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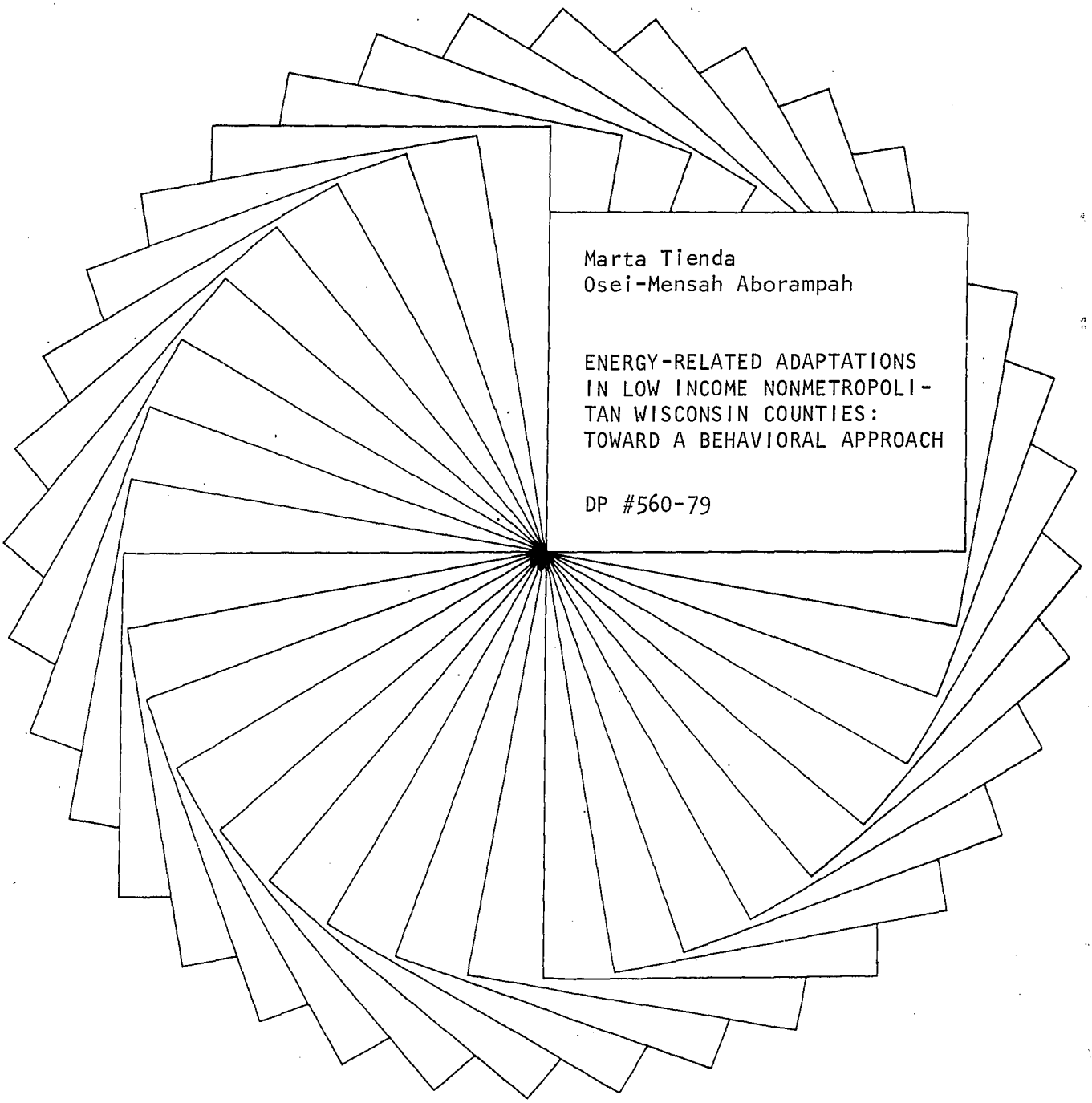

ENERGY-RELATED ADAPTATIONS IN LOW INCOME NONMETROPOLITAN WISCONSIN COUNTIES: TOWARD A BEHAVIORAL APPROACH

Marta Tienda

and

Osei-Mensah Aborampah

Department of Rural Sociology
University of Wisconsin-Madison

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ABSTRACT

Behavioral adaptations to tightening energy supplies among a sample of nonmetropolitan Wisconsin residents are examined to determine the relative importance of physical-structural, socioeconomic and demographic factors in shaping domestic coping strategies. A typology for conceptualizing the domestic response to energy is developed, and specific behaviors used by respondents to cope with higher energy prices are catalogued according to whether their adaptive responses involve household or other members (Internal/External Response Domains) and whether they involve changes in monetary inflows and outflows (Pecuniary/Non-pecuniary Adjustment Foci). Results showed that practices which impinge on individual freedom to choose or entail more substantive personal sacrifices are generally less attractive behavioral responses for all, but the poor apparently have somewhat less freedom to choose among the range of possible behaviors. Still, nearly half of all respondents claim to have experienced decreases in economic well-being because of the increasing energy prices. The results of a multivariate analysis reinforced a previous conclusion that physical-structural characteristics of the familial micro-environments are more important than socioeconomic and family factors in molding consumption levels and behavioral adaptations, particularly those classified as non-pecuniary adjustments. With the exception of the strategy of switching to less expensive fuels for space heating or supplementing the primary source of heat with an alternative fuel (most likely to be wood), pecuniary adjustments, that is, those involving adjustments in monetary inflows or outflows, did not emerge as important correlates of the conditions which alter household energy consumption patterns.

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1. INTRODUCTION

The ability of low income families to absorb fuel price increases depends on a collective household strategy to allocate scarce resources against potentially competing demands. This view implies that families have flexibility to cope with changing circumstances by making internal changes and drawing on outside resources, but it requires that the content of adjustments at the household level be specified. Research which considers how families prioritize expenditures and behave in ways which compensate for higher energy costs would contribute to our understanding about the latent effects of the energy crisis, but this issue has received very spotty attention in the literature.

Concern over the sociological dimensions of energy usage has resulted instead in a number of studies dealing with energy conservation, conflicts between environmental and social welfare goals, and the changing consequences of rapidly rising energy costs. More specifically, recent, past, and ongoing investigations have examined citizens' attitudes, perceptions, opinions, and beliefs about the reality of the crisis and finite supplies (Barnaby and Reinstein, 1975; Bultena, 1976; Gotlieb and Matre, 1976a, 1976b; Murray, et al., 1974; Warren and Clifford, 1975; Morrison, 1975; Zuiches, 1976; Honnold and Nelson, 1978), the causes of inflation (Bach, 1973; Bosworth, 1978 and Clark, 1976), the policies needed to change the current situation (Brunner and Bennet, 1978; Lewis, 1977; Klausner, 1975; Cohn, 1977; Appleby, 1976; Bucknell III, 1976; Bardin, 1977; Linden, 1978; Carter, 1977) and observed

changes in household energy consumption subsequent to the 1973 oil embargo (Bullard and Herendeen, 1975; Heberlein, 1975a, 1976b; Winett and Nietzel, 1975). Overall, the findings are not especially promising either about the potential for long-term behavior modification or permanent changes in energy use patterns. For example, Brunner and Bennet (1978) suggest that an educational process of broad scope is necessary to persuade consumers to consider future generations by reducing present energy consumption levels, but they also note that there is little reason to believe that such efforts would be supported.

