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The Iowa legislature debated whether to change its utility disconnection policy. The debate centered around three questions: 1) whether family size or income influences energy consumption; 2) whether elderly people consume more energy than families; and 3) whether energy subsidies foster increased energy use and energy waste. This paper reports energy consumption patterns for a sample of low income people. Economic demand theory predicts that energy consumption will increase as income increases. This hypothesis was statistically rejected. Second, legislators assumptions about energy consumption were formulated into hypotheses. These hypotheses were statistically rejected.

Public Policy and the Energy Needs of Low Income Families

Energy price increases during the 1970's affected the ability of low income people to pay utility bills. Customer disconnections increased as the arrearages for utility companies climbed. The problem of arrearages and disconnections led to a public policy debate: should government meet the energy needs of low income people through the regulatory function or through the welfare function? States implemented a variety of energy protection mechanisms to deal with the arrearage and disconnection problem: disconnection moratoriums; rate relief; spreading the cost of unpaid bills across all customers; checkoff programs; and mandatory budget billing. This paper reports energy consumption patterns for a sample of low income people. Finally, the paper applies the study findings to energy policy options.

Public Policy Debate

The Iowa legislature was under pressure to change its utility disconnection policy. There was considerable dissatisfaction with the disconnection moratorium which protected customers from energy disconnection during high consumption months from November through March. Utility companies were dissatisfied because they were holding millions of dollars in unpaid gas and electric bills. Human needs advocates were dissatisfied because customers had no protection after March 31. Further, once a customer was disconnected, the utility company usually would not reconnect service until the arrearage and a service deposit were paid.

But legislators found it difficult to formulate policy. First, consumer lobbyists supported proposals quite different from lobbyists for utility companies. Second, none of the proposals provided sufficient data about the number of people who would be affected, or the projected fiscal cost of each proposal. As the debate continued, legislators began to ask questions about the cost of energy subsidies, energy consumption patterns, and energy conservation.

The debate centered around three researchable questions: 1) whether family size or family income influences consumption; 2) whether elderly people in single family homes consume more energy than families in similar dwellings; and 3) whether energy subsidies foster increased energy use and energy waste. This study empirically tests the validity of policy maker assumptions. We collected income and consumption data to statistically test the questions and hypotheses expressed by policy makers, particularly whether low income people have special characteristics which influence energy consumption.

Energy Protection Models

Low income families typically reside in housing which has not been adequately weatherized from wind, cold and precipitation. Energy costs can constitute a considerable portion of a poor family's income. In the tier of states known as the frost belt, an estimated 25 million poor people spend up to 20 percent of "after tax" income on energy (Cullen, et. al., 1983).

When poor people spend a significant portion of income on energy, they must reduce consumption for food, clothing and medical care (Cullen, et. al., 1983). Unlike other consumer goods, a family can not shop for a secondhand cubic foot of gas or a slightly used kilowatt of electricity. All a poor family can do is try to consume less energy (Deerwester, 1987).

Rate relief was proposed for helping low income people obtain sufficient energy. The lifeline model (a form of rate relief) would provide a minimum number of kilowatts for customers on low or fixed incomes, and a special rate for this use (Lawrence, 1979). The model assumed that income has a strong, positive effect on demand. Therefore a lifeline rate would "subsidize" use by low-income people and "tax" use by high-income customers.

Two problems emerged with the lifeline model. First, it was electricity based, and most people in the frost belt use natural gas to heat homes or apartments. Therefore, the lifeline model would not help most low income people with overall energy costs. Second, researchers found that electricity use varies for reasons largely unrelated to income (Burgess and Paglin, 1981).

Utility companies and economists generally opposed rate shifts on the basis they distort the market and lead to wasteful use (Scott, 1981). Utility companies argued that rate preferences for low income people "are a subsidy" (Davis, 1982:197). Economists concluded that income transfers are easier and cheaper to administer, as well as more effective in reaching the target population, than rate relief (Aaron and Von Furstenberg, 1971; Berg and Roth, 1976; Burgess and Paglin, 1981).

Another model to help utility companies and customers deal with energy costs is the Guaranteed Service Plan (GSP). The GSP model helps low-income people pay current energy costs while also making payments toward arrearages from unpaid bills. A GSP guarantees that a customer who makes regular payments of a specified amount to the utility company will not be disconnected. These payments cover energy costs and arrearage payments. Common payment thresholds are 10 or 15 or 20 percent of a customer's annual income.

A critical element of the GSP model involves writing off arrearages too large to be paid by a low income family. A GSP limits current energy costs and limits arrearages to keep the total cost burden within a designated percentage of a family's income. Once a GSP plan is established for a customer, the arrearage amount does not grow, even if current energy costs exceed the payment plan. Utility companies, regulators and poverty advocates concluded that the GSP model can be effective. This occurs because the shortfall between utility bills and manageable GSP payments does not significantly differ from the bad debt which companies currently write off (Colton and Hill, 1987).

Method

This study is based on a sample of 483 households randomly selected from more than 11,000 Polk County households receiving help from the federally financed Low Income Energy Assistance Program (LIHEAP). In Iowa, any family below 150 percent of poverty is eligible. Approximately half the eligible people apply for a subsidy.

