purchase additional fuel on the white market without undue hardship.

SUMMARY

The findings of this paper generally support the vehicle-allocation plan selected by DOE for rationing fuel. Such a plan would allocate fuel in a manner that best replicates existing travel patterns. In that respect, the transfer of income from one group to another would be minimized. The vehicle registration plan would not be biased against the poor. Almost half of the households earning less than $6000/year do not own cars and, consequently, do not consume fuel. For the low-income households that do have cars, their average travel is less than the overall average for all households owning the same number of vehicles.

There is also no justification for providing supplementary allocations to households who reside in rural or suburban areas. Any differences in their travel are explained by the higher levels of vehicle ownership.

The major drawbacks of a vehicle registration plan are that it aids in preserving the status quo (i.e., 15 percent of the households accounts for 45 percent of the VMT) and encourages households to obtain additional vehicles that, once purchased, are used. In respect to the former drawback, it is unlikely that the trend toward multivehicle families would continue if the price of fuel were unconstrained.

Because 16 percent of all households already has more vehicles than drivers, limiting allotments to each registered vehicle matched with a specific driver would certainly aid the goals of energy conservation. Furthermore, it would place a ceiling on the number of allotments a household could obtain.

The finding that 15 percent of households is responsible for 45 percent of travel is significant. However, since many of these same households possess more than one vehicle, there does not seem to be a way of restricting their travel more than the lower-mileage households. However, government initiatives should encourage more efficient use of personal travel. Such efforts might encourage people to plan their travel and combine trips, if possible, and to improve their driving habits.

Our extraordinary dependence on private vehicles is vividly illustrated in Table 3. With less than 3 percent of personal travel on transit, it is doubtful that even major expansion of transit service will have a substantial impact on fuel conservation.

This paper has focused on household and travel characteristics that could influence the rationing of fuel. There are many additional factors that also influence travel behavior, such as age, sex, and life-style. In fact, the elements that influence how, when, and where a person travels are so numerous that it would be naive for government officials to declare that one is essential and another is not. A rationing plan that enables the individual to decide what portion of his or her travel must be reduced would be the preferable plan.

Driver- Versus Vehicle-Based Rationing and the Potential for Coupon Sales Between Different Income Groups in Michigan

Martin E. H. Lee

In June 1978, DOE released a proposed standby gasoline-rationing plan for public comment, which replaced an earlier plan. Both plans were prepared in response to the Energy Policy and Conservation Act of 1975. The primary difference between the two plans is the use of registered vehicles rather than licensed drivers as the unit of allocation for gasoline. It was asserted that this would make rationing quicker to implement and be a more realistic response to existing use than a driver-based allocation. The recent plan also emphasized the value of a white market for the unrestricted exchange of rationing rights at uncontrolled prices.

In subsequent federal legislation in November 1979, Congress renewed the President's authority to impose rationing and, in 1980, specified congressional review of standby plans. A revised standby plan was released by DOE for comment in December 1979. The main differences between this plan and that released in 1978 are an increased role for the states in resolving priority use and hardship problems and a proposal to allow the federal government to intervene in the coupon market to control the number of coupons in circulation. The vehicle-based allocation and white-market proposals together raise controversial questions about the impact of rationing on different income groups. However, to investigate distribution-related questions, it is necessary to have detailed data on the trip-making characteristics of drivers and vehicles.

SURVEY AND DATA BASE DESCRIPTION

The Michigan Driving Experience Survey (MDES), a micro data base on vehicle ownership and use, was built from 7581 personal interviews of driver's license renewal applicants conducted throughout Michigan during 1976. It used a controlled selection procedure for random selection of sites within two dimensions—level of urbanization and gasoline sales per capita (the latter was the only indicator available of gross personal travel activity). Because of the scarcity of rural trip-making data, the rural areas were deliberately oversampled. All data are capable of being weighted to compensate both for sampling rates and for variations owing to the day of week of the interview and the level of nonresponse. Overall response was very high—85 percent of those asked to participate. The number (7581) of usable interview forms represents 72 percent of the number of interviews predicted from the workload of the 30 local driver's license bureaus selected for the survey. The difference between the two percentages primarily represents some continuity gaps inevitable in the conduct of a decentralized survey operating over an entire year.