Although few would question that most individuals are motivated to conserve for egotistic as opposed to altruistic reasons, reduction in consumption levels can benefit society as well as individual households that wish to offset increasing costs. The wide appeal of conservation-oriented strategies for mitigating the inflationary impact of the energy crisis resides in their potential to alleviate the price squeeze in the short run and their voluntary as opposed to forced nature. Incentives to use less energy through the manipulation of prices can be masked with publicly sanctioned messages advertising how to cut costs and how the obligation to preserve the environment rests with everyone. The important point, however, is that the outcomes of conservation behavior benefit the actors in two ways: first, through individual cost savings and second, through emotional reinforcement that reduction in unnecessary consumption will benefit the nation. Of course, advocacy of the need to conserve presumes that the means to do so exist. In reality this assumption is not always justified because of differences among families in abilities to comply with policy-designated consumption standards.

With limited exceptions, relatively few studies have examined the determinants of energy utilization as a function of macro and micro physical and social constraints which define families' decision-making context. Morrison's (1976) study of the relative importance of physical and structural characteristics and lifestyle factors as determinants of households' energy consumption levels is a notable exception. Underlying her interpretation is a conservationist orientation which assumes that all families have real choices to change their demand for energy through changes in living standards and/or consumption patterns. This assumption is short-sighted because of significant income-based differences in the ability to make such changes (Perlman and Warren, 1975; Berman and Hammer, 1973; Bloom, et al., 1975) and rural-urban differences in the receptiveness to different alternatives (Zuiches, 1976; Grier, 1976). Behavioral changes that are either directly or indirectly linked with energy consumption patterns are important for assessing the social equity implications of the energy crisis. In fact, consideration of the "latent" effects is especially pertinent for low income groups whose motivations to conserve or consume more energy may be overshadowed by economic and social constraints upon individual choices.

2. RE-CONCEPTUALIZING THE SOCIAL IMPACT OF ENERGY

As the cost of energy increases, energy-related behavior will presumably experience changes of a quantitative and qualitative nature. In other words, the adjustments families make to provide for domestic energy needs will vary both in number and in kind, depending on disposable resources and demand levels. Households that do not experience increases in family income to compensate for rises in fuel and utility costs must either streamline consumption or seek alternative strategies to cope with the fuel price squeeze. To

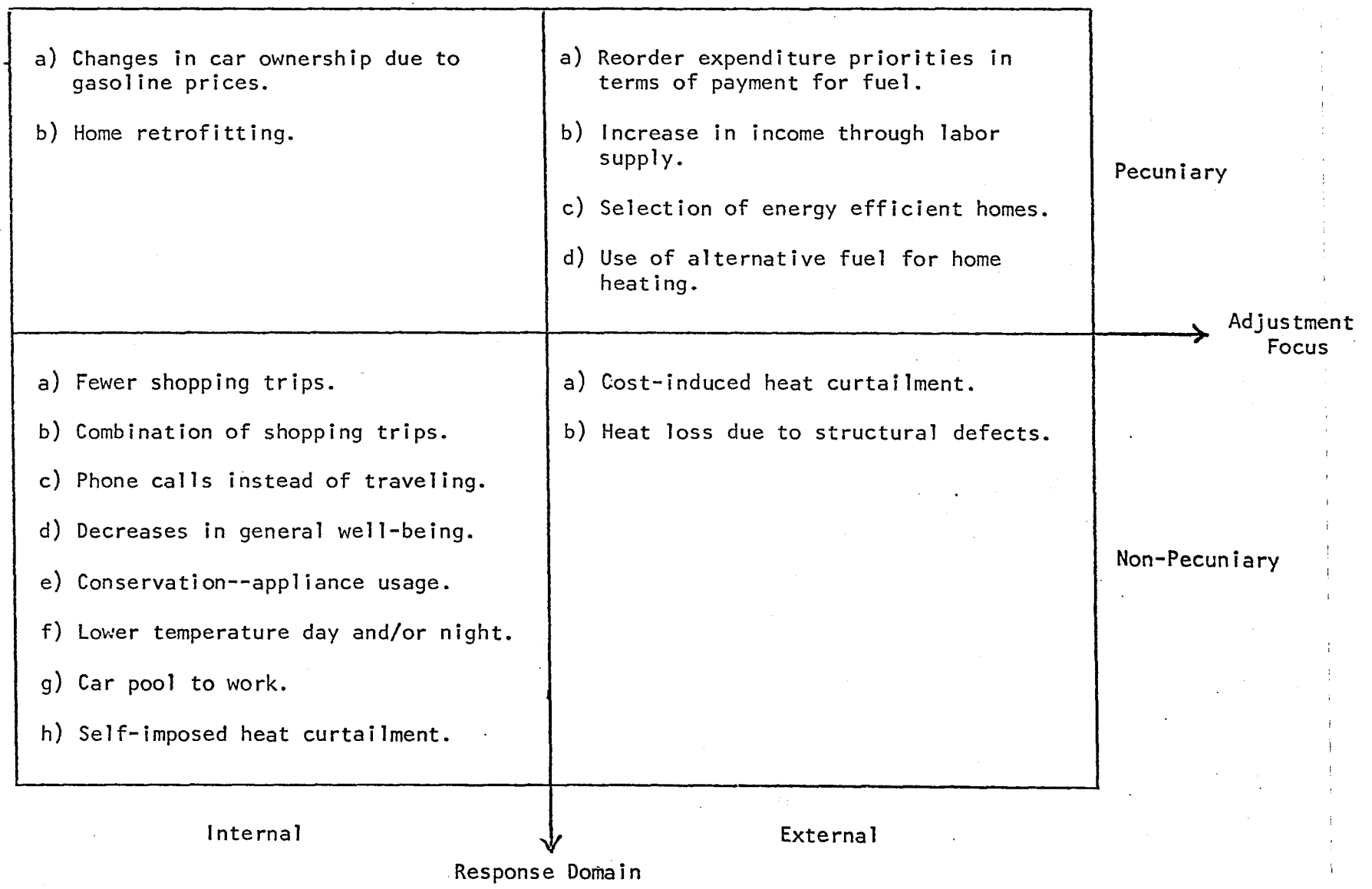
illustrate how families might adjust to a situation of increasingly more limited and costly energy supplies, it is instructive to consider the mechanisms by which energy needs are satisfied through various alternatives.