The study collected de-identified household data from the LIHEAP application. Utility companies generated a monthly gas and electric consumption statement for each LIHEAP household. Households using deliverable fuels were excluded. Energy data was analyzed for the six month heating season—from November 1 through March 31. This period is the high consumption season, and fits both the seasonal disconnection moratorium as well as a "guaranteed service program" model.

The study uses income and consumption data to examine the energy consumption patterns of low income people. The study also calculated the common GSP thresholds ("percent of income spent on energy") of 10, 15 and 20 percent of income. The legislative debate about the possible influences of household characteristics such as family size and family income led us to include several of these independent variables in the study to determine if they were good predictors of seasonal energy use. The selected variables were: annual family income; number of persons in the household; single versus multi-unit dwellings; number of preschool children; elderly families; and amount of the LIHEAP grant.

Findings

Data analysis begins by examining energy consumption for households and then proceeds to test whether there are consumption differences between households in the various GSP thresholds. We then test for energy consumption differences for different types of households. Finally, data analysis tested which variables make a statistically significant contribution to energy consumption.

The utility company provided total consumption data for all residential customers served by the company. Natural gas consumption by LIHEAP households in the sample is comparable to consumption by all residential users. The "table of means" for income and energy consumption in Table 1 contains the income distribution and gas consumption for Polk County households. The category Polk is all Polk County households. The category LIHEAP is all LIHEAP households for the sample. The remaining categories contain households which fit the "percentage of income categories."

The typical LIHEAP household in Table 1 consumed 989 CCF for the heating season, about 5 percent higher than the 941 CCF consumed by the typical residential household buying energy from the utility company. The typical LIHEAP household consumed 80 percent of its annual gas usage during the six-month heating season. Seasonal electric consumption represented 54 percent of annual use. We computed correlation coefficients to test the relationship between income and gas consumption. The correlation coefficient (..071) between income and gas consumption did not fit the usual economic assumptions for market behavior, i.e., household income for the sample does not predict gas use.

We then tested to determine whether there are differences between the consumption patterns of households in the various thresholds for GSP categories ("percent of income spent on energy"). We want to note however, that household income—and percent of income spent on energy (GSP categories)—are two quite different variables.

For this sample, energy (gas and electric) consumption increases as the "percent of income spent on energy" increases. The differences between energy consumption for households in the 20 percent category versus households in both the 10 percent and 15 percent categories were significant at the .01 level. Households spending more than 20 percent of annual

Table 1

Liheap and Polk County Households Income by Seasonal Gas Consumption

	Income	Seasonal CCF	% Avg CCFUSE
Polk	$36,842	941	100.0
LIHEAP	7,114	989	105.1

Liheap Households GSP Thresholds of Income Spent on Energy By Seasonal Gas Consumption

Under 10%	9,340	813	86.3
10–15% Cat	5,471	975	103.6
15–20% Cat	4,891	1302	138.4
Over 20% Cat	3,849	1680	178.5

income on energy averaged 1680 CCF; households in the 10–15 percent category averaged 975 CCF; households in the category under 10 percent averaged 813 CCF.

Income and energy consumption for households in the "percentage of income categories" are negatively related. LIHEAP households with heating season energy bills exceeding 20 percent of annual income have lower income and higher energy use than those in the other categories. These households used more gas than either the typical sample household or the typical Polk County customer. We also tested to determine if differences in seasonal electrical consumption contribute to variation between the categories. The hypothesis was rejected. Further analysis showed there is minimal difference in electrical consumption between households in the 10 percent of income category and those in the 20 percent of income category: $274 and $279 respectively.

Every household in the 20 percent category had income below the 100 percent poverty level (less than $8,850 for a family of three). This group had an average annual income of $3,849, which is only 10.5 percent of the average household income ($36,842) for Polk County. Income for this group was 54 percent of the average income ($7,114) for all LIHEAP households.

Families living in multi-unit dwellings receive lower LIHEAP grants than families in detached houses. The LIHEAP rules assume that apartments are cheaper to heat than houses. We tested the hypothesis that families in detached houses consume more energy than families in apartment units. This hypothesis was rejected. The outcome was opposite the predicted direction.

The energy consumption difference between detached units and apartment units for all LIHEAP families in Table 2 was significant (T-test) at the .01 level. The difference between detached units and apartment units for families in the 20% of income category was significant (T-test) at the .01 level.

We then looked at gas consumption rates for families which fell into the "20 percent of income category" compared with the average for all families. Families in detached houses had seasonal gas consumption 32% greater than the average for all families in like units for the sample. Families in apartment units had seasonal gas consumption 166% greater than the average for all families in like units for the sample.

