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Household energy expenditures, 1982–2005

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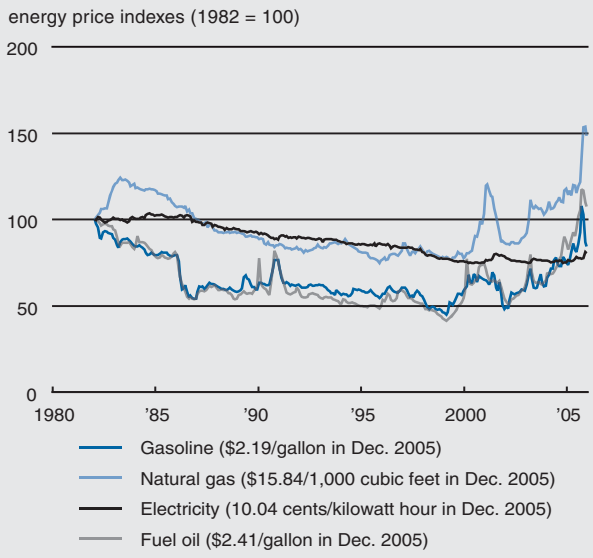
While energy's share of total expenditures has risen in recent years, it remains below the shares seen in the early and mid-1980s. Furthermore, the impact of the price increases on a household differs, based on the household's specific energy consumption patterns.

In this *Chicago Fed Letter*, we look at energy consumption over time and across groups. We find that energy consumption represented approximately 7% of expenditures between 1990 and 2004, a decrease from 11% in the early years of the 1980s and an average of 9% throughout the 1980s. We estimate energy expenditures made up approximately 8.5% of total household expenditures in 2005. Across demographic groups, we find that energy spending shares decline but energy expenditure levels increase as income increases. We also find that most groups that spend more on home heating as a share of total expenditure spend less on gasoline. The exception to this is the working poor, who spend a high fraction of their total expenditure on both gasoline and home energy.

1. Real monthly energy price indexes in the U.S., 1982–2005



SOURCES: Authors' calculations based on data from the U.S. Bureau of Labor Statistics and U.S. Department of Energy, Energy Information Administration.

Consumer energy purchases

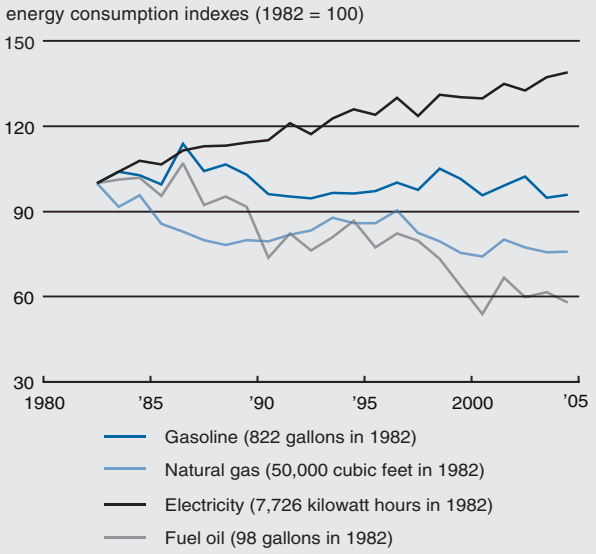
Consumers' direct purchases of energy are primarily used to power private vehicles and homes. Gasoline and motor oil are used by nearly 90% of Americans who commute by car or truck to their jobs. Most natural gas consumption is used for home heating. Electricity supplies general home energy uses, including the heating of some homes and the cooling of most homes. Fuel oil is a declining source of home heating energy and is primarily consumed in the Northeast.

Using data from the *Consumer Expenditure Survey* (CES) from 1982 through 2004, we can tabulate the fraction of total expenditure that is used by urban consumers to directly purchase energy. We find that consumers' direct expenditure on all types of energy has fallen from 9%, on average, in the last eight years of the 1980s to 7% in the 1990s and in the first four years of the current decade.

Gasoline expenditure is highest, followed by spending on electricity, then natural gas. Fuel oil expenditure is comparatively small. There are also strong seasonal patterns. Gasoline and motor oil expenditures are highest in the summer months, corresponding to high levels of personal travel. Electricity expenditure shares peak in the summer air conditioning season and in the winter heating season. Likewise, natural gas and fuel oil expenditures peak in the coldest months. Combining these seasonal demands, we find that the total energy demand is highest in the winter due, in large part, to an increased demand for heating.

