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Higher energy prices in the Midwest

by William A. Testa and Thomas Klier

It has been remarked that the Midwest enjoys two climatic seasons—winter and summer. Lately, at least one wag has characterized these two seasons by the particular fuel—natural gas or gasoline—that is pinching the pocketbooks of Midwest consumers. This *Chicago Fed Letter* reviews recent experience for these two fuels and measures the extent to which rising prices have been draining consumer pocketbooks in the Midwest.[1]

Midwest natural gas

As prices soared and temperatures dropped this past winter, residential sector expenditures on natural gas—especially for space heating—climbed sharply in many areas. These prices stung consumers across the nation, but many midwestern residents were severely affected because the region's winter climate is cold, and because natural gas is the primary fuel for space heating purposes. The Midwest residential sector consumes more natural gas per capita than the U.S. average by a factor of 70%; total consumption over all sectors exceeds the national level by 12% (figure 1).

Delivered prices for natural gas tend to follow production costs or "wellhead" price movements. However, sudden swings in price of the product delivered to homes are muted by the fixed costs borne in operating pipeline and delivery systems. Nationally, both wellhead and delivered prices of natural gas to residential customers remained low to moderate (in real terms) throughout the late 1980s and 1990s, followed by a spike in 2000—especially in the fourth quarter of that year. Before abating during the second quarter of this year, wellhead prices topped all-time records late last year. However, delivered prices (on an annual average basis) did not reach their previous peak, which was experienced in the early 1980s.

1. Natural gas consumption per capita—1999

Area	Residential	Commercial	Industrial	Transportation	Electricity	Total
	(- *thousand cubic feet* -)					
Illinois	36.7	15.5	25.2	4.5	3.4	85.3
Indiana	25.5	12.4	53.8	2.4	1.3	95.4
Iowa	24.9	15.6	35.5	2.8	1.8	80.7
Michigan	35.6	18.2	30.5	2.2	5.2	91.7
Wisconsin	24.3	15.6	27.9	0.8	2.7	71.2
Seventh District	29.4	15.5	34.6	2.5	2.9	84.8
United States	17.3	11.2	33.0	2.7	11.4	75.6

Sources: Consumption data from the U.S. Department of Energy, Energy Information Administration; population data from the Census Bureau.

Natural gas is largely a domestically produced fuel, with nearby Canada filling in 17% of U.S. consumption needs. Despite its home-grown production, gas prices tend to follow international petroleum prices because natural gas and fuel oil are used as substitute fuels in some industrial applications and in home heating use. Accordingly, the recent run-up in petroleum-based fuels has contributed to pressures on natural gas prices and consumption. But the demand for natural gas also climbed owing to the fact that a number of natural-gas-fired electric generating plants, mostly so-called peaker plants, have been constructed. From 1996 to 2000, consumption of natural gas for the generation of electricity grew by an average of nearly 11% per year.

In addition, peaker plants burn their natural gas during warm weather months when gas electric usage peaks, at just the time when gas storage and accumulation for the winter heating season takes place. This development, along with unexpected price hikes that induced intermediate gas vendors to slow their pace of summer storage, left distribution utilities in short supply during the cold weather months of this past winter. Inventories at the end of September 2000 averaged just over 8% lower than the previous year in the eastern United States. And so, the nation and the Midwest were ill-prepared for the cold snap that pushed across the nation this past November and December. In response, local utilities and private vendors turned to spot markets to shore up dwindling gas supplies. As a result, following years in the mid-1990s when natural gas prices hovered around $2 to $2.50 per thousand cubic feet, spot market prices near gas fields such as Louisiana peaked near $10. Down the line, "city gate" prices near Chicago rose in concert.

What's the bill?

Our estimates of incremental Midwest residential expenditures for natural gas require an estimate of this past winter's consumption and price. On average, delivered residential prices are estimated to have risen about

one-fifth in 2000 over 1999 for the Midwest. This compares to gas price hikes of 15% for the U.S. on average in 2000 over 1999. Individual states in the Midwest were affected fairly uniformly, the exception being Michigan where households continued to enjoy low residential prices during 2000 and into the first quarter of 2001. This enviable position was due to temporary rate freezes that were in effect for many Michigan consumers as the state makes a transition to a more deregulated market.

