Individual Responses to Rising Gasoline Prices: A Panel Approach

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A panel survey design is used to study how individual motorists responded to rising gasoline prices during the latter half of the 1970s. Data on past and future responses to rising gasoline prices were obtained in 1975, 1976, and 1980; the responses were coded into three categories: drive less, other economy measures, and no change. Almost all drivers reported some effect of gasoline prices, and by 1980 most drivers were prepared either to drive less or to pay up to $2.00/gal to maintain their current level of driving. Analysis of trend data suggests that many drivers do eliminate some of their discretionary driving when gasoline prices rise, particularly when the rate of increase is faster than the increase in inflation.

This research is an attempt to describe the patterns of responses made by drivers as gasoline prices rose sharply during 1974-1980. Some responses cope with costs by making travel more efficient, whereas others simply limit travel without making it more efficient. Some information on changing travel patterns is available in the form of aggregate data, such as overall gasoline consumption and changes in transit ridership from one year to the next. These aggregate trends will be examined, and so will the trends in individual travel behavior in a panel of respondents. The panel data will allow the examination of individual responses in some detail. Moreover, because these respondents were interviewed up to three times during the period under examination, it will be possible to determine which coping strategies are attempted for a short time and then abandoned and which are more resilient in that respondents continue to use them. Thus, it will be possible to differentiate long-term from short-term responses to rising gasoline prices.

METHODS AND DATA

In a transportation survey in the spring of 1975, the researchers asked respondents a series of questions about their travel behavior, among them, how they would respond if the price of gasoline rose to $1.00/gal. In surveys in 1976 and in 1980, more questions concerning travel behavior and response to rising gasoline prices were asked. These data are the basis of the analysis in this paper.

The study design is a panel survey in which the respondents in the first survey (1975) are reinterviewed in the second and third surveys (1976 and 1980). This design allows direct assessment of how individuals change over time in contrast to the normal cross-sectional survey that allows only assessment of changes in aggregates. The panel is the preferred design for microanalysis of change.

In 1975 a representative sample of 305 nonstudent adult householders in an Appalachian city of about 38,000 population (1), including its surburban fringe, was selected. Students, whose travel patterns, car ownership rates, and length of tenure in the local area tend to be distinct from those of the nonstudents, were excluded from the survey. In 1976, 221 of the original 1975 sample plus a supplementary sample of 102 new respondents were reinterviewed. The panel was continued in 1980 when 195 of the total of 323 respondents from the 1976 survey were reinterviewed. In essence, a panel of respondents was followed over the 5-year period; each respondent was interviewed two or three times. The shrinkage in the sample represents those who moved from the area, died, refused to be reinterviewed, or could not be located. The combined result of panel shrinkage and the drawing of supplementary samples is a series of sample sizes, depending on which pair of surveys is compared. Sample size is also affected by the exclusion of respondents who do not own vehicles.

Before the panel data are analyzed, the trends in the changing gasoline prices and the possible responses on the part of the driving public will be examined. This analysis uses two kinds of aggregate trend data. Whenever possible, local or regional data are used. In cases where local or regional data are either unavailable or inappropriate, national data are used as an approximate indicator of the local situation. In a subsequent section, panel data from the survey region on individual responses to gasoline price increases are examined.

CHANGING TRAVEL SITUATION: 1974-1980

The Gasoline Crisis

The gasoline crisis consists of gasoline shortages and rising prices following the Arab oil embargo of 1973. Shortages appeared to have had only a temporary effect on gasoline consumption (2), but it is not clear what effect rising prices had. The years following the embargo witnessed rising gasoline prices and persistent inflation in prices of other commodities as well. Although "creeping inflation is generally characterized by a reduction in discretionary expenditure" (3), these reductions are not the same in all purchase categories. Differential reductions in consumption, or substitution effects, will occur for items the prices of which become dearer relative to the prices for other items (4). Substitution effects inevitably occur, because inflations always alter the relative prices of goods and services (5). In the case of gasoline this implies, first of all, that the portion of a consumer's gasoline purchases that is used for discretionary driving should show a higher elasticity than gasoline purchases for nondiscretionary driving. To the extent that motorists make both discretionary and nondiscretionary trips, gasoline may be elastic to the point where most discretionary driving is eliminated, after which point it may become inelastic. This argument will be pursued later.

A second implication of the relativity of substitution effects during inflation is that motorists probably base their purchase decisions over time not on gasoline prices per se but rather on relative gasoline prices [i.e., prices adjusted by the consumer price index (CPI)]. Both nominal (pump) prices and inflation-adjusted prices are given in Figure 1 to show the difference between the two types (6). (Figure 1 shows average national prices because accurate and relevant localized prices were unavailable for the study area.)

First consider the retail pump price, the uppermost trend line in Figure 1. The price rises experienced by drivers during this period are much greater after 1978 than before. The price of gasoline in 1974 was $0.52/gal, but the price was up to $0.63 in 1977. This represents a yearly annual increase of about 5 percent. As shown in the graph,

the price rose sharply from 1977 to 1980 (a 32 percent annual increase). The lower trend line in Figure 1 is the retail pump price of gasoline adjusted by the CPI ("real" price). Whereas the upper trend line represents the numbers on the gasoline pumps that motorists faced every week, the lower trend line represents the relative cost of gasoline compared with other typical consumer expenditures. Interestingly, the real price of gasoline actually declined slightly from 1974 to 1978. From 1978 to 1980 the real price jumped 46 percent from $0.50 to $0.73/gal in 1974 dollars.