Within the 30 sites, a random number system—beyond the control of the employees—was used to select seven or eight interviewees per office per week from among all driver's license renewal applicants. Because the system used a meaningless sequence number that became a transaction identifier in an audit trail, it was possible to verify later that none of the (unannounced) eligible drivers had been missed. Follow-up procedures, which were more time-consuming than an interview done at the time the driver was in the local bureau, helped keep administrative response very high. Overall, this provided a representative sampling of the Michigan driver population, but it must be noted that drivers under the age of 19 are not represented because they are not old enough to be renewing a driver's license.

The interviews were conducted by the managers of the

local license bureaus, who generally have excellent public contact skills and who received training in the interview procedures in a seminar and on site. The emphasis of the survey was on the careful reconstruction of a recent trip day, usually the previous day, and on the complete set of vehicles to which the respondent had access.

The survey was designed primarily to yield a series of measures of the amount and type of driving undertaken, aggregated over the entire trip day. Thus, the total time and distance driven by each respondent are expressed in terms of travel under different trip regimes, purposes, light conditions, road types, vehicles used, and passenger load. The vehicles owned and used are identified at the level of make, model, and year. This information is available for each trip made during the day.

The survey data have been integrated with the individual accident and traffic conviction records from the files of the sponsoring agency (while individual identity has been deleted). Cross-reference capability has been established with selected socioeconomic characteristics of the traffic zones (used by state transportation modelers) in which the respondents resided. Certain socioeconomic characteristics are also available by zip code of residence. In addition, the interview itself provides basic biographical information on the respondent and his or her household.

Considerable effort has been completed to build two verified summary files: in a driver file, all time and distance information has been aggregated over the trip day for all trip attributes, including algorithm-assigned travel by purpose in multipurpose trips; in a second file, each trip is treated as a separate case, with driver descriptors repeated. The files were built primarily with OSIRIS.IV software for use with both the OSIRIS and the MIDAS software packages on the University of Michigan computing system.

ANALYZING THE STANDBY RATIONING PROPOSALS

The recent standby rationing plan provides for a fixed allocation of gasoline to all registered vehicles. All privately owned vehicles under 10 000 lb (4.5 Mg) would receive an allocation based on the national average consumption for an automobile, which was estimated in 1978 as 748 gal (2830 L) per year, less a percentage necessary to respond to the predicted shortfall in supply. The allocations would be made for periods of about 90 days. Ration rights would be distributed directly to the public, with an amount of additional rights distributed through state government agencies to provide relief for hardship cases. Vehicles more than 10 000 lb would receive larger allocations based on average fuel consumption and historic mileage trends. Motorcycles would receive a very small allocation and recreational vehicles none at all. The proposed plan considers, and leaves open, the possibility of placing all commercially used vehicles on a separate allocation based on historic use. The plan also discusses the possibility of adjusting allocations to entire states based on past consumption patterns.

This study examines some aspects of vehicle-based, as opposed to driver-based allocation in relation to a white market. Ration rights would be traded legally at uncontrolled prices under the latest plan, and much is claimed for the value of this white market in redistributing income to offset general inflationary effects and to benefit poorer households. A discussion of likely scenarios for the behavior of commercial companies is beyond the scope of this study, however. Thus, most analyses are confined to the 98.7 percent of the respondents who stated that the vehicle they drive most often is a private automobile, van, pickup, or recreational vehicle. (Because many vehicles registered in Michigan as recreational vehicles are primarily passenger vehicles with a camping or off-road capability, these vehicles were included despite the intention of the plan to allocate no gasoline to motor homes.) The assumption is made that a white market is most likely to operate among private-vehicle owners, despite the interest of the proposed DOE plan in a flow of money from commercial to private users.