The assessment of household behavior that reflects either a direct or indirect response to inflated prices must consider a range of adaptations which are both realistic and viable for a designated subgroup. For heuristic purposes, it is helpful to distinguish between pecuniary and nonpecuniary adjustments and between internal-external response domains (Figure 1). The internal-external dichotomy reflects whether the household responses (coping mechanisms) are directed inward or outward. In the former case, the means to cope and the consequences of doing so are contained within the household whereas outward responses mean that the domestic unit must draw upon outside resources to accommodate price increases. The pecuniary-nonpecuniary axis refers to the content of adjustments or, specifically, whether coping behavior involves monetary inflows or outflows directly or whether it instead reflects an attempt to influence energy consumption vis-a-vis lifestyle factors or comfort levels.[1] No specification concerning the conscious or unconscious nature of these adjustments is made. A no response category is conceivable only if families are completely sheltered from cost and scarcity impacts, an unlikely circumstance given the interdependence of social units.

The very general distinction between response domains and adjustment foci is compatible with the notion that family units define a strategy to provide for essential and nonessential needs even though this process may not be a conscious one at all times. This is because a given stimulus, whether endogenously or exogenously initiated, triggers a compensatory reaction. Rephrased in terms of energy use, the rapidly changing prices and "scarcities" stimulate a variety of adjustments in activity which may be

FIGURE 1

TYPOLOGY OF RESPONSES FOR FAMILIES TO MEET HOUSEHOLD ENERGY NEEDS



related, albeit indirectly, to a household's ability to meet consumption demands. This perspective is useful not only for highlighting the behavioral content of households' responses to the energy cost spiral, but also for identifying less visible impacts that result from declining purchasing power, and, therefore, signal parallel declines in the financial circumstances of households.

Using the fourfold division with the response domains and adjustment foci as axes, it is possible to classify household reactions to cope with increasing costs and limited fuel availability. Coping strategies may include one or more of the following: (1) a re-ordering of household expenditure priorities; (2) home retrofitting (that is, modifications in a dwelling which improve the efficiency of energy use); (3) an increase in household income by sending additional family members into the labor force; (4) soliciting supplements to family income through direct public assistance or transfer payments; (5) making deliberate cutbacks in the amount of energy consumed; (6) altering living arrangements to decrease aggregate demand on utilities; (7) changing residence in order to find alternative or cheaper forms of energy; (8) acceptance to government regulatory/distributive policies; or (9) going into debt. Obviously, these specific reactions are neither mutually exclusive nor exhaustive of the range of concrete possibilities. Rather, these can illustrate the multifaceted nature of the way in which households experience the energy crunch. A better appreciation of the heuristic value of the conceptual framework (Figure 1) is afforded in the following discussion of the typology.

1. *Internal Pecuniary and Nonpecuniary Responses*

A re-ordering of household expenditure priorities, particularly those concerning energy-consuming items, represents an internal pecuniary response because the behavioral adjustment is contained within the household and it is directly involved with monetary flows and their allocation. This response is frequently unconscious and unplanned, but it need not be. Unless the increases in the cost of energy can be offset by comparable amounts of dissavings, a family's disposable income will be reduced by the amount that energy prices rise, all other things being equal. Home retrofitting is also an internal pecuniary reaction because the intended goal of eliminating waste (and thus saving money over the long run) is accomplished through direct money outlays to purchase thermal efficient materials. This alternative might be less appealing for low income families because savings would be difficult to appreciate during a period of rapid inflation. Moreover, investment in thermal efficient equipment (particularly siding, wall and ceiling insulation and storm windows) could cause considerable financial stress in the short run unless arrangements are made to finance costs at low interest rates through a lending agency. However, if outside assistance is solicited to purchase or finance energy-saving materials, the behavioral response would qualify as an external pecuniary adjustment.[2]

Direct cutbacks in the level of energy consumed through voluntary conservation represent internal nonpecuniary reactions because the consequences of deliberately modifying usage levels are contained with the households and the behavioral responses are not themselves directly geared to influence monetary inflows or outflows. The elimination of unncessary

consumption (waste) can be accomplished by changing household uses of appliances and home temperatures and modifying travel behavior (i.e., making fewer trips; using telephone instead of travel; or, in general, more rational planning of trips, including carpooling to work). The amount of energy consumed can also be influenced by changing the number of members contributing to household consumption levels.[3]

External Pecuniary and Nonpecuniary Responses

Externally-oriented behavioral adjustments highlight the circumstances that constrain the ability of families to make choices. This is because, in general, individuals are likely to be more effective in manipulating their micro (domestic) environment rather than their macro environment which includes economic forces (supply/demand); natural conditions (weather); and surrounding actors (particularly, fuel and utility companies). Such resources as supplementing household income through increases in labor force participation of family members, requests for public assistance to offset energy costs, efforts to use alternative less expensive fuels and to participate in budget payment plans with fuel and utility companies represent behaviors that are directed towards the monetary flows associated with meeting energy needs. Because these activities entail drawing upon resources outside of the household, they are classified in the external response domain. However, their viability is not determined by individual effort alone, hence the incidence of externally oriented coping behaviors should be less frequent.

Structural defects in dwellings are factors which positively influence energy consumption levels. Drafty basements, porches or windows and inefficient furnaces not only require more fuel, but unfortunately do not

ensure commensurately adequate comfort levels. Reports that homes are not warm enough because of physical structural defects (as contrasted with voluntary reductions to conserve energy) or because individuals are not able to meet basic costs illustrate the nature of limitations on individual household's ability to absorb continually increasing fuel prices. While home retrofitting appears to be a logical solution for problems of heat loss and drafts from structural defects in homes, this option is not always within the reach of the most needy such as the elderly or the low income households.

Overall the typology is helpful for highlighting the complexity of the ways in which households devise strategies to cope with increasing energy costs, including the less visible (latent) aspects, and for bringing into focus a basic research question: What kinds of behavioral response sets are likely to emerge among households which differ in social and material resources as well as demographic composition? If the popular contention that low income groups have fewer means with which to counter energy-related inflationary pressures has any empirical foundation, one might hypothesize that responses in the external domain would be relatively more common among this group. Recall the basic claim that conservation, however attractive, is possible only to a limited extent among groups whose consumption is basically for essential as compared to nonessential needs (Newman and Day, 1975). Alternatively, the nonpoor should exhibit a greater degree of flexibility in their response sets to cope with higher energy costs because of the possibility to make cash outlays for thermal efficient equipment, higher fuel prices, and investment in alternative fuels. Furthermore, the well-off have the choice of reducing nonessential consumption.