If, in the case of gasoline, consumers repond to nominal prices, it would be expected to find some decrease in gasoline demand throughout the period encompassed by this research, with perhaps a sharp decrease after 1978. These decreases would correspond to the successful implementation of various strategies to cut travel costs by individual consumers. On the other hand, if consumers respond to relative prices, any decrease in gasoline sales would not be expected until after 1978, when a modest decrease might be evident. In either case there can be a considerable lag in consumer response to gasoline prices because some saving strategies (e.g., buying a more gasoline-efficient automobile) require more time to carry out than others (e.g., cutting down on discretionary driving).

Figure 1. Nominal and adjusted prices for regular (leaded) gasoline (1974 = 100 CPI) (6, p. 186).

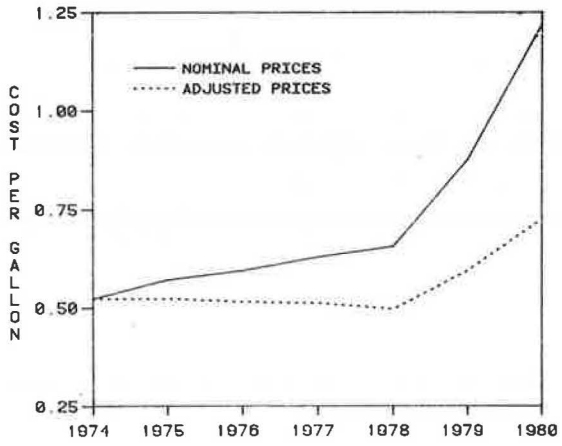
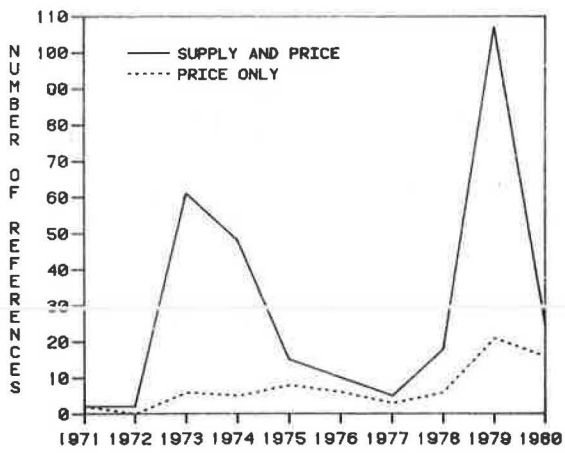


Figure 2. Regional graph of references to gasoline situation in American periodicals (7).



Media Response

If some relationship is assumed between media coverage and public perception of the gasoline price situation, trends in media coverage can be examined to gauge the impact of events on the American public. Figure 2 is a regional graph showing trends in the number of articles discussing the gasoline situation. The data source is the Reader's Guide to Periodical Literature (7). The space under the upper trend line represents the total number of articles published in a large number of American periodicals on the topics of gasoline prices, rationing, supplies, and conservation. The lower region shows the number of articles dealing solely with prices out of the total number of articles published each year. If Reader's Guide citations are a reasonably valid indicator of consumer exposure to issues, it may be seen that the issue of gasoline prices was never forcefully raised until 1979, and even then only 20 percent of the articles on the gasoline situation had to do with prices.

If the price issue was not a focus of media attention during these years, what issues relevant to the gasoline situation were raised? Of all the articles cited from 1971 to 1979, 74 percent concerned either supply or rationing of gasoline. In other words the issue of price was dwarfed by the issues of supply and rationing. If gasoline were a highly elastic commodity (i.e., one for which the price would have a strong relationship to demand), it would be expected that much public attention would be given to the price issue. Instead issues of supply and rationing received much more media exposure. The pattern hints, first of all, that gasoline may be a relatively inelastic commodity and second that savings strategies may be in response to other issues, particularly the perceived availability of gasoline.

Some Aggregate Trends in Travel Behavior

When automobile drivers are confronted with the gasoline situation (higher prices and occasional shortages), they can respond in three major ways to defend their mobility or their standard of living. First there are both individual and aggregate changes that can increase the efficiency of private automobiles. Scores of magazine articles have advised drivers to increase efficiency by getting more frequent tune-ups, properly inflating tires, avoiding fast driving, cutting warm-up times, and limiting use of automobile air conditioners. On the aggregate level, efficiency can be improved by enforcing speed limits, timing traffic lights, and creating one-way streets. All these actions serve to make automobiles more fuel efficient regardless of the average load factor per vehicle.

Second there are strategies to change the average load factor to achieve greater efficiency without necessarily increasing the mileage efficiency of individual vehicles. One of these is ridesharing. Another is using some form of public transit rather than a private automobile. Both of these strategies allow one to be mobile at less net cost and without making vehicles more fuel efficient.