Of course, expenditure shares are not the same as expenditure levels. Some of the decline in consumption shares in the

2. Annual household energy consumption indexes, 1982–2004



SOURCES: Authors' calculations based on data from the U.S. Bureau of Labor Statistics; U.S. Department of Energy, Energy Information Administration; and the *Consumer Expenditure Survey*, 1982–2004.

1990s could be due to increased expenditure in other areas that occurred independent of the market for energy. After examining expenditure levels, we found that shares were falling primarily because energy spending was falling, not because of changes in other spending patterns.

Energy prices and quantities

Changes in expenditure are the result of interactions between changes in prices and changes in quantities. We separate expenditure into prices, in figure 1, and quantities, in figure 2. In figure 1, we show monthly real energy prices relative to the price in January 1982. These prices are generated by taking the most recent nominal energy price available from the U.S. Department of Energy, calculating nominal prices for months before and after that date based on monthly Consumer Price Indexes (CPI) for each of the different types of energy, and deflating these values using the overall CPI. We compare these relative to the 1982 base because the energy sources are priced in different units.

Prices for gasoline and fuel oil fell during the mid-1980s, were fairly constant throughout the late 1980s and 1990s, and have been increasing in the current decade. Current inflation-adjusted prices are close to their 1982 levels, with fuel oil slightly higher and gasoline slightly lower. The high prices in the wake of Hurricane Katrina, as well as the moderation of prices afterward, are also apparent. Natural gas prices rose in the mid-1980s, fell steadily throughout the remainder of the 1980s and 1990s, and have been volatile but primarily rising since 2000. In the winter of 2000–01, a combination of cold weather and poor hydroelectric output spurred demand for natural gas and increased prices. We also see a substantial run-up in natural gas prices since the end of 2002, capped by a spike in November 2005 that put prices at 154% of their January 1982 level. Given the magnitude of the price changes in the past three years, it is not surprising that these changes have garnered much attention in the popular press.

The price trend in electricity is a striking contrast to that of the other energy sources. Electricity prices have been less volatile and have gradually fallen throughout the entire period. This may be due to efficiencies resulting from increased industry deregulation and to declines in the price of coal, the primary input in electricity generation, throughout the 1980s and 1990s. The low relative volatility of electricity prices is likely due to the price-regulated environment in which electric utilities continue to operate, compared to other energy providers.

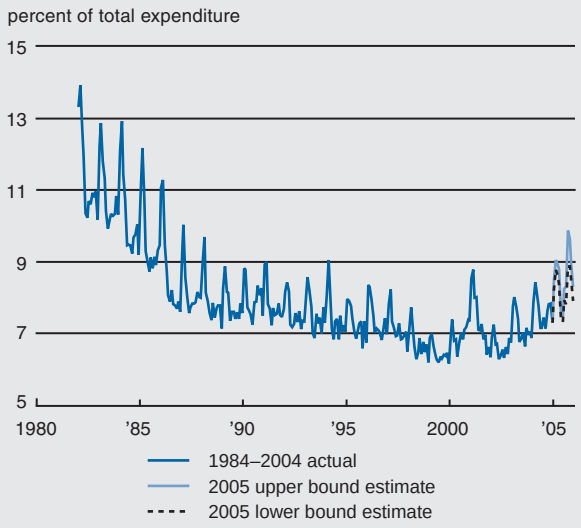
Given that we have calculated energy prices and total expenditure by energy source, we can derive consumption levels. We graph the implied annual consumption levels per household, relative to 1982, in figure 2. For gasoline, consumption has been relatively flat. Natural gas consumption has declined moderately. Electricity consumption has steadily increased and fuel oil consumption has steadily declined.[1]

We find that the drop in energy consumption levels and shares between the 1980s and 1990s was due to declines in both prices (especially in the 1990s) and quantities.