These statements also must be qualified in terms of additional variables which are likely to condition both consumption levels and the appeal of

various coping behaviors. Literature on energy consumption patterns suggests that the physical characteristics of dwellings significantly influence the amount and efficiency of home energy consumption (Morrison, 1976; Newman and Day, 1975). For example, tenancy status is important because renters and buyers differ in their incentives to conserve and invest in thermal efficient equipment. Dwelling type also influences consumption, and while most studies indicate that single family residences are the least efficient for purposes of space heating, these nonetheless are the most popular choice of dwelling in the U.S. In addition, the size of the dwelling and the number of major appliances also dictate energy usage levels and thus condition the likely magnitudes of both the price impacts and the family's compensatory coping strategy. In short, we propose that household strategies to cope with energy costs are a function of five categories of variables: (1) physical structural features of the dwelling (including outside construction material, type of home, number of rooms and major appliances); (2) housing tenure (including renter/owner status and number of years in residence); (3) socio-economic characteristics of the household (including head's educational level and the family poverty status); (4) demographic composition (including age and sex of the respondent head and the number of household members); and (5) change in the average monthly cost of the primary heating fuel between the 1976-77 and 1977-78 seasons.

Three general objectives guide the empirical analysis. First, we seek to describe the behavioral responses to changes in the cost and availability of energy among a sample of nonmetropolitan Wisconsin residents. Second, patterns of relationship are identified between the set of independent variables hypothesized to influence energy usage levels and a corresponding set of variables reflecting behavioral responses to more costly and tight

supplies. Finally, the relationship between actual fuel costs and the compensatory behavioral responses elicited from households is discussed. The data and statistical techniques are discussed further prior to reporting the results.

3. DATA

The data analysis is based on responses from a random survey of household heads residing in four nonmetropolitan Wisconsin counties--Florence, Forest, Marinette and Vilas. A telephone survey was designed to ascertain the social and economic impact of rising energy costs among families with limited economic opportunities and resources. Accordingly, a primary consideration in the selection of these counties for drawing of the sample was their disproportionate number of poor families and their nonmetropolitan classification (Tienda and Williams, 1977). Survey respondents were randomly selected by the Wisconsin Survey Research Laboratory (WSRL) sampling division using a random digit dial selection method and screening by county of residence. A total of 297 telephone interviews were conducted with eligible household heads by trained interviewers during late January and early February of 1978. Respondents were not evenly distributed among each of the four counties due to differences in the incidence of telephone ownership and population density within counties.

Only adult heads of households were eligible for inclusion in the sample. As is frequently the case in nonmetropolitan counties, a disproportionate number are of retirement age or older. About one in five respondents was 65 years or older at the time of the interview and an additional 24 percent were between 50 and 64 years of age. The mean age of those interviewed is 48 years. Almost three-fourths of the respondents were

married and living with their spouses. An additional 18 percent were in disrupted marital status and only 7 percent were reportedly never married (Tienda, 1979). About 78 percent of the respondents lived in family households, 12 percent were widowed and 10 percent lived in non-familial arrangements.

Socioeconomic characteristics have implications for energy-related behavior not only because they correspond to individuals' level of awareness and receptiveness to change (Zuiches, 1976) but also because they are related to life style preferences and consumption patterns (Newman and Day, 1975). In the Wisconsin sample, 90 percent of the respondents reporting having attended high school, but only three-quarters of those who attended high school received diplomas or went on to college. Of the 77 individuals with some post-secondary education, almost one-third of the respondents reported having only primary school training or less. The median school attainment was about 12 years for both respondents and their spouses.

Respondents were classified by poverty status based on their reported 1977 income and the official poverty thresholds for categories of family size. According to these two criteria,[4] 22 percent of the respondents were considered poor. An additional 9 percent were classified as near poor because their family income level was equal to or less than 125 percent of the official poverty threshold. A comparison with the population parameters based on the 1970 Census provides some basis for confiding in the results based on the approximate poverty status codes. In 1970, the proportion of all families in the sampling area with incomes below poverty ranged between 18 percent (Forest) and 12 percent (Marinette) whereas the combined proportion of poor and near-poor families ranged between 19 and 28 percent (Tienda and Williams, 1977: Table 17). Estimates based on households were slightly higher.

TABLE 1

PERCENTAGE DISTRIBUTION OF RESPONDENTS BY POVERTY STATUS

Non Poor	68.9
Near Poor	9.5
Poor	21.6
Total	100.0
(N)	(273)

A consideration of types of fuel used is pertinent for study of households' behavioral responses to fuel price and availability because of the greater reliance on non-utility distributed fuels by non-metropolitan residents. Households that do not use utility distributed fuels neither experience the same price/availability impacts nor do they benefit from the public policies geared at regulating utility fuel increases. As shown in Table 2, only about one-third of the respondents indicated that they used natural or utility gas for space heating and an additional 6 percent reported using electricity for heating. Of the 60 percent who used non-utility regulated types of fuel for space heating, fuel oil and kerosene was used by 26 percent and bottled, tank and LP gas was used by an additional 18 percent. Unlike in urban areas, wood is a relatively common source of fuel for space heating. Seventeen percent of all respondents use wood as their primary fuel for space heating, and wood is also popular among

TABLE 2

PERCENTAGE DISTRIBUTION OF RESPONDENTS BY PRIMARY AND SECONDARY FUELS USED TO HEAT HOME

Fuel	Primary Fuel	Secondary Fuel
	Percent	Percent
Natural or Utl. Gas	33.0	2.2
Bottled, Tank or LP Gas	17.8	9.5
Fuel Oil or Kerosene	25.6	10.2
Electricity	5.7	14.6
Coke or Coal	0.3	0.7
Wood	16.8	62.8
N.A.	0.7	--
TOTAL	99.9	100.0
(N)	(297)	(137)

those who use a secondary source fuel for heating. Of the 137 respondents who indicated use of a secondary heating source, 63 percent reported wood as their fuel.

The information presented thus far outlines the outer edges of the research problem and serves to preface the multivariate analysis. Our basic expectation is that households' responses to tightening energy supplies will differ according to the physical and socioeconomic conditions of the living environment as well as the magnitude of the price changes experienced. In the section that follows, the specific behaviors used by respondents to cope with higher energy prices are identified and catalogued in terms of their

adjustment foci and response domains.

4. RESULTS

Internal-nonpecuniary responses to rising energy costs are basically concerned with trivial (PHONSHOP: CONSAPPL) to moderately significant (CARPOOL: AUTOCURT) lifestyle changes. Between one- and two-thirds of all respondents reported having changed shopping behavior by planning trips better and using the phone in lieu of travel. Even more popular behavior changes are the adoption of conservation practices by family members in the use of major appliances and setting home temperatures, as over four-fifths claim to have eliminated unnecessary waste through these two means. The popularity of these internal-nonpecuniary responses is not surprising because most voluntary conservation efforts consist of activities that entail relatively little personal sacrifice. Practices that impinge on individuals' freedom or entail more substantive personal sacrifices are generally less attractive. Thus, less than 20 percent indicated that gasoline conservation was accomplished by regularly carpooling to work and a meager 3 percent voluntarily lowered their home temperatures to levels of discomfort as a way to conserve energy. Despite these varied efforts to mitigate the inflationary impact of energy costs, nearly half (45 percent) claim to have experienced decreases in economic well-being.