If one chooses not to adopt any of these strategies for defending mobility, he or she can decide to sacrifice mobility in defense of standard of living. In other words, one strategy for drivers who face a gasoline shortage is to drive less and therefore travel less. Unlike the alternatives discussed above, this strategy will have an effect on the number of miles traveled as well as on aggregate gasoline consumption. Like the second alternatives--use of transit and ridesharing--driving less

will reduce per-capita aggregate gasoline consumption and highway mileage. Only fuel-efficiency measures, such as buying high-mileage automobiles and enforcing speed limits, would be expected to decrease gasoline consumption independent of miles driven.

To what extent have American drivers adopted fuel-efficiency measures? This question will be answered by focusing on fuel-efficiency ratings of new automobiles rather than on other factors such as tune-ups. Probably the overall efficiency of automobiles has a much more profound effect on mileage than do keeping automobiles tuned and keeping their tires properly inflated. Furthermore there are concrete data on automobile efficiency provided in the mile-per-gallon (mpg) ratings by the U.S. Environmental Protection Agency (EPA) of automobiles sold in recent years. Figure 3 shows the trend in EPA ratings of new automobiles from 1974 through 1980 (8). Obviously the average efficiency of automobiles has increased a great deal. The 1980 average mpg of 23.3 is a 66 percent increase over the 1974 mpg of 14.0. Of course the actual mileage of all cars driven in a given year is a complex mix of cars of varying efficiencies being driven various distances under varying conditions, but the tendency for consumers to buy more efficient cars is clear. It may be assumed that this trend represents consumer preferences, because Detroit's underestimation of the consumer demand for smaller, more efficient automobiles is widely considered a major cause of the recent rise in sales of imported automobiles at the expense of domestic automobiles. On the other hand, consumers buying a car at random in 1980, for example, would have obtained a more efficient car than they would have in 1979 simply as a function of the greater efficiency of all automobiles available. Although it cannot be determined to what extent Corporate Average Fuel Economy (CAFE) standards forced shifts to more efficient automobiles in spite of consumer preferences, the strong revealed preference for fuel-efficient imported automobiles leads one to believe that consumers really wanted more efficient automobiles.

Figure 3. EPA mileage ratings of new cars sold in the United States (8).

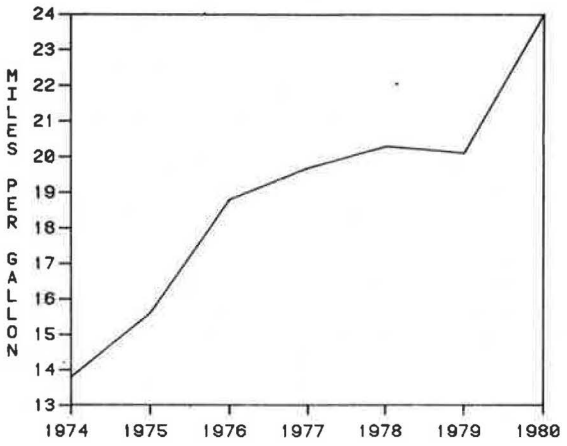
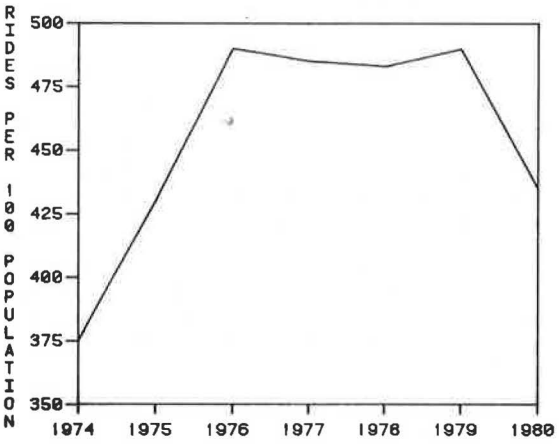


Figure 4. Rides on municipal bus system per 100 population.



Another strategy for maintaining mobility and reducing cost is to switch to public transit. Nationally ridership on public transit increased during the 1970s. In general, transit use in the study area is low. The Morgantown municipal bus system is quite small, and relatively few townspeople travel on the Morgantown downtown people mover located on the campus of West Virginia University. Figure 4 shows rides per 100 population on the municipal bus system, according to data from the Morgantown Municipal Transit. The increase between 1974 and 1976 may reflect in part the system's acquisition of a new bus in 1974. The total number of route miles has remained fairly constant since 1974. Whatever the cause of the increase between 1974 and 1976, patronage leveled off until 1979, when it dropped. However one might wish to interpret the rise or the subsequent drop in ridership, there is no evidence that the gasoline shortage spurred transit use in the study region (this generalization may not hold in urban areas with more extensive transit systems). Recall that adjusted gasoline prices actually declined when local transit use increased (from 1974 to 1976), and when adjusted gasoline prices finally rose after 1978, transit use dropped locally.