Natural gas consumption was up modestly in 1999 and 2000 in the Seventh District, reflecting mild winters accompanied by the growth of housing and related natural gas demand. However, the fourth quarter of 2000 spiked at a 25% increase year over year, and the first quarter of 2001 increased around 8%. These jumps were commensurate with the overall average national experience. Yet, since Midwest natural gas consumption is higher, price increases exert a larger impact on expenditures.

In the Midwest, estimated consumer expenditures peaked at just above 1.6% of disposable personal income in 1983 and 1984 on an annual basis, falling steadily to around .9% by 2000. This is about two-thirds greater than the average for the United States (.54%). From 1999 to 2000, expenditures on natural gas as a share of personal income in the Seventh District increased only modestly (figure 2), rising from .73% to .86% of disposable personal income, or .13 percentage points. This compares to a hike of only .06 percentage points in the U.S. over the same time period.

The winter-only impact was somewhat larger. The 2000:Q4 spike moved the natural gas bite out of income from .86 to 1.39 on a fourth quarter/fourth quarter basis, or .53 percentage points (as compared to .24 percentage points for the nation on average). For the winter quarter of 2001:Q1, a .45 percentage point rise was estimated to have taken place for the U.S., and a .84 percentage point rise in the Seventh District. On average, for the six-month heating period, Seventh District natural gas expenditures took a 1.05% nick out of disposable personal income in 1999–2000, and a 1.74% nick the following winter, for a rise of .69 percentage points. These estimated expenditure shares exceeded those of the U.S., which experienced a 1.01 percentage point share of natural gas spending, up from .67—a rise of .34 percentage points.

These estimates suggest that the residential sector has experienced an erosion of discretionary income during the cold-weather season running from October 2000 through March 2001. This erosion has been more significant in the Seventh District where seasonal consumption runs high for home/business heating purposes.

2. Natural gas expenditure/income

	Average 1967–2000	1998	1999	2000
	(- - - - - - - - - - - - *percent* - - - - - - - - - - -)			
Illinois	1.20	.73	.77	1.02
Indiana	.97	.72	.69	.74
Iowa	.95	.66	.68	.86
Michigan	1.19	.74	.77	.75
Wisconsin	.94	.61	.65	.80
Seventh District	1.11	.71	.73	.86
United States	.71	.49	.48	.54

Sources: Price and consumption data from the U.S. Department of Energy, Energy Information Administration; disposable income data from the Bureau of Economic Analysis.

Gasoline

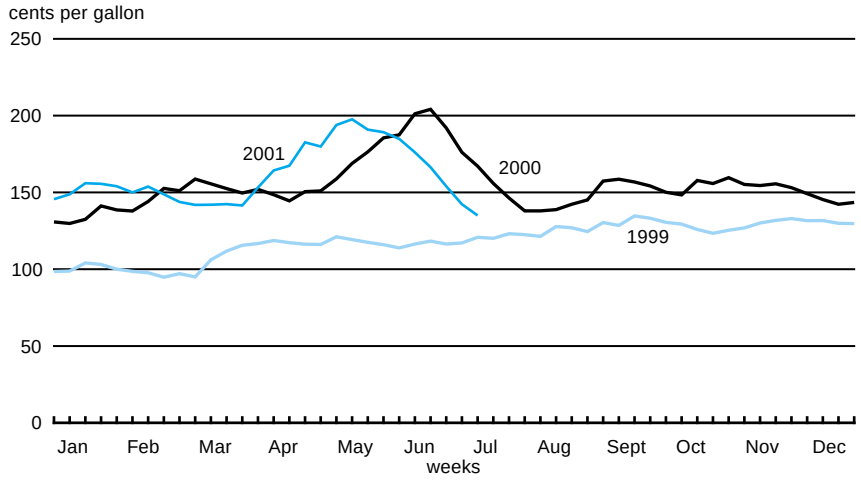
During the months of May and June of this year, the Midwest experienced a rerun of last summer's record-setting run up in gasoline prices, with prices rising earlier than last year (see figure 3). However, it is important to keep in mind that these comparisons are based on nominal prices. In real terms, recent gasoline prices are only about half of the historical peak reached in the early 1980s. Similar to last year, the rapid price rise initiated a supply response, with imports increasing and refineries producing more gasoline, causing prices to return to pre-peak levels rather quickly.[2]

What drives gasoline prices?