Life style adjustments that directly involve monetary inflows or outflows are not viable alternatives for many families with tight budgets. Still, three out of five respondents claim to have invested in thermal efficient equipment during the previous five years. This includes relatively minor expenditures for materials to weatherstrip doors and windows as well as

TABLE 3.

BEHAVIORAL RESPONSES TO ENERGY BY RESPONSE DOMAIN AND ADJUSTMENT FOCUS

(Proportion with Affirmative Responses)

Categories and Responses	Percent	(N)
A. Internal Non-Pecuniary		
1. Life style change--Fewer shopping trips (LTSHOP)	31.9	(87)
2. Life style change--Combination of shopping trips (LSTCOMB)	37.7	(103)
3. Life style change--Phone calls instead of traveling (PHONSHOP)	67.8	(185)
4. Life style change--Decreases in general well-being (LESSCOMF)	46.9	(128)
5. Conservation practices--Appliance usage (CONSAPPL)	83.2	(227)
6. Conservation practices--Lower temperature day and/or night (CONSHEAT)	81.0	(221)
7. Conservation practices--Car pool to work (CONSTRAV)	19.4	(53)
8. Conservation practices--Self-imposed heat curtailment (AUTOCURT)	3.7	(10)
B. Internal Pecuniary		
9. Expenditure priority 1--Changes in car ownership due to gasoline prices (EXPRIOR1)	43.6	(119)
10. Conservation practices--Home retrofitting (RETRO1)	62.3	(170)
C. External Non-Pecuniary		
11. Cost-induced heat curtailment (COSTCURT)	7.3	(20)
12. Heat loss due to structural defects (EXCONSTR)	15.0	(41)
D. External Pecuniary		
13. Reordering expenditure priorities in terms of payments for fuel (PAYBEH)	13.9	(38)
14. Increase in income through labor supply (LABSUPP)	10.6	(29)
15. Selection of energy-efficient homes (ENEREFF)	41.8	(114)
16. Use of alternative fuel for home heating (ALTFUEL)	33.3	(91)

considerably larger outlays for wall and ceiling insulation. A somewhat less frequent response is a change in automobile purchases. For 44 percent of our respondents, decisions about car ownership, such as trading in large cars for smaller ones, selling older cars without replacing them or postponing the purchase of additional vehicles were made in response to increases in gasoline prices over the previous five years.

Both examples of external, nonpecuniary adjustments illustrate the inability of families to compensate for hardships fostered and maintained by outside forces through changes in resource allocation patterns. What results, therefore, is a forced subjection to the consequences which are reflected in a deteriorating living condition. Combined, about one-fifth of the survey respondents acknowledged having experienced uncomfortably chilly homes due to factors which they were unable to remedy, namely (1) excessive heat loss from structural defects in the dwelling (e.g., drafty porches, basements, windows, or old, inefficient furnaces) or (2) the inability to pay for increases in fuel prices. The poor and near poor are disproportionately represented among these groups (Table 4).

Among the adaptive responses that entail drawing upon resources outside the household domain, the selection of energy efficient dwellings and the use of alternative, less expensive fuels are the most common. About two-fifths of the respondents indicated that their efforts to cope with rising energy costs entailed selecting energy efficient homes, but this consideration was notably more frequent among those who changed residence within the last five years, that is, following the 1973 oil embargo. Specifically, of those who had lived in their homes 6-9 and 10+ years, only 38 and 36 percent respectively indicated that energy efficient features were considered in the selection of a home. Alternatively, 57 percent of those who had lived

in their homes 1 year or less and 49 percent of those who had moved 2-5 years after the oil embargo reported that energy efficient features were considered when selecting a home. The data do not permit us to determine whether any changes of residence were themselves precipitated by energy related pressures.[5] The use of alternative, less expensive fuel for home heating is a feasible option for many residents of northeastern Wisconsin largely because of the plentiful timber resources in this region of the state (Tienda and Williams, 1977). Thus, one-third of the respondents reported having switched to alternative fuels for space heating, among which wood was the primary choice.

Less frequent strategies to cope with high energy costs are the practices of arranging budget payment plans or defaulting on payments to fuel distributors and utility companies until the ability to pay changes (14 percent) or generating more household income by sending additional family members into the workforce (11 percent). Possible explanations for the lower incidence of the latter two responses are that individuals have strong desires to be self-reliant or that the limits to their cost-absorbing capacities have not been reached. An alternative view is that these options may not actually exist for most families for such basic reasons as: failure of fuel or utility companies to offer budget payment plans to customers; limited job possibilities in nonmetropolitan communities; or the absence of additional members who may buffer inflationary pressures by serving as secondary earners. These conditions are further emphasized by considering income-based differences in the ability to make choices.

Previous studies have acknowledged the special plight of the poor in coping with the energy crisis, but the structural circumstances which shape their choices as well as delimit their ability to decide have not been

identified well. From our point of view, the question of differential ability to adapt is essentially, but by no means exclusively, a matter of economics. The disaggregated responses in Table 4 are suggestive along these lines. As shown in the upper panel, nonpoor are about equally likely to report having made changes in shopping behavior due to rising gasoline prices, but the near poor report a higher incidence of carpooling to work. If we compare these two aspects of travel behavior in terms of their importance for satisfying basic needs as well as their attendant implications for life-style changes, carpooling to work is clearly the least trivial.
We note with interest that while the poor and near poor are more likely to report experiences of uncomfortably cold houses due to heat loss from faulty structures than the nonpoor, yet they are less likely to have responded by retrofitting homes. Moreover, the poor are almost three times more likely to report forced curtailments in the amount of heat due to cost factors whereas the nonpoor are more apt to curtail heat voluntarily.