Estimates for 2005

Our data on energy spending stop in December 2004. While some of the recent price increases occurred prior to 2005, the increases in 2005 were more dramatic. We use data from 2004 to estimate 2005 monthly energy expenditure shares. We do this in two ways. First, we assume that total expenditures, as well as units of energy consumption, were the same in each month of 2005 as in the corresponding month in 2004. We also assume that energy expenditure fully crowds out other spending rather than leading to an increase in overall spending levels. This is our "upper bound" estimate. Our second method of estimation takes short-run demand elasticities from the energy literature of –0.23 for gasoline, –0.13 for residential natural gas and fuel oil, and –0.22 for residential electricity. We calculate

3. Energy as a monthly share of total expenditure, 1982–2005



SOURCES: Authors' calculations based on data from the U.S. Bureau of Labor Statistics; U.S. Department of Energy, Energy Information Administration; and the *Consumer Expenditure Survey*, 1982–2004.

4. Average annual expenditure share, 1982–2004

	Total energy	Gasoline and motor oil	Electricity	Natural gas	Fuel oil
Urban population	8.0	3.8	2.8	1.1	0.3
Elderly	8.1	2.9	3.2	1.5	0.6
Non-elderly	7.9	3.9	2.7	1.1	0.3
Without high school diploma	9.6	3.9	3.6	1.6	0.5
High school graduate	9.1	4.2	3.2	1.3	0.4
Some college	8.1	4.1	2.7	1.1	0.3
College graduate	6.8	3.3	2.3	0.9	0.3
Bottom income quartile	9.2	3.8	3.5	1.5	0.4
Second income quartile	8.9	4.1	3.1	1.3	0.4
Third income quartile	8.2	4.1	2.7	1.1	0.3
Top income quartile	6.7	3.3	2.2	0.9	0.3
Nonpoor	7.8	3.8	2.7	1.1	0.3
Poor	9.1	3.7	3.6	1.5	0.3
Working poor	9.6	4.3	3.5	1.4	0.3
Nonworking poor	8.8	3.3	3.7	1.6	0.3

NOTE: All values are in percent.

SOURCES: Authors' calculations based on data from the *Consumer Expenditure Survey*, 1982–2004.

units consumed and hence expenditure amounts based on these elasticities.[2] We also assume that total expenditure increases by the amount of the increase in energy expenditure. This is our "lower bound" estimate. The estimates are shown in figure 3.

We estimate that energy expenditure shares averaged between our lower bound of 8.2% and our upper bound of 8.6% of total expenditures in 2005. These are comparable to consumption shares last seen in 1986 and 1987. While this represents a substantial increase from the 1990s and early 2000s, it remains below the double-digit expenditure shares of the early 1980s. This trend is primarily driven by high estimated gasoline expenditures in August through October and high estimated natural gas expenditures from October to year-end.

Energy expenditure by group

The CES gives us information on the characteristics of the consumers being surveyed. This allows us to ask which groups are more and less sensitive to changes in energy prices given their energy consumption patterns. We look at three groups. First, we compare elderly households (head or spouse age 65 or over) with non-elderly households. Second, we break households into income quartiles, adjusted for family size using the National Academy of Sciences' equivalence scale.[3] Third, we compare the poor and the nonpoor, and we further compare the working poor (household members work more than 1,750 hours combined a year) with the nonworking poor (household members work fewer than 1,750 hours combined a year). These results are in figure 4.[4]

These expenditure shares capture only direct household expenditures. There are three types of indirect expenditures that may influence our results. First, individuals in some households rely more heavily on public transportation. Energy costs represent some of the price of public transportation, but we do not include these expenditures in our calculation. Second, heat, natural gas, and electricity are sometimes included in the price of rental units. The absence of these costs from our calculation indicates that we are underestimating total energy expenditures for groups with low homeownership rates, in particular the young and the poor. Third, the Low Income Home Energy Assistance Program (LIHEAP) pays providers directly for some of the home energy used by eligible households. However, the number of households receiving LIHEAP aid is small. In 2003, about six million households (or about 5.6% of households) received some energy assistance.

We find that the elderly and non-elderly concentrate a similar fraction of their expenditure on energy (8.1% versus 7.9%). A lower fraction of the elderly group's expenditure is on gasoline and motor oil (2.9% versus 3.9%) relative to the non-elderly, while a higher fraction is on electricity, natural gas, and fuel oil. This is consistent with low commuting-related gasoline expenditure among the elderly (who are less likely to be employed) and higher home energy spending. In addition to the elderly spending more time at home, the high home energy spending may be due to a higher share of homeownership. The elderly are less likely to rent their homes (37% of the non-elderly were renters in 2004:Q2 versus 22% of the elderly). However, elderly renters are more likely than non-elderly renters to have their heating covered in the rent (53% of elderly renters compared with 29% of non-elderly renters in 2004:Q2).