In addition to various taxes levied on the sale of gasoline, several supply and demand factors influence the price of gasoline. In general, demand for gasoline responds very little to price changes in the short term. However, over a number of years consumers respond noticeably to changes in the price of gasoline. For example, consumption fell by 12% between 1978 and 1982 in response to the two oil price shocks of the 1970s. Since then it has been rising steadily, partly as a result of consumers' growing appetite for light trucks, which tend to be less fuel-efficient than cars.

The main drivers of supply availability are the price of crude oil, refinery capacity, as well as environmental regulations. The price of crude oil represents the single largest factor in determining gasoline prices.[3] Crude oil prices, as measured by the West Texas Intermediate benchmark, have recently been around $28 per barrel, up sharply from just over $10 per barrel at the beginning of 1999. Inventory fluctuations have also contributed to spiking gasoline prices. Last year, gasoline inventories were 7.5% below the level desired at the beginning of the summer travel season. Toward the end of spring 2001, inventories were actually slightly below the levels seen in 2000. Part of this results from last year's pipeline problems, especially in the Midwest where the main pipeline from the Gulf Coast unexpectedly had to be taken down. Aside from transport of fuel, the capacity to refine gasoline remains limited. In the U.S. no new refineries have been built in more than two decades, while a number of refineries have closed.[4] As a result, the refineries are operating near full capacity. Last summer, they were operating at 94% capacity; this year started at even tighter levels. Consequently, the gasoline market and prices are very sensitive to supply disruptions. With little time for routine maintenance, the likelihood of breakdowns of refineries has become less avoidable.

3. Midwest reformulated gasoline retail price, all grades



Source: Data from the U.S. Department of Energy, Energy Information Administration, available on the Web at www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_history.html.

Regulatory requirements give rise to significant regional variations in gasoline prices, especially during summer months.[5] As part of the Clean Air Act Amendments of 1990, the areas of the country in violation of ozone air quality standards are required to use cleaner or reformulated gasoline (RFG). In particular, RFGs use "oxygenates," i.e., hydrocarbons that contain oxygen atoms. When added to gasoline, they increase its combustion efficiency and reduce carbon dioxide emissions. However, there are no uniform standards for reformulated gasoline. Rather, compliance with air quality regulations resides at the state level. The states can choose among a number of specifications for reformulated gasoline. As it turns out, the two main oxygenates used to produce cleaner burning fuel are methyl tertiary butyl ether (MTBE) and ethanol.[6]

This lack of consistency in the specification of reformulated gasoline has resulted in a variety of reformulated fuels that are not substitutable. In combination with the high capacity utilization at which refineries are operating, this makes regions that sell reformulated gasoline more dependent on a specific set of refineries and hence susceptible to supply interruptions.[7]

Last year marked the beginning of the Environmental Protection Agency's (EPA) phase II reformulated gasoline program. It represents the second generation of reformulated gasoline and requires stringent reductions in gasoline vapor pressure. These can be difficult to meet particularly when blending gasoline with ethanol. Partly in response to last summer's price spikes—which were experienced primarily in the Midwest—the EPA this year has relaxed the vapor pressure requirements for reformulated gasoline containing ethanol. Nonetheless, this driving season started with lower gasoline inventories and higher prices for MTBE and ethanol than last year.

Hence, this year retail prices for gasoline repeated their price spike near the beginning of the summer driving season (see figure 3). The difference was in the timing, with prices rising earlier this year. Looking ahead there is little to indicate relief from such seasonal supply constraints in the medium term. For example, stricter regulations are on the way for refineries in order to comply with low sulfur gasoline standards by the year 2004. In addition, at the beginning of June, California's request to discontinue the use of oxygenates in its gasoline was denied by the U.S. EPA. The state now plans to switch from using MTBE to using ethanol by 2003, thereby increasing the demand for that particular oxygenate.