It is an almost impossible empirical task to ascertain whether the voluntary and involuntary reductions in heat consumption levels correspond to the same comfort and "well being" levels. The findings concerning reports of decreases in general well being are suggestive of the difficulties entailed in making such assessments. Whereas half of the nonpoor experienced decreases in general well being due to the energy crunch, the respective share of near poor is approximately three fifths. This result might be interpreted in absolute terms to mean that the greatest impact is felt by the near poor, or in relative terms to mean that the changes in consumption patterns have changed in more noticeable ways for the near poor. The latter is possible because the nonpoor use more energy overall and greater shares for

TABLE 4

BEHAVIORAL RESPONSES TO ENERGY BY RESPONSE DOMAIN AND ADJUSTMENT FOCUS FOR NON-POOR, NEAR POOR AND POOR FAMILIES

(Proportion with Affirmative Responses)

Categories and Responses	Poverty Status		
	Non-Poor	Near Poor	Poor
A. Internal Non-Pecuniary			
1. Fewer shopping trips (LSTSHOP)	29.8	42.3	33.9
2. Combination of shopping trips (LSTCOMB)	37.8	38.5	37.3
3. Phone calls instead of traveling (PHONSHOP)	68.6	80.8	59.3
4. Decreases in general well-being (LESSCOMF)	45.2	61.5	45.8
5. Appliance usage (CONSAPPL)	82.4	96.2	79.7
6. Lower temperature day and/or night (CONSHEAT)	83.5	76.9	74.6
7. Car pool to work (CONSTRAV)	20.2	30.8	11.9
8. Self-imposed heat curtailment (AUTOCURT)	4.8	--[a]	1.7
B. Internal Pecuniary			
9. Changes in car ownership due to gasoline prices (EXPRIOR1)	42.6	65.4	37.3
10. Home retrofitting (RETRO1)	67.0	57.7	49.2
C. External Non-Pecuniary			
11. Cost-induced heat curtailment (COSTCURT)	4.8	11.5	13.6
12. Heat loss due to structural defects (EXCONSTR)	12.2	26.9	18.6
D. External Pecuniary			
13. Reordering expenditure priorities in terms of payments for fuel (PAYBEH)	16.5	7.7	8.5
14. Increase in income through labor supply (LABSUPP)	12.8	11.5	3.4
15. Selection of energy-efficient homes (ENEREFF)	44.7	42.3	32.2
16. Use of alternative fuel for home heating (ALTFUEL)	39.9	34.6	11.9

[a]Cell size too small for meaningful statistical results.

nonessential (luxury) purposes (Newman and Day, 1975). The fact that the changes made in response to higher energy costs were perceived to be equal to those of the poor does not warrant the conclusion that the objective negative impact is similar because no account for comparable reference points is provided. There is no question that the nonpoor have greater leverage for coping with higher energy costs. As shown in the bottom panel, nonpoor are considerably more likely to resort to behavioral responses that entail manipulation of monetary resource

In spite of its informativeness, a bivariate item analysis cannot illustrate households' strategies to cope with energy inflation in their true multidimensional character. Therefore, we turn to a multivariate analysis to examine simultaneously the underlying relationship between the sets of behavioral responses and a series of variables hypothesized to influence the ways in which families experience and respond to high energy costs. Because of its facility to accommodate several dependent and independent variables in a single operation, canonical correlation analysis was selected as a multivariate technique.[6] Canonical analysis is analogous to multiple regression analysis except that it permits a set of dependent, or criterion, variables (as opposed to a single variable) to be related with a set of independent, or predictor, variables. The existence of a relationship between the two sets of variables is revealed by a series of variates analogous to those generated in factor analysis. For each variate, the existence of a relationship is indicated by the canonical correlation coefficient and its square, the eigen value, is analogous to the square of the multiple correlation coefficient. As such, it approximates the amount of variation shared by the linear combinations of the two sets of variables, thus providing an indication of the strength of the association. The coefficients, or weights, for each variable indicate the quantity by which

each variable must be multiplied in order to maximize the relationship between their linear combinations.

A total of five canonical correlation analyses were computed relating the total set and each of the four subsets of behavioral variables corresponding to the theoretical constructs of the paradigm with a set of 15 independent variables. These are summarized in the Appendix which provides for each item used in the multivariate analyses a brief description, an acronym, a mean and its standard deviation. The first analysis involving the entire set of dependent variables was intended to highlight the profile of behavioral responses to selected characteristics of households' micro social environments. This computation produced one significant canonical variate with an R of .6. These results are shown in Table 5.

An inspection of the combination of variables with high loadings is the guide for ascertaining the existence of meaningful substantive relationships. Appropriate items are underlined for greater ease in interpreting the results. Tenancy status emerges as an important correlate of behavioral strategies to cope with difficulties of meeting energy needs, but the patterning of a response set depends on its combination with the circumstances characterizing the micro decision-making context. For example, in the solution represented by the first canonical variate, a clear relationship emerges between tenancy status, one type of dwelling and the number of years in the current residence on the one hand and several behavioral consequences: use of alternative fuels for home heating (ALTFUEL), selection of energy efficient homes (ENEREFF), changes in payment arrangements with fuel and utility companies (PAYBEH) and changes in shopping behavior

TABLE 5

CANONICAL CORRELATION ANALYSIS OF BEHAVIORAL RESPONSES TO ENERGY

	Canonical Variate
Independent Variables	
YEARSRES	-.55
BUILDMAT	-.09
AGE	-.01
RESPED	-.10
TENSTAT1	.74
TENSTAT2	.67
TENSTAT3	.78
HOME1	.71
HOME3	.28
HOME4	-.19
TFS	.11
MAJORAPP	.20
ROOMS	.19
POVSTAT	-.24
MCOSTDIF	-.20
Dependent Variables	
LSTSHOP	-.03
LSTCOMB	-.48
PHONSHOP	.32
LESSCOMF	.09
CONSAPPL	.01
CONSHEAT	-.14
CONSTRAV	.18
AUTOCURT	.23
EXPRIORI	.05
RETRO1	.12
COSTCURT	-.02
EXCONSTR	.21
PAYBEH	-.31
LABSUPP	.17
ENEREFF	.51
ALTFUEL	.49
Canonical Correlation	.605
Eigen value	.365
Significance	.035

(LSTCOMB, PHONSHOP). In terms of a substantive behavioral strategy, this suggests that residents (owners, buyers and renters) of single-family dwellings are likely to seek alternative and less expensive fuels and/or to alter the manner of payment for utilities and fuel. Also, results indicate that the selection of energy efficient features in homes may be negatively relatively related with years of residence in a home.

Two messages might be inferred from these results. One is that given the continued increases in energy costs, all families living in single family dwellings irrespective of differences in ability to pay, may eventually have to scale down the amounts of energy used either voluntarily through adoption of more stringent conservation measures and personal sacrifices or involuntarily through inflationary pressures. In addition, there may be greater need to alter the ways in which energy is consumed (travel, appliances, heat, etc.). Given that the majority of Americans either own their homes or are in the process of buying, it is understandable that considerations about shifting to the use of alternative, less-expensive fuels for space heating and preference for energy efficient homes would be important items for budgeting and planning coping strategies. The fact remains, however, that most families will never be able to exercise the option of relying on wood for space heating and it is unlikely that the price of any of the fossil fuels will stabilize in the near to distant future.