These findings lead to the conclusion that the elderly are more sensitive to changes in the price of home energy and less sensitive to changes in the price of gasoline than the non-elderly. The current high level of natural gas prices disproportionately affects elderly households. Many elderly individuals are on fixed incomes and, unlike employed individuals, do not have any leeway to adjust their incomes through overtime work or other means. However, older households also have greater accumulated wealth, which may allow them to smooth expenditures better over time.

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When we examine income quartiles, adjusted for family size and composition, we find that overall energy expenditure shares, as well as shares for natural gas and electricity, decline as income increases.[5] Given that home energy is a necessity, it is not surprising that the expenditure share is highest among the group that has the lowest income level. One factor mitigating the gap in energy expenditure shares between the lowest income quartile and the top three income quartiles is the low homeownership rates of the lowest income quartile. In 2004:Q2, 21% of these households were renters with heating covered in the rent, compared with 5%, 7%, and 11% for the top three income quartiles, respectively.

Fuel energy expenditure shares decline as income increases, with the exception of individuals in the bottom quartile, who have expenditure shares below those in the second quartile. For gasoline expenditure shares, we see the lowest share among the highest income group, followed by the lowest income group. The middle income groups have the highest shares. The poorest group's relatively low energy expenditure shares can be explained by the comparably low level of labor force attachment and hence commuting costs of this group. More individuals in this group also cannot afford a car.

Our final comparison is between the poor and the nonpoor. We further divide the poor into the working poor and the nonworking poor. Consistent with the results based on income, the poor have higher expenditure shares on total energy than the nonpoor, with higher shares on home energy sources overshadowing lower shares on gasoline. These high shares on home energy occur despite a sizable gap in rental rates between the two groups. In 2004:Q2, 26% of the poor were renters with utilities covered in the rent as opposed to 9% of the nonpoor. When we look at the breakdown by work status, we find that the working poor spend a far higher share on gasoline and on all forms of energy combined than the nonworking poor and the nonpoor.

Conclusion

The comparisons across all of these groups have been consistent across different periods and have held when energy prices were high in the 1980s, low in the 1990s, and increasing in the early years of the current decade. As a result, we would expect these patterns to hold in the current run-up in energy prices.

Overall, many of the groups that spend the highest share of their total expenditure on home energy costs—such as the elderly and the poor—are the same groups that spend the lowest shares on gasoline and motor fuel. This suggests that when gasoline and home energy prices rise in tandem, as has happened recently for gasoline/fuel oil and natural gas, the effects on the different groups are more similar than would be suggested by only looking at one energy source. The one exception to this is the working poor, who consume both home energy and motor fuel in large quantities.

[1] These patterns are similar to patterns generated from data on energy consumption from the U.S. Department of Energy, Energy Information Administration (EIA). However, the consumption levels differ somewhat.

[2] Gasoline elasticity is from Federal Trade Commission, 2005, *Gasoline Price Changes: The Dynamic of Supply, Demand, and Competition*, report, Washington, DC, June, available at www.ftc.gov/reports/gasprices05/050705gaspricesrpt.pdf. Natural gas and electricity elasticities are from C. Dahl, 1993, *A Survey of Energy Demand Elasticities in Support of the Development of the NEMS*, report, Contract No. DE-AP01-93EI23499, Washington, DC, October. Fuel oil elasticity is assumed to be the same as that for natural gas. If we compare consumption levels from the EIA for the first 10 months of 2004 with consumption levels for the first 10 months of 2005, we see that natural gas consumption fell 2%, electricity usage increased 5%, fuel oil consumption decreased 1%, and gasoline usage was flat.

[3] The equivalence scale states that the income needs of the family is based on the following formula: [number of adults + (0.7 × number of children under 18)]$^{0.7}$.

[4] We also calculated the real dollar expenditure levels for each group and the expenditure measures for three separate periods—1982–89, 1990–99, and 2000–04. These results are available from the authors.

[5] Income is not well measured in the CES. Therefore, figure 4 also examines energy expenditure shares by educational attainment, which acts as a proxy for earnings potential. Not surprisingly, the trends for educational attainment and income are quite similar.