Another way to maintain mobility while holding the line on cost of travel is to increase the load factor in private vehicles, i.e., to share rides. In standard metropolitan statistical areas (SMSAs) surveyed by the Census Bureau in 1975, 21 percent of the automobile and truck commuters reported that they shared a ride to work (9). In the study region, a metropolitan area much smaller than any SMSA, 34 percent of the automobile and truck commuters reported that they shared a ride to work with at least one other person, and the average load factor in this sample is 1.54 persons per vehicle (10). Evidently ridesharing is a popular strategy for maintaining mobility while reducing cost.

Vehicle miles traveled (VMT), monitored by the West Virginia Department of Highways, can serve as an indicator of the extent to which drivers reduce vehicle travel or increase the average load factor per vehicle. Thus, to the extent that people drive less, ride share, or use public transit, VMT will be affected (on the other hand, VMT will not be affected by changes in fuel efficiency as drivers switch to automobiles that have high mpg ratings).

VMT in the study region, shown in Figure 5, increased over the study period except for declines in 1975 and in 1979, the last year for which data are currently available. The drop in 1975 is hard to explain. There were no serious gasoline shortages during that year. The price of gasoline did climb in 1976, but the adjusted price actually declined. It cannot be determined whether the 1975 drop was a short-lived response to unadjusted price increases, but by 1976 an upward trend in VMT began that continued until 1978. It will be seen that the decline

Figure 5. VMT per mile of road (x1,000), Monongalia County, W. Va.

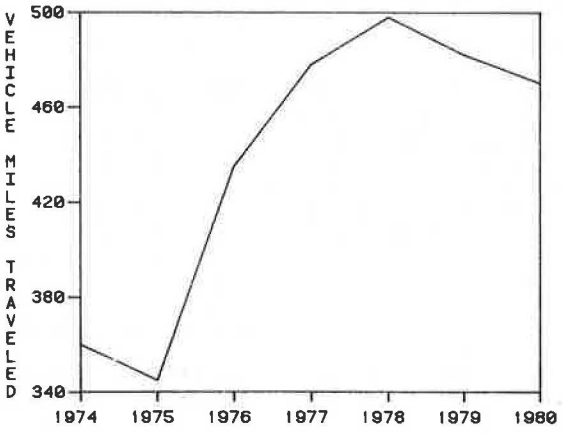
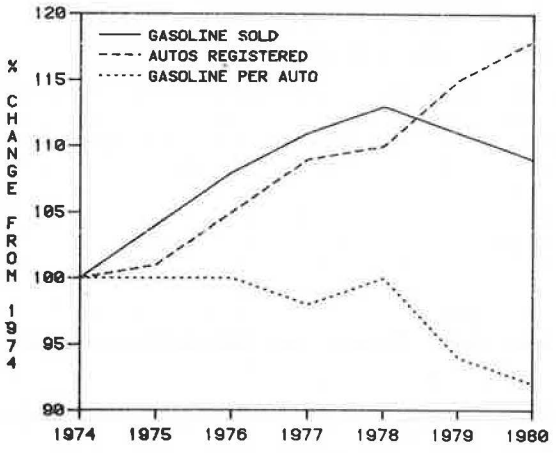


Figure 6. Changes in automobiles registered and gasoline consumed, 1974-1980 (11, p. 107).



in VMT after 1978 parallels a drop in actual gasoline consumption that occurred nationally as well as in the study region. Thus it seems likely that automobile travel has decreased since 1978, and in the study region the decrease cannot be attributed to increased transit use, because transit use actually declined after 1979. Moreover changes in the overall efficiency of automobiles on the road could not explain such an abrupt decline. Evidently automobile travel had actually dropped. This is most likely the result of more ridesharing and less discretionary travel.

Consumption of Gasoline

Changes in consumption of gasoline reflect a mix of changes in all of the strategies discussed so far, assuming that actual shortfalls do not occur. Other factors will affect gasoline consumption; some are too minor to warrant much attention (frequency of tune-ups, for example) and others are not under consumer control (increased efficiency of new automobiles in general). Figure 6 shows national trends in total gasoline consumption, number of automobiles registered, and gasoline consumption per registered automobile, all calculated as percentage changes from 1974 through 1980 (11). Total gasoline consumption closely paralleled the increase in number of automobiles through 1978. In 1979 and 1980 gasoline consumption dropped even though the size of the national automobile fleet continued to grow at about the same pace as before. The effect of these combined changes is seen in the lower trend line; gasoline consumption per automobile declined after 1978.

This drop in gasoline consumption is probably not simply a function of the greater fuel efficiency of newer cars. For one thing the growth in mpg rating of new automobiles is not rapid enough to explain this sudden and sharp decline in gasoline consumption. Although the new cars have been increasingly more efficient, the impact on the national average mpg rating has been slight (12). In addition the decline in VMT in the study region has been seen to parallel the drop in gasoline consumption. Therefore, people must be driving their vehicles less than before, either because they are sharing rides or because they are limiting their discretionary travel.