Although the results in Table 5 produced substantively meaningful patterns of relationships, they are insufficient to adequately assess the heuristic value of the analytical framework. This is because of the multi-dimensional nature of household coping strategies which compel individual units to make adjustments in as many ways as possible. To further evaluate the significance of the theoretical constructs of the model (Figure 1), separate canonical analyses corresponding to each of the four cells are computed. Operationally, the criterion variable set was divided into four subsets corresponding to the categories shown in Table 3 and each subset was related with the entire set of predictor variables. If the analytical distinctions underlying the behavioral response categories are substantively distinct, we would expect only one unique canonical solution for each cell.

Results shown in Table 6 were consistent with this expectation except that the solutions for the internal and external nonpecuniary adjustments were not statistically significant at the .05 level. Also, the external pecuniary response variate just barely reached significance. The specific predictor variables that are most highly associated with the nonpecuniary adjustment response sets are tenancy status with one physical characteristic of the home (number of major appliances) and apartment residence for the internally oriented responses and tenancy status with poverty status and total family size for the externally oriented responses. Because the overall relationships are not significant, no substantive interpretation of these variates is attempted.

Of the two items classified as internal pecuniary reactions to higher energy costs, only the practice of retrofitting homes emerges as an important correlate of the predictor set. Although three characteristics--years in current residence, and two types of dwellings (single family homes and duplexes)--produce negative loadings ranging between .3 and .5, tenancy status is clearly the

most salient feature of household micro-environments which influence consumption patterns. In this regard, it is noteworthy that the renter category did not emerge as an important correlate of retrofitting. This is plausible because presumably renters do not have the same incentives to change energy consumption patterns as do the owners and renters of single family dwellings. Moreover, renters are constrained in different ways because repair of structural defects in dwellings depends on a third party--the property owner. If utilities are included in the monthly rent payments, tenants may not have any incentive to conserve, unless rent costs continue to rise to reflect these increases. However, in multiple family structures, it may be difficult to appreciate the benefits of changes in consumption practices unless all residents of the unit change accordingly and the structure is adequately insulated. It is unclear to what extent either of these conditions is met among the general population of renters, but the particular circumstances of this group also deserve special attention.

External pecuniary coping strategies were associated with two types of tenancy status, two kinds of single family homes and the number of years in the current residence. Tenancy status and dwelling types are positively related with the response of seeking alternative, less expensive fuels and inversely with the length of residence in the same home. This outcome is consistent with the fact that individuals who own their homes outright generally live in older dwellings because of the time involved in paying off a mortgage.[7] At the same time, older homes are more likely to need repairs. To the extent that home owners are older than average, they may be least able to afford the costs of major repairs, such as the replacement of inefficient furnaces or sealing of drafty areas. Thus, the circumstances that accompany ownership of old homes are particularly vulnerable to the regressive impacts of energy inflation.

TABLE 6

CANONICAL CORRELATION ANALYSIS OF BEHAVIORAL RESPONSES TO ENERGY: SEPARATE SAMPLES

	Canonical Variates			
	I.N.P.	I.P.	E.N.P.	E.P.
	I	I	I	I
Independent Variables				
YEARSRES	- .05	- .38	.26	- .62
BUILDMAT	- .12	- .15	- .06	- .01
AGE	- .22	.08	- .23	- .18
RESPED	.12	- .15	- .01	- .22
TENSTAT1	1.00	1.03	1.33	.42
TENSTAT2	1.28	.54	.61	.21
TENSTAT3	1.27	- .18	1.13	.41
HOME1	- .04	- .34	.10	.93
HOME3	.07	- .50	.00	.43
HOME4	- .39	- .15	- .01	- .08
TFS	.03	.23	.38	.02
MAJORAPP	.36	- .18	.33	.19
ROOMS	.22	.13	- .06	.14
POVSTAT	- .06	- .27	.64	- .27
MCOSTDIF	.04	- .07	- .14	- .23
Dependent Variables				
LSTSHOP	- .21			
LSTCOMB	- .36			
PHONSHOP	.80			
LESSCOMF	.30			
CONSAPPL	- .37			
CONSHEAT	- .47			
CONSTRAV	.54			
AUTOCURT	.19			
EXPRIOR1		- .06		
RETRO1		1.00		
COSTCURT			.81	
EXCONSTR			.69	
PAYBEH				- .40
LABSUPP				.26
ENEREFF				.57
ALTFUEL				.66
Canonical Correlation	.446	.465	.279	.501
Eigen value	.199	.216	.078	.251
Significance	.166	.011	.925	.053

Discussion

Overall, the findings in Tables 5 and 6 reinforce Morrison's (1976) conclusion that physical structural characteristics of the familial micro-environments are more important than socioeconomic and family factors in molding consumption levels. Our analysis shows that these factors are also significant in eliciting various behavioral responses, particularly those which entail pecuniary adjustments related to energy use. It is of some interest that the nonpecuniary responses did not emerge as important correlates of energy related adaptations, with the exception of the aggregated analysis where changes in shopping behavior loaded high relative to other adaptive responses. The pecuniary responses consisting of switching to less expensive fuels for space heating or supplementing the primary source of heat with an alternative which was most likely to be wood and investing in materials to retrofit homes (or select energy efficient homes in the first place) appear to be the most salient correlates of the conditions which alter households' energy consumption patterns. However, the importance of the tendency toward an increased reliance on wood must be qualified in terms of its generalizability to other nonmetropolitan populations because this sample was drawn from an area where wood resources are unusually plentiful.

We were puzzled that the measure of change in average monthly heating costs did not emerge as a particularly important correlate of the behavioral responses in any of the canonical solutions and the poverty status indicator produced a high loading only one canonical variate--one which was not statistically significant. Our reasoning had suggested

that the magnitude of the price increases coupled with differences among households in the ability to pay would be related to the incidence of certain coping behaviors. Although the descriptive analysis provided some support for this expectation, the results based on the multivariate analysis were largely disappointing.

The contention that the energy crunch tolls hardest on economically disadvantaged groups is predicated on the argument that the middle and upper income groups can adjust relatively easily to rising prices (Berman, et al., 1972; Cohen, 1976; Perlman and Warren, 1975; Warkov, 1976). Whereas the well-off can either spend a higher proportion of the family budget on energy or cut back on luxury consumption without necessarily altering comfort levels, the poor seldom have the same range of options for accommodating rising prices. In effect, continued increases in the cost of energy can potentially reduce the real incomes of low income groups at a relatively higher rate than those of higher income groups. At the same time, this impact can be partially disguised by the variable amounts of indirect energy consumption among households.

Even though results from studies by King (1975), Bullard and Henendeen (1975), Barth, et al. (1974) and others indicate that increases in expenditures on energy for the poor represent a larger proportion of their disposable income than for the high income households, the relative amount of change is yet to be measured. Changes in the proportion of household income spent on energy over a three to five year reference period would have probably performed better as a predictor of differential coping strategies among poverty status groups. However, the difficulties of recalling both billing and income data precluded us from obtaining this

information from respondents and we did not have access to income tax records for verifying income.