In order to compare driver- and vehicle-based allocation methods, it is preferable to have trip-making information for individuals and for each owned vehicle in a household. The MDES data provide very detailed individual trip-making information and support a surrogate for per-vehicle trip making. As the total number of drivers and vehicles owned in the respondent's household is known, the surrogate is obtained according to the following equation:

$$VT = (PT \times DH)/VH \quad (1)$$

where

VT = vehicle trip making (distance and time),
PT = person trips reported by respondent,
DH = total number of drivers in household, and
VH = total number of vehicles owned in household.

This provides a measure of vehicle travel adjusted for the driver-to-vehicle ratio in the household. The number of privately owned vehicles per 100 drivers is high in Michigan. The table below shows data based on the ratio between mean drivers per household and mean vehicles per household, and it is seen that they change little by income. This is of key importance to vehicle-based plans.

Household Income ($)	Number of Privately Owned Vehicles per 100 Licensed Drivers
<5000	83.4
5000-10 000	80.3
10 000-15 000	86.5
15 000-25 000	86.9
>25 000	84.4
All	85.2

In tabulating data for this study, income groups refer to household income and should be considered approximate because of the sensitivity of asking financial questions in a government survey. Vehicle size classes are used that were condensed from make and model codes. Specialty automobiles, such as luxury cars, are placed in the closest-size category. For all analyses not expressly using vehicle class as a control variable, the truck-bus and motorcycle classes were deleted in this analysis. Vehicle size in this paper refers exclusively to that which the respondent declared he or she most often drove.

Geographic location is based on a classification of the zip codes in which respondents reside. They are in six classes in descending order of housing density and should not be considered as economically homogeneous; for example, central city includes the centers of some medium-sized affluent towns, while inner ring contains both poor and wealthy neighborhoods on the outskirts of some metropolitan areas.

Costs of rationing in terms of white-market cash exchanges are, of course, subject to widely differing assumptions. However, as the value of the MDES data is in providing trip-making data, some simplistic scenarios are postulated to examine the distributional effects. The analyses use a projected gasoline supply shortfall of 25 percent for private vehicles. Costs are estimated here on the artificial basis that, if all drivers reduced their travel by the same percentage as the shortfall (25 percent in this instance), a fixed allocation of gasoline based on a similar reduction in supply would be more than sufficient for some and insufficient for others. Given that a 1978 DOE economic analysis projects a per-gallon white-market price of $0.90 under a 20 percent shortfall and inflation since then, the average cost in dollars per month is calculated by using the following formula:

$$\$/\text{month} = [(MD \times 0.75) - MR](365/12)(1.25/MPG) \quad (2)$$

where

MD = miles traveled in one day (per driver or per household vehicle);
MR = miles allowed by ration allocation, and
MPG = miles per gallon of vehicle used.

For analyses by vehicle size, MR is adjusted to the average fuel economy of the vehicle class analyzed, and MPG is set to that figure. The fuel economy constants are based on DOT standards for 1972 vehicles (1) and are subcompact, 22 miles/gal; compact, 16 miles/gal; intermediate, 14 miles/gal; and full size, 12 miles/gal. Vans, pickups, and recreational vehicles were estimated by the driver to average 11 miles/gal. The formula used for MR is

$$MR = (\overline{MD} \times 0.75 \times MPG)/\overline{MPG} \quad (3)$$

where

$\overline{MD}$ = grand mean of miles traveled in one day for entire sample (per driver or per household vehicle),
MPG = miles per gallon of vehicle used, and
$\overline{MPG}$ = average MPG (13.5).

For analyses in which vehicle size is not differentiated, the MPG constant used is the same as that quoted in the DOE plan, namely 13.5.

RESULTS OF RATION PLAN ANALYSIS

A clear finding of the MDES data is the major increase in daily mileage driven with increasing household income. Table 1 shows this both per driver and for the surrogate per-vehicle variable. This suggests considerable potential for a white market to operate between high- and low-income groups and is slightly greater with a per-driver allocation basis.