In summary, during the latter part of the 1970s a gasoline crisis occurred. Gasoline prices rose dramatically, as did prices in general. Although pump prices rose, adjusted gasoline prices did not increase appreciably until after 1978. Similarly the media responded to the gasoline situation mainly in terms of supply and rationing until 1978 when the number of articles dealing with gasoline prices rose rapidly, paralleling the increase in adjusted gasoline prices. After 1978 there was also a substantial deline in VMT and gasoline consumption. The data appear to indicate that neither changing vehicle efficiency nor changing transit ridership can adequately account for reduced VMT and gasoline consumption after 1978. It appears that drivers were actually driving less in response to the rising adjusted price of gasoline.

PANEL-SURVEY ANALYSIS

In the previous section the gasoline situation as it developed after the Arab oil embargo in 1973 was examined. These changes in gasoline availability and price led to a complex set of aggregate responses on the part of consumers, transportation policymakers, and transportation markets. In this secton individuals rather than aggregated responses will be used to examine the problem-solving processes consumers use to adjust to changing market conditions. Because the samples are relatively small, it will not be possible to examine age, socioeconomic factors, and other subpopulations in this analysis.

Citizens Assess Their Travel Options

At the time of the first survey in the spring of 1975, panelists were asked, "If gasoline goes up to $1.00/gal, what will you do?" Their responses were recorded in the order that they were given. Everyone in the sample gave some response to this question. Thus in 1975, with the Arab oil embargo still fresh in the public's mind, the respondents were able to articulate how they would react to what appeared to be a large increase in the price of gasoline.

Answers to questions on how respondents would cope with higher gasoline prices were coded into three categories: drive less, other economy measures, and no change. Drive-less respondents are those whose only reaction to higher prices is to drive less and therefore travel less. Other economy measures included any answer, such as ridesharing, buying a more efficient automobile, and bus riding, that indicates an attempt to maintain mobility by economizing in some way other than by simply driving less. No-change respondents asserted that they would not change their travel patterns.

We have seen that respondents have strategies in mind as they contemplate rising gasoline prices. Do different behaviors result when prices actually do go up? The individual behavioral data required to answer this question are not available; so self-reported behavior must be substituted. In 1975 respondents chose one of three strategies to cope with $1.00/gal gasoline: 39 percent said they would drive less, 27 percent said they would employ one of the economy strategies, and 33 percent predicted they would make no change. (These and all the other percentages discussed in the following are based on turnover tables of respondents who provided answers to a pair of questions on two of the three surveys; sample size will vary as a consequence.) In the following tabulation, respondents reported whether gasoline prices had affected their driving by 1976 according to the reaction they had predicted in 1975 (during this 1-year interval the pump price of gasoline rose from about $0.57 to $0.59/gal, but the price adjusted for inflation remained virtually stable):

	Predicted Reaction to $1.00 Gasoline in 1975 (%)		
Effect in 1976?	Drive Less (N = 89)	Economy Measure (N = 51)	No Change (N = 64)
Yes	44	49	19
No	56	51	81

About one-third reported an effect as of 1976. The percentage of respondents who predicted they would drive less or use an economy strategy was evenly split in 1976 between reporting an effect and reporting no effect. But of those who had predicted that $1.00 gasoline would have no effect on their driving behavior, only 19 percent reported an effect. In other words about half of those who had said that they would take positive steps reported having done so, whereas those who had said that they would not take steps generally did not.

In the next tabulation remembered effects of gasoline prices in 1980 are given according to respondents' 1975 predictions:

	Predicted Reaction to $1.00 Gasoline in 1975 (%)		
Effect in 1980?	Drive Less (N = 56)	Economy Measure (N = 32)	No Change (N = 40)
Yes	70	75	43
No	30	25	58

In this 5-year span, the overall proportion of those who remembered any effect of rising gasoline prices is 63 percent (compared with only 37 percent for the 1975-1976 interval). Once again, a remembered effect is much more likely among those who either had predicted they would drive less (70 percent) or would use an economy strategy (75 percent) than among those who in 1975 had said that they would not change (43 percent).

Taken together, the preceding tabulations demonstrate that

1. More people believe that they have been affected by rising gasoline prices, especially over the 5-year span;
2. In both the short run and the long run, those who had predicted that they would respond to higher gasoline prices with a positive strategy (either driving less or economizing) were more likely to remember having made a response to gasoline prices than those who had initially stated that they would make no change; and
3. Even among those who in 1975 had predicted that they would not respond to higher gasoline prices, almost half reported having made some change by 1980.

Having established the prevalence of reported effects of price increases, let us turn to a more precise description of differences between respondents who had initially selected different ways of coping. Respondents will be compared according to how they answered the question of their response to $1.00/gal gasoline in the short run, i.e., from 1975 to 1976. As an aid to interpreting the following tabulation, note that if respondents always reported the same strategies--that is, if there was no shifting of strategies whatever--all of the cases would lie on the diagonal, running from the upper left to the lower right:

	Predicted Reaction to $1.00 Gasoline in 1975 (%)		
Actual Reaction in 1976	Drive Less (N = 81)	Economy Measure (N = 45)	No Change (N = 55)
Drive less	56	40	18
Economy measure	13	29	16
No change	31	31	66

Actually, there is a great deal of shifting manifest in the data in spite of the relative stability of the marginal proportions. Of those who in 1975 had selected a drive-less strategy, a few (13 percent) changed to an economy strategy, but almost one-third switched to a no-change position. Of those who had initially selected an economy strategy, 40 percent later said that they would drive less if gasoline rose to $1.00/gal, and 31 percent moved to the no-change category, which left only 29 percent maintaining their original position. Those who had initially said that $1.00 gasoline would not change their travel habits were most likely to reiterate their stance 1 year later with 66 percent stability.