Our decision to include the cost difference measure, despite its crudeness,[8] was based on the intrinsic importance of the price stimulus. Given that the winter of 1977-78 was not as severe as the one preceding it, energy usage levels for space heating on the average should have been less. Moreover, as nearly 70 percent of those interviewed reported conserving heat by lowering home temperatures in the winter, absolute usage levels per degree heating days may have actually declined. Our cost difference measure is a conservative lower limit approximation of the magnitude of the price change and we attribute its poor performance to its conservative derivation. More specifically, we insist that prices more than moral incentives are what ultimately produce behavioral changes in energy consumption practices.

Policy makers would be pleased to learn that households claim to be attempting to conserve energy in a number of areas ranging from trivial to more essential needs, but the net aggregate impact may not be appreciated in the face of continued cost increases. It is unclear, however, whether any further changes can be made and for how long. Curtin's (1975) study showed, for example, that while one-third of a national sample said that they have conserved energy in the past and could do so again without difficulty, another 25 percent said they did not conserve and could not do so without reduction in comfort and well-being. When asked what additional things they might do to help pay for the rising cost of energy, over half of our own respondents indicated that there is nothing else to be done or that they did not know what else could be done. Of the few who perceived alternatives for dealing with future price increases, the use of alternative fuels and the

reduction of their economic well-being were the most frequent responses. Interestingly, only two percent felt that public policy might play a significant role in helping families adjust to the energy crunch. Such differences, which are rooted in social inequality, suggest that energy-related inflationary pressures may bring special hardships to the economically disadvantaged groups--perhaps more than already experienced. Thus, a predominantly conservation-oriented energy policy which emphasizes voluntary as opposed to mandatory reductions in consumption levels may deflect attention from the differential ability of households to cope. Moreover, critics (Carter, 1977; Lewis, 1977) have argued that many conservation efforts are directed at token uses such as lighting and cooking. While conservation in all spheres is desirable, regardless of the token aggregate consequences, a case may still be made that the ability to reduce energy consumption is directly related to income.

NOTES

[1]The distinction between pecuniary and nonpecuniary adjustments is at times difficult to delineate empirically, for one might argue that all social behavior has some monetary value irrespective of whether or not is is directly geared to influence monetary flows. For our purposes, the distinction corresponds to activities directly aimed to alter income flows and those which reflect adaptations to given levels of material resources.

[2]This example illustrates the difficulty of sorting the multidimensional aspects of social behavior into clearly defined conceptual categories, but it does not invalidate the usefulness of our conceptual distinctions.

[3]This alternative might be especially appealing to large households which could readily "shed" members to reduce consumption, but often, this must be accompanied by a simultaneous move to a smaller dwelling. While the marginal benefit of "shedding" members (particularly in instances where no attempt is made to also reduce the size of the living dwelling) is not likely to be great, the opposite reaction, changing living arrangements by incorporating individuals who live alone could result in greater social benefit. This would be especially true for those individuals who live alone in single family dwellings because of the significantly higher per capita costs required to heat separate structures.

[4]Because categorical income data was used in deriving the poverty status measure, some uncertainty arose in determining the status of a few cases. In such instances, individuals were allocated conservatively, that is, near poor.

[5]It would seem that retrofitting homes would be a more reasonable and economically feasible way to make older residences energy efficient, but its

appeal would also depend upon the tenure status of the residents (owners, renters) and the type of home (i.e., single family, mobile unit, apartment).

[6]We first attempted to scale our behavioral indicators into four indexes representing the domain and focus of each of the cells shown in Figure 1. Results of a factor analysis did not justify pursuing this strategy because multiple factors were produced in some instances and the use of the factor score coefficients for the first factor would have resulted in an unknown degree of arbitrary distortion.

[7]There exists a significant relationship between the housing tenure categories and the length of time in the same residence. $X^2 = 87.49$ with 15 d.f.; $p < .001$.

[8]Two imperfections of the cost increase measure must be acknowledged. First, only primary heating fuel was used in deriving the cost change measure because of variable amounts of missing data in the billing data about secondary fuels. As such, it only represents a <u>partial</u> cost difference. Second, we only ascertained changes in the cost of energy used for <u>space</u> heating but were unable to ascertain the amount of value of wood used. Thus, even if wood usage increased, the measured <u>cost effect</u> was zero because we assumed that it was obtained at no cost on a cut-and-haul basis with a permit.

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APPENDIX

Summary of Means and Standard Deviations of Variables Used in the Analysis

Variable and Category	Acronym	Mean	S.D.
(1) Demographic			
Age	AGE	47.74	17.20
Total family size	TFS	2.96	1.62
(2) Physical/Structural			
Building material	BUILDMAT	1.88	.62
Type of home:			
single family	HOME1	.88	.32
duplex	HOME2	.03	.17
mobile	HOME3	.05	.23
apartment	HOME4	.03	.17
Number of rooms	ROOMS	6.96	1.81
Major appliances	MAJORAPP	2.73	.85
(3) Housing Tenure			
Owner	TENSTAT1	.57	.50
Buyer	TENSTAT2	.28	.45
Renter	TENSTAT3	.13	.34
Other	TENSTAT4	.01	.11
Number of years in residence	YEARSRES	13.00	15.33
(4) Socioeconomic			
Head's education	RESPED	12.09	2.62
Poverty status	POVSTAT	1.44	.78
(5) Price Stimulus			
Average monthly cost 76-77	AVGCOST1	55.84	42.69
Average monthly cost 77-78	AVGCOST2	59.08	46.98
Average cost difference	MCOSTDIF	3.24	19.15
(6) Behavioral Responses			
Fewer shopping trips	LSTSHOP	.30	.46
Combination of shopping trips	LSTCOMB	.40	.49
Phone calls instead of traveling	PHONSHOP	.64	.48
Decreases in general well-being	LESSCOMF	.44	.50
Changes in car ownership due to gasoline prices	EXPRIOR1	.43	.50

Variable and Category	Acronym	Mean	S.D.
Behavioral Responses continued...			
Conservation in appliance usage	CONSAPPL	.84	.37
Lower temperature day and/or night	CONSHEAT	.80	.40
Car pool to work	CONSTRAV	.22	.42
Home retrofitting	RETROI	.62	.49
Self-imposed heat curtailment	AUTOCURT	.04	.20
Reordering expenditure priorities in terms of payment for fuel	PAYBEH	.13	.34
Increase income through labor supply	LABSUPP	.12	.32
Cost-induced heat curtailment	COSTCURT	.08	.27
Selection of energy efficient homes	ENEREFF	.43	.50
Use of alternative fuel for home heating	ALTFUEL	.34	.47
Heat loss due to structural defects	EXCONSTR	.16	.37