There are also significant differences in the amount of daily mileage as a function of the vehicle size most often used. Table 2 shows that use of smaller cars is associated with increased mileage. Other MDES analyses have revealed that this effect generally holds true regardless of the age of the driver. The higher mileages for those driving vans and pickups reflect some degree of rural bias in the location of these vehicles, with associated longer trip lengths.

The effect of vehicle size on rationing is also influenced by this distribution of vehicle classes within each income group. Table 3 shows that the higher-income groups opt for more large vehicles and that the use of vans and pickups is an especially middle-income phenomenon. The popularity of the smallest cars, once a higher-income specialty market, is now growing in the lower-income groups.

One way of looking at a 25 percent shortfall is shown in Table 4. This gives the percentage of each income group who already drive less than 75 percent of the statewide average; for comparison, this table also shows the same data for a 50 percent shortfall. (Note that the two lowest-income groups make up about 25 percent of the statewide driving population.)

The cost analyses were performed by using mean daily travel for the various population subgroups. Summaries of the costs to each income group under a 25 percent shortfall, and postulating a 25 percent reduction in travel by all, are shown in Figures 1 and 2. (All of the results shown in the tables and the figures are based on weighted sample data.) Figure 1 examines differences by geographic location, while Figure 2 gives results according to the vehicle size most often used. Both figures compare the costs on a per-driver basis (upper graph) and a per-household-vehicle basis (lower graph). It should be pointed out that, for Figure 1, the results assumed that all household vehicles have similar fuel economy.

Of major importance are the relative effects of this scenario on different income groups. It is clear from this perspective that the per-vehicle and per-driver schemes are very similar in impact. Although this might be expected, given the high ratio of vehicles to drivers in Michigan regardless of income, it is not necessarily true that the amount of driving done is independent of numerous driver-vehicle configurations found in households.

The differences between geographic locations are of interest in that the rural towns—some of which presumably have long-distance commuters—do not seem to carry the

Table 1. Mean distance driven in one day, by income group.

Household Income ($)	Miles per Driver	Miles per Vehicle Owned in Household
<5000	16.0	20.9
5000-10 000	19.6	25.1
10 000-15 000	24.6	30.9
15 000-25 000	29.1	37.0
>25 000	38.6	47.7

Note: Figures are based on 6605 interviews of respondents who most often drive vehicles other than trucks, buses, and motorcycles.

Table 2. Mean distance driven in one day, by size of vehicle most often used.

Size of Vehicle Used Most Often	Miles per Driver	Number of Drivers in Sample Using Vehicle Class Most Often
Subcompact	28.9	658
Compact	26.2	1058
Intermediate	24.9	1359
Full size[a]	24.7	2763
Vans, pickups, and recreational vehicles	33.0	905
Motorcycles	20.4	16
Trucks and buses	103.2	78
Total	27.3	6837

[a]The full-sized category includes luxury automobiles that have high average use.

Table 3. Percentage distribution of vehicle classes within income groups.

Vehicle Type Most Often Used	Household Income ($) <5000 (N = 688)	5000-10 000 (N = 1418)	10 000-15 000 (N = 1826)	15 000-25 000 (N = 2113)	>25 000 (N = 1121)	All (N = 7164)
Subcompact	15.9	10.3	10.5	6.5	8.1	9.3
Compact	11.4	14.8	15.3	10.7	8.5	15.0
Intermediate	19.8	20.9	16.6	23.3	27.2	19.1
Full size	36.9	39.0	40.0	45.8	47.9	39.2
Vans, pickups, and recreational vehicles	3.7	10.7	14.1	11.7	7.8	13.0
Motorcycles	0.4	0.1	0.2	0.1	0.0	0.2
Trucks and buses	4.6	0.6	2.2	0.9	0.1	1.7
Unknown	7.3	3.6	1.1	1.0	0.4	2.5

penalty of increased driving that is conventionally assumed. One possible explanation is the concentration of retirees in the resort towns of Michigan. By far the heaviest users of gasoline on average live in the suburbs and remote areas. The inner-ring drivers have the highest income potential on a per-driver basis and a per-vehicle basis. This reflects the relatively high percentage of urban dwellers who are in the low-income groups. However, this study does not reveal anything about those people in central cities and elsewhere who would not appear in the system at all because they have no access to private automobiles.