Table 2

Seasonal Gas Consumption in Attached and Detached Dwellings

	Detached	Attached (Apartment)
Consumption All Households (CCF)	1009	1036
Consumption 20% Households (CCF)	1333	2755

During legislative debate, policy makers questioned whether family composition affects energy consumption. They particularly wondered whether people who are home all day—the elderly, and families with preschool children—consume excessive energy. We tested the hypothesis that elderly people consume more energy than other families in the sample. This hypothesis was rejected. The outcome was opposite the predicted direction. Average heating season gas consumption for LIHEAP households over age 60 was 962 CCF; average heating season consumption for LIHEAP recipients under age 60 was 1007 CCF. The difference was significant (T-test) at the .01 level. We then tested the hypothesis that families with preschool children consume more energy than other families in the sample. This hypothesis was accepted. Average heating season gas consumption for LIHEAP households with preschool children was 1041 CCF; average heating season consumption for LIHEAP households with no preschool children was 972 CCF. The difference was significant (T-test) at the .01 level.

The economic literature on utilities suggests that the independent variables income, LIHEAP grant and household size are demand variables, and therefore predict energy consumption. They also are continuous variables. The independent variables of dwelling type, young children and elderly were included in the equation because they reflect policy maker beliefs that these variables also influence consumption. These are categorical variables in this data set.

The final step in our data analysis tested which independent variables make a statistically significant contribution to energy consumption. For this analysis, we used the stepwise regression procedure to compute the regression equation for gas consumption. The dependent variable for energy demand in Table 3 is expressed as:

EU = Seasonal gas consumption

The independent variables in Table 3 are:

I = Annual family income in dollars
HH = Number of persons reported living in the household
Ll = LIHEAP grant in dollars
ATT = Whether dwelling is detached or multi-unit
YC = Number of preschool children
AGE60 = Elderly in home

Each independent variable in Table 3 was hypothesized to have a positive effect on energy demand. Unexpectedly, none of the independent variables predicts gas consumption

Table 3

Demand Equation for Seasonal Gas Consumption

Correlation	Coefficients
EU	EU
1	.071
LI	.065
HH	.110
ATT	−.018
YC	.077
AGE60	−.074
Multiple R = .155	F = .966
R2 = .024	sig = .44

for this sample of low income families. In fact, the correlation coefficients calculated in Table 3 for each of the variables are barely above zero. This finding was unexpected since it seems to negate (at least for this sample of low income households) the expectations of economic demand theory. Nor does it fit with the assumptions of policy makers.[1]

Discussion and Implications

The findings provide important insight on energy consumption by low income people. The analysis in this paper is based on two separate models. First, economic demand theory predicts that energy consumption will increase as income increases. This hypothesis was statistically rejected. Second, legislators also made certain assumptions about energy consumption. These assumptions (proposed as policy guidelines) were formulated into hypotheses. These hypotheses were statistically rejected.

The findings suggest that the choices of low income consumers are not predictable when we consider energy demand purely as function of income. First, as income declined, people not only had less disposable income for energy costs, but energy costs dramatically increased. Second, the low correlation between LIHEAP and energy use indicates that energy consumption does not increase with subsidy size. Thus, people with very low incomes use more energy. This does not mean they are more wasteful than other people. Rather, we suspect that they are more likely to live in houses converted to apartments, substandard, poorly insulated buildings which do not have the interior walls, ceilings and floors which help reduce energy consumption. Therefore, services such as weatherization or household relocation would produce greater savings.

Third, the findings confirm previous studies that the rate relief model is not useful in meeting the heating needs of low income people. Rate relief for natural gas would further penalize households in the 20 percent of income category, the poorest of the poor, for their poverty. Such households would pay premium rates on consumption exceeding the "minimum use," driving energy costs even higher.

Finally, a GSP for poor families would have to include both the level of poverty, and percentage of income category in the allocation system. LIHEAP funds are now divided among all eligible households. Dollar awards vary depending on family income, household size and whether the dwelling is a house or apartment. Re-allocation would negatively impact on some current recipients (for example, families from 125–150 percent of poverty would have to be dropped from the program) to adequately cover people in the lowest category and to prevent budget shortfalls.

The public policy choices of legislators and utility regulators about energy use were based on political or economic "common sense" assumptions rather than data. But while "common sense assumptions" may predict the behavior of some individuals, they do not necessarily predict behavior for the target population as a whole. This may appear self-evident to the reader, but is not at all obvious in the heat of legislative debate. As funds for social welfare programs tighten, policy makers will be increasingly constrained to make policy decisions which meet the needs and demands of one group at the expense of another group. The efficient and effective allocation of economic resources becomes increasingly important in difficult economic times.

The findings for this study should encourage researchers interested in examining social welfare policy. The findings support the idea that the assumptions and questions raised by policy makers during debate can be formulated as testable hypotheses. Research does require some familiarity with the welfare program under investigation. It also requires familiarity with the major policy arguments. But with some effort, it is possible to collect and statistically test the data for these hypotheses.

Note

1. Even though electrical consumption does not significantly vary between the heating season and the non-heating season, we tested whether any of the independent variables make a statistically significant contribution to electrical consumption. We used the stepwise regression procedure to compute the regression equation for electrical consumption. Again, there is almost no relationship between electrical consumption and the demand variables income or LIHEAP grant. There is a moderate relationship between electrical consumption and household size.

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