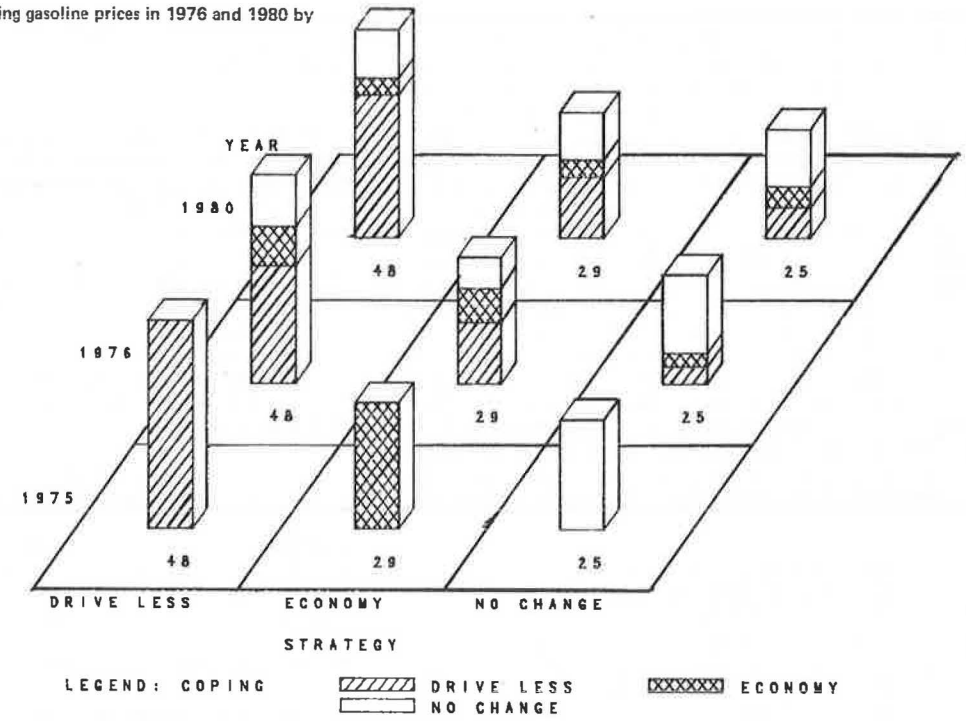
More shifting is evident in this last tabulation, which shows long-run changes in coping strategies (the 1980 data are based on the reaction of the respondent to a rise in price to $2.00/gal because the $1.00 standard used in 1975 and 1976 had become obsolete):

	Predicted Reaction to $1.00 Gasoline in 1975 (%)		
Actual Reaction in 1980	Drive Less (N = 29)	Economy Measure (N = 32)	No Change (N = 49)
Drive less	31	50	67
Economy measure	21	13	8
No change	48	38	24

Of respondents who in 1975 had chosen a drive-less strategy, almost half by 1980 predicted that they would not change their habits any more if gasoline increased to $2.00/gal. Only 21 percent said that they were prepared to shift to some economy strategy. Those who had initially chosen an economy strategy were, by 1980, mostly ready to drive less (50 percent) or make no change (38 percent). Finally, respondents who had initially said that they would make no change were prepared in 1980 to begin driving less (67 percent) to save gasoline, a few (8 percent) would select an economy option, and 24 percent would continue to resist any change in travel habits.

The long-term changes shown in the previous tabulation can be summarized briefly if it is assumed

Figure 7. Predicted responses to rising gasoline prices in 1976 and 1980 by predicted strategy in 1975.



that respondents who in 1980 reported that they would make no changes to accommodate $2.00 gasoline are mostly those who had already put one or more strategies into effect. Thus both the drive-less and the economy respondents in 1975 were quite likely to say that rising prices had affected their travel behavior both in 1976 and in 1980. A difference between those two groups is that although only 21 percent of the drive-less respondents would shift to an economy strategy, 50 percent of the economy respondents would shift to a drive-less strategy. Most of the economy strategies either require a substantial life-style change (such as using more public transportation) or involve a one-time change (such as buying a smaller car) that will not allow a scaled response to gasoline prices. From this perspective, driving less appears to be a more flexible response. Indeed the 1975 no-change respondents contributed a great deal to the predominance of the drive-less category in 1980 because a full 67 percent of those who would not change their response to $1.00 gasoline in 1975 had decided by 1980 that if the price of gasoline became $2.00/gal, they would drive less. So, again, it may be seen that over the long run respondents can always turn to limitation of driving as an easy-to-implement strategy.

If it is true that one's early reaction to gasoline prices can structure one's subsequent options, it may also be true that some options are more durable than others in the sense that they are the most likely to be used in the long run. In particular, driving less might be expected to be the response of choice initially and even more as time goes on.