The data on vehicle size in Figure 2 reveal that those with the smallest cars could be in a positive cash-flow situation in this scenario, regardless of income group. The lowest two income groups could potentially sell some ration rights on average in all cases except where the vehicle most used is a van, pickup, or recreational vehicle. The higher average mileage of those driving vans and pickups shows up clearly. Those in the higher income groups could spend an additional $750/year or more to maintain 75 percent of their previous mileage.

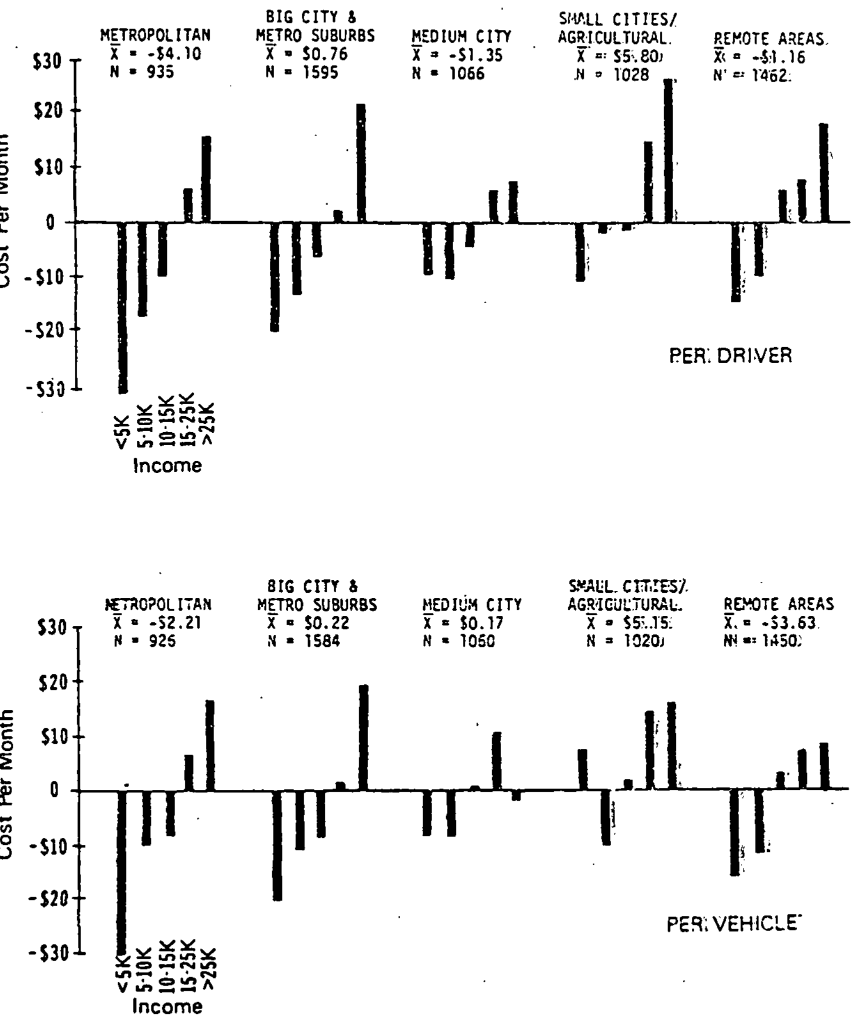
A more accurate calculation of gasoline consumption is supported in MDES by the data on vehicle type actually driven during the trip days. Figure 3 shows consumption by income group based on the average MPG estimates for the vehicles actually driven. For comparison, the average miles driven within each income group is plotted against the right-hand scale. A comparison of the shape of the curves suggests that there is a slight trend for the higher mileage of the $25 000 plus group to be associated with more fuel-efficient vehicles. Considerably more adaptation to fuel-efficient vehicles by high-mileage drivers than these analyses reveal will be necessary if conservation is sought in this way. It should be noted that the average fuel economy has improved since 1972, the year for which estimates were used and the median year of most-used vehicles in this sample.