Budget impact

To estimate the impact of the rise in gasoline prices on consumer expenditures, we use data from the 1999 *Consumer Expenditure Survey*. During that year, households in the Midwest spent an average of 2.8% of their after-tax income on gasoline and motor oil.[8] If one assumes that income accrues equally across the year and no seasonality in the demand for gasoline, one can quantify the summer spike of gasoline prices relative to expenditures and income. During the 11 weeks of higher than average prices in the summer of 2000, the retail price of RFG gasoline in the Midwest rose by 51% compared with the same period of 1999. This resulted in an extra $44 of expenditures by households on gasoline per month during the summer, bumping the share of gasoline expenditures out of personal income after taxes from 2.8% to 3.9%. As figure 3 shows, the current summer's price spike very closely resembles the one from last summer. Hence the hit taken by consumers is estimated to be in line with that estimated for the year 2000. However, this year's episode played out against a much weaker economy.[9]

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Conclusion

From an economic perspective, one may be concerned over the potential impact of eroding personal disposable income due to rising gasoline and natural gas prices. In fairness, some of the impact may be more temporary than sustained. For example, over three-quarters of the natural gas consumed in the United States is produced in the United States—albeit outside of the Midwest—with most of the remainder being imported from neighboring Canada. This means that income from rising gas prices is partly re-circulated via profits and rents to stockholders, energy company employees, and owners of natural gas wells who may spend it on Midwest-produced goods and services. Midwestern residents may accrue income from these channels. The situation for gasoline is somewhat less sanguine, as rising gasoline prices in part reflect an eroding national "terms of trade" with oil-exporting nations. So too, for both of these fuels, the average relative effect on low-income households is sharper, and the offset to income less beneficial.

[1]The authors thank Carrie Jankowski for research assistance. This *Fed Letter* is part of an ongoing project to address longer-term infrastructure issues that are key to the Midwest region's fortunes.

[2]For a detailed analysis of the rise of gasoline prices in the Midwest during the summer of 2000, see Federal Trade Commission, 2001, *Midwest Gasoline Price Investigation, Final Report*, March 29.

[3]In 2001, crude oil accounted for about 35% of the cost of a gallon of regular grade gasoline. Federal, state, and local taxes represented 25%; refining costs and profits about 26%; and distribution, marketing, and retail costs and profits account for 14% of the cost. These data are available from the U.S. Department of Energy, Energy Information Administration (EIA) on the Web at http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp.

[4]For example, at the end of January, Premcor Inc. permanently closed its 80,000 barrel-per-day refinery in Blue Island, IL. This refinery accounted for about 2% of the Chicago–Milwaukee market.

[5]Apart from taxes, regional and local price differences are also caused by proximity of refineries, incidence of supply disruption, and the degree of competition in local markets.

[6]The EIA definition of the Midwest encompasses 15 states: IL, IN, IA, KS, KY, MI, MN, MO, NE, ND, SD, OH, OK, TN, WI. The nonattainment areas in the EIA's Midwest region are Chicago–Milwaukee; St. Louis; and Louisville, KY. Only Chicago and Milwaukee exclusively rely on RFG made with ethanol. Indiana and Iowa voluntarily add ethanol to gasoline sold in their states.

[7]In addition, gasoline reformulated with ethanol can be blended only at the final delivery terminal due to its high degree of water solubility. This prohibits shipping already blended gasoline through pipelines, leading to the potential for further supply disruptions.

[8]Incidentally, overall transportation expenditures, which includes vehicle purchases, represent the second largest expenditure category (about 18%) for the average household. Gasoline and motor oil represent approximately 15% of transportation expenditures.

[9]The calculation for 2000 as well as the estimates for 2001 are likely to represent lower bounds of expenditures on gasoline, as they assume no growth in the consumption of gasoline since 1999. The income effects are estimated for the Midwest as a region using RFG gasoline retail prices, averaging across all grades. Within the region, however, there is noticeable variation of retail prices for gasoline.

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