The data in Figure 7 were assembled to see how each response option--drive less, economy, or no change--either leads to another option or remains a feasible option for the respondent. The first row of bars shows all respondents according to the options they chose in 1975, the baseline. For each of the baseline groups, the second and third rows of bars show respondents' choices of options in 1976 and 1980. During one year a significant minority of the drive-less group (left column) switched to one of the other categories. By 1980 it is clear that for most respondents driving less is the preferred response, even though some felt that they would make no more changes. Perhaps they had already reduced their driving to a level approaching an irreducible minimum.

The population of respondents who had initially picked an economy response (center column) had by 1980 largely changed to the drive-less category. Smaller groups stayed with an economy response or asserted that they would change no more. In other words, respondents who had initially decided to cope with some other strategy than driving less either switch to driving less or, by remaining in the no-change category, assert that their demand for gasoline is inelastic up to $2.00/gal.

The right-hand column in Figure 7 shows the 1975 no-change respondents as they move through the 5 years of the study. By 1976 a few of them had decided that they would try one of the positive strategies, and by 1980 this proportion had increased to not quite half, which means that not changing is a fairly resilient response to rising gasoline prices.

CONCLUSIONS

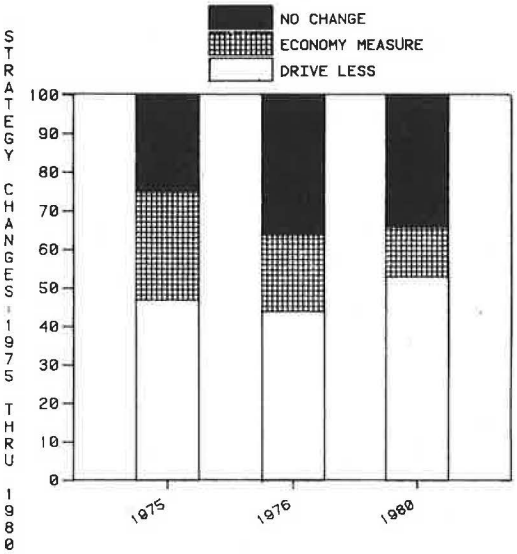
During the latter half of the 1970s, gasoline prices rose in the study region as well as in the nation as a whole. But it was not until 1979 that gasoline prices began to rise rapidly compared with prices for other consumer goods and services. It has been shown that gasoline consumption fell as the adjusted price of gasoline rose. This reduction in gasoline consumption paralleled a drop in vehicle miles traveled in the study region, which leads to the belief that the real price increase in gasoline caused drivers to limit their use of personal vehicles.

Panel data were used to examine specific changes in consumer behavior that are marked by the aggregate trends. Thus, by repeated questioning of respondents, it was possible to examine the processes by which consumers adjusted their behavior to different price schedules. It was found that on the individual level one's response to gasoline prices has a history.

Under what circumstances is gasoline an inelastic commodity? In other words, under what circumstances do rising gasoline prices fail to result in reduced consumption? Most obviously, the price increases have to be real. If the rise in gasoline prices is no greater than the rise in the CPI, the proportion of a consumer's budget spent on gasoline remains about the same. But when a real price increase does occur, as in 1979, a consumer's response depends on the available options. Those respondents who had initially said that they would not respond to a higher price ($1.00/gal) were quite likely to reiterate their stance over the 5 years of the study with only a gradual decline in the proportion who resisted changing their travel habits. These respondents could either be those for whom money is no object for a broad range of gasoline prices or they could be those for whom options--in the form of reduced driving or alternative transportation modes--were unacceptable or unavailable. In contrast, those respondents who did start out with a positive strategy (either driving less or economizing) tended to gravitate into the category of no further change. Apparently options can be used up, so that respondents make adjustments and then have little freedom to make more adjustments without paying a high personal cost, perhaps in mobility or in change in life-style. It could also be that some options prove to be more costly in terms of inconvenience than they appear to be initially. In either case, some respondents appeared to be discovering that they had little incentive to make further adjustments in their behavior even if gasoline prices rose to $2.00/gal.

Among the respondents who initially predicted that they would take positive action in response to $1.00/gal gasoline, it was found that different strategies resulted in different behavior sequences as gasoline prices did rise. Those who had initially classified themselves in the economy category (that is, all savings strategies except driving less) tended to abandon these strategies, so that by 1980 most of them reported that they would either drive less or not change in response to another large price increase. In contrast, those who had initially said that they would drive less were likely to continue saying that they would drive less in 1976 and 1980. By 1980 23 percent were in the no-change category and only 8 percent fell in the economy category; 69 percent of the initial drive-less respondents were still considering that option as of 1980.

Figure 8. Prevalence of strategies for coping with higher gasoline prices in 1975, 1976, and 1980.



Now that the turnover data have been examined in detail, the overall trends, presented in Figure 8, can be summarized. At all points in this study, respondents clearly preferred driving less as a strategy to cope with high gasoline prices. By 1980 the predominance of this strategy was clear; the majority chose it. In 1975 slightly more than one-fourth of the panelists chose one of the economy strategies. By 1980 only 13 percent chose this option. Finally, the proportion of respondents who said they would make no further changes grew from one-fourth to about one-third because respondents who had initially chosen other strategies either changed their minds or actually used up their options so that they predicted no further change in their travel behavior.