Perhaps more significant are the characteristics of those who would or would not be able to operate with little change in travel habits under a 25 percent shortfall. In addition to the information in Figures 1 and 2, Table 5 shows some characteristics for those whose daily mileage is above or below 75 percent of the statewide mean (regardless of vehicle size). Approximately one-third of the drivers surveyed is above the 75 percent level. As expected, these figures imply the dominance of the journey to work. It should be remembered that they are based on a personal survey; therefore, the figures do not reveal the overall demand for gasoline in households. Further analyses can be

Table 4. Percentage of drivers whose daily mileage is less than the statewide average, by income group.

Household Income ($)	Less Than 75 Percent of Average Mileage	Less Than 50 Percent of Average Mileage
<5000	80.3	72.8
5000-10 000	73.4	63.3
10 000-15 000	66.6	54.7
15 000-25 000	61.1	49.6
>25 000	51.9	40.1

Figure 1. Distribution of potential white-market costs under a 25 percent gasoline shortfall for private vehicles, by income group and geographic location.



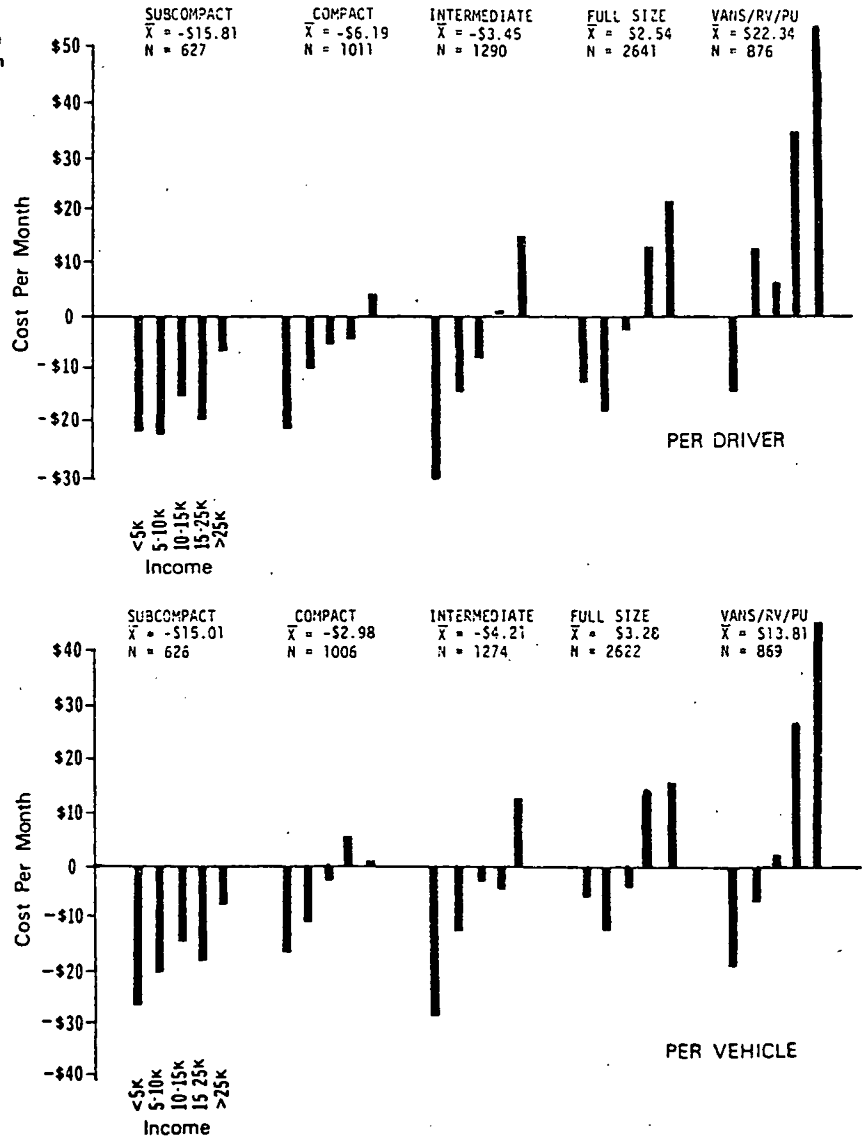


Figure 2. Distribution of potential white-market costs under a 25 percent gasoline shortfall for private vehicles, by income group and vehicle size most often used.

done to identify the characteristics of target populations for conservation strategies. Such analyses would be of particular relevance if rationing is considered on a per-driver basis.

This is a manipulation of personal travel data to examine who might be able to benefit from a white market in ration rights. It poses the highly improbable zero-sum scenario that all drivers could reduce their mileage an equal amount under rationing. Taken at face value, it does appear that wealthier vehicle users would be likely to buy available ration rights from the spare (coupon) capacity of lower income groups. Before assuming that to allow such a market to operate contributes to the general welfare, it should be asked if it is right in a shortage situation to assent to a system that reinforces existing demand patterns. Wealthier people will in all probability pay the white-market price; and at $1.25 more per gallon, the inhibition of their mileage will probably be minimal, given their inelasticity of demand for gasoline.

POST-MDES COMMENT

Since the analyses in the body of this paper were first reported in 1979, considerably more exploration of gasoline use, of the most promising targets for conservation policy, and of various conservation scenarios has occurred. An important extension of this work has been the examination of gasoline consumption by population group, not only in total gallons but also in terms of productivity (measured in occupant miles per gallon). This was calculated in a fully disaggregated manner and is based on the actual occupancy and vehicle size used for each of the 13 000 trips reported in the MDES. The results of the more recent work have given a broader perspective on the rationing policy issues raised in this paper. This section summarizes my conclusions on (a) rationing versus other measures, (b) examples of mechanisms for the use of ration rights to encourage efficient use of gasoline, and (c) some thoughts on future disaggregate data needs for energy conservation planning.

Rationing Versus Nonrationing Measures

The analyses of gasoline conservation scenarios have assumed the possibility of a major disruption in foreign oil supplies and a need for government policies to sharply reduce consumption of gasoline. Discussions of potential political instability in the Middle East have raised the possibility of gasoline supply shortfalls as high as 40 percent of normal. For the rationing scenarios, I assumed a 25 percent shortfall (5 percent more than the minimum needed to trigger presidential rationing authority).

From some of the more recent MDES analyses, it has

Figure 3. Average gasoline consumption and mileage driven per day, by survey respondent's household income.

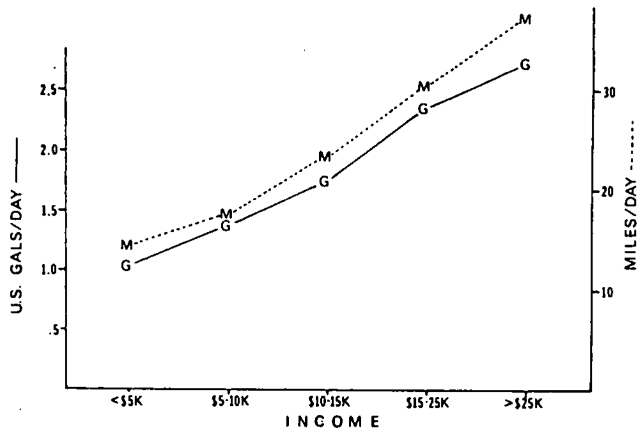


Table 5. Characteristics of drivers whose daily mileage is less than or more than 75 percent of the statewide average.

Characteristic	<75 Percent of Average Daily Mileage (N = 4593)	>75 Percent of Average Daily Mileage (N = 2310)
Male (%)	44.0	70.9
Under 30[a] (%)	34.1	37.0
Has chauffeur's license (%)	4.1	8.8
Mean number of other drivers in household	1.39	1.48
Mean number of children in household	0.87	0.99
Employed full time (%)	43.7	69.9
No education beyond high school (%)	59.5	51.1
In current residence more than 20 years (%)	20.0	15.4

[a]Survey covers drivers over 18 years old only.

been concluded that the most technically promising areas of conservation policy are commuter carpooling and the use of smaller cars (2). However, even in combination with politically favored measures—notably the 55-mph speed limit—it is estimated that the saving in the short term would not be enough to avert rationing in a 20 percent shortfall, let alone a 25 percent shortfall. By using these estimates, a policymaker might assume that there is no alternative to rationing (or a massive price increase) except to ban all nonessential driving. In fact, there is little evidence from available data to suggest that one type of driving is valued by a group more than another, that groups with higher mileages are not characterized by higher percentages of what is conventionally assumed to be nonessential (i.e., social and recreational), and that, therefore, a partial ban on driving—even if it were feasible—would not serve its implicit goal.

Nevertheless, recent estimates offer some valuable comparisons of the relative magnitude of total gasoline demand by various subgroups. For example, the fuel cost of allowing remote areas and small villages combined to continue 1976 levels of consumption, when everyone else is using 25 percent less, amounts to only 6.6 percent of the fuel being used by the suburbs. Or, if a consumption goal was set for those making under \$10 000/year on the basis that they could not be expected to afford smaller cars and would therefore need a higher allocation, the fuel cost would be only 1.9 percent of the gasoline now used by those with incomes of more than \$15 000/year.

The most important point of all, however, is that a policy decision made solely on the distributions of potential total gallons saved would be a decision made on incomplete information. Almost all of the policy discussions published focus on the bottom line of gallons saved and sometimes are accompanied by estimates of the income transfers that result from gasoline price. Through other disaggregate analyses not reported in this paper, it is possible to show that the efficiency with which gasoline produces occupant miles is neither constant nor a stable correlate of the amount of gasoline consumed. Thus, the potential exists to select policies not only on their potential to lower the number of gallons used but also in terms of the productivity with which different constituencies make use of these gallons. If it is acceptable to distribute ration allocations to states on the basis of historic use and to establish a white market that will reinforce a business-as-usual distribution of the available gasoline over income groups, then it should be acceptable to require that groups with special claims to normal levels of gasoline supply maximize the occupant miles produced. Thus, it might be reasonable to allow the remote areas of Michigan to continue consuming their 1976 average of 842 gal/driver, provided that they continue to produce 29.8 occupant-miles/gallon. Suburban drivers, who use almost the same amount (484 gal), would require 1003 gal to produce the same number of occupant miles as the remote-area drivers at their 1976 level of 25.2 occupant-miles/gal.

In contrast, policymakers have good reason to allocate the total available occupant miles that the nation or a state would have at its disposal based on mean occupant miles per gallon rather than on available gallons in their raw form. This simply involves an analysis of existing gasoline use to adjust the per-driver or per-vehicle allocation to a region or a user group. Historic use would remain the initial basis for allocation, but the number of gallons would be reduced by the amount of the supply shortfall and then adjusted up or down according to the region or user-group's deviation from mean occupant miles per gallon. Note that this would be much less disruptive than either a per-capita allocation, with the multitude of hardship claims that would follow, or an allocation based strictly on historic use. The latter has the effect of rewarding past wastefulness.

Another major conclusion of these studies is that, in addition to the use of existing occupant miles per gallon to normalize ration allocations, occupant miles per gallon varies enough to warrant the use of rationing to raise the efficiency of gasoline use. This implies that rationing would be modified to permit incentives or disincentives affecting behavior that changed passenger loads or the size of vehicle used.

Some Examples of Direct Incentives for Efficient Gasoline Use as Part of Rationing

Although it is impractical for rationing to be totally geared to individual driver differences in the number of occupant miles per gallon produced, some portion of a limited quantity of ration rights could be used to reward shifts to more efficient behavior. Some possible mechanisms follow that correspond to the areas of conservation identified from the data to have the greatest potential. These mechanisms differ from conventional ration allocation systems in that they use some institutional distribution points.

For commuter carpooling, a mechