical work come to widely differing conclusions about whether volatility helps or hinders investment. However, it would appear that most energy companies do have the profile (long-lived assets that tend to be irreversible once started in an industry known for risk aversion) that would suggest that volatility would impede investment. For a more complete discussion see, Pindyck (1988), pp. 969–985. For an interesting empirical study, see Bell and Campa (1997), pp. 79–88.

[13]A measure of the coldness of the weather experienced, based on the extent to which the daily mean temperature falls below a reference temperature, usually 65 degrees Fahrenheit. For example, on a day when the mean outdoor dry-bulb temperature is 35 degrees Fahrenheit, there would be 30 degree days experienced. A daily mean temperature usually represents the sum of the high and low readings divided by two. A form of degree day used to estimate energy requirements for air conditioning or refrigeration. Typically, cooling degree days are calculated as how much warmer the mean temperature at a location is than 65 degrees Fahrenheit on a given day. For example, if a location experiences a mean temperature of 75 degrees Fahrenheit on a certain day, there were 10 CDD (cooling degree days) that day because 75 – 65 = 10.

[14]Diaz and Quayle (1980) found that the correlation between energy use and heating degree days was as high as .97 at the household level. Energy consumption increases as the number of heating and cooling days increase in a highly related relationship. See Diaz and Quayle (1980), pp. 241–246.

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