These findings are in contrast to those of a cross-sectional study conducted in New York State (13). The authors of that study found driving less to be one of the least consequential strategies employed by consumers. However, the region studied here had a more dispersed population and much less transit service. In rural areas and small towns, driving less may be the best option for many consumers who cannot find alternative means for essential work and shopping trips. Indeed, a study conducted in South Carolina (2) found that one-third of the respondents coped with gasoline shortages by limiting discretionary travel. The effect of the availability of options in various regions has yet to be determined.

To return to the original question of whether gasoline is an elastic commodity, it can be said that many, at least in this study region, still have enough slack in their personal automobile use to cut back in the face of rising prices. On the other hand, the economy strategies, which include the much publicized options of ridesharing and public transit, now appear less feasible than they did when gasoline prices began to rise dramatically. With a large proportion in 1980 saying that a rise to $2.00/gal would not change their travel behavior, a plateau may have been reached. Apparently gasoline prices would have to increase more than 100 percent and other options would have to become much more attractive before drivers could be expected to respond to prices by any means other than cutting their discretionary driving. Gasoline prices may have to rise greatly relative to other consumer goods and services before they have any effect on drivers other than to limit their driving and thereby their mobility. This would not necessarily be true in urban regions where alternatives to private automobile use are more easily accessible than in our study area.

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Determinants of New-Car Fuel Efficiency

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The determinants of new-car fuel efficiency during the period 1976-1981 are examined statistically with cross-sectional data on new automobiles. A significant improvement in overall fuel economy is found during this period. Most of the increased fuel economy from 1976 through 1979 is because of weight reduction, but from 1979 through 1981 the improvement came about primarily because of additional measures. Variables such as domestic versus foreign manufacturer, horsepower, and performance are not statistically related to fuel economy during this period.

In 1973 the price of gasoline increased sharply as a result of the Arab oil embargo, which prompted a shift in automobile demand toward more fuel-efficient cars. The Energy Policy and Conservation Act, passed by Congress in 1975, mandates incremental fuel economy increases until 1985, at which time average fleet fuel consumption of each manufacturer must be at least 27.5 mpg. The interest in fuel efficiency shown by Congress, automobile consumers, and automobile producers encourages the examination of the recent history of fuel-efficiency improvements in the automobile fleet.

In a Mellon Institute report, Shackson and Leach (1) document several ways in which vehicles can be made more fuel efficient. Downsizing reduces vehicle weight, thus improving fuel efficiency, but fuel efficiency also can be improved by more efficient engines, tires with less rolling resistance, improved aerodynamics, and other means that do not affect vehicle weight. Shackson and Leach forecast that fuel consumption relative to weight of new automobiles will diminish significantly in the future as a result of these measures. Their forecast is depicted graphically in Figure 1, which shows the relationship of fuel consumption to curb weight expected in future years. The downward rotation of the line depicts fuel economy improvements caused by measures other than weight reduction, whereas movement along a line results entirely from reducing vehicle weight. Figure 1 shows the expectation that future fuel economy will be achieved by further weight reduction and by complementary measures. Automobile manufacturers have now had a few years' experience in attempting to improve fuel efficiency. By quantifying the effectiveness of the recent history of fuel economy efforts, the reasonableness of the Mellon and other forecasts can perhaps be judged.

THREE HYPOTHESES

The interest in fuel-efficiency trends in this study can be stated in terms of three hypotheses:

1. Recent improvements in fuel economy are due almost entirely to vehicle weight reduction,
2. The rush to reduce vehicle weight has had secondary punitive effects on fuel economy, and
3. Weight-reduction efforts have been complemented by other fuel-efficiency efforts.

These alternative hypotheses are depicted graphically in Figures 2-4. The sample mean curb weight and corresponding gasoline consumption for the 1976 and the 1981 model years are shown in Figures 2-4.

In Figure 2 the relationship between gasoline consumption and curb weight estimated with 1976 new-car data corresponds closely to the same relationship estimated with 1981 data, even though 1981 cars are lighter and more fuel efficient. In this case the improvement in fuel efficiency is due to weight reduction, as stated in hypothesis 1. In Figure 3 the relationship of fuel consumption to curb weight estimated with 1981 new-car data lies above the 1976 relationship. In Figure 3 weight reduction has improved fuel economy, but the improvement efforts have been offset partly by secondary punitive effects. For example, in an effort to make small cars more appealing, manufacturers have offered them with more options such as air conditioners, which diminish fuel economy. Figure 4 shows the hypothesis that weight-reduction efforts have been complemented by other fuel economy efforts. The mean curb weight and corresponding fuel consumption in 1981 (and in 1976) are the same in Figures 2-4. However, the downward shift in the relationship of fuel consumption to weight depicts the effect of fuel economy improvements in addition to weight reduction.

During the sample period of 1976 through 1981, the fuel efficiency of new cars has indeed improved. The objective here is to define statistically the reasons for this improvement, specifically, the extent to which fuel efficiency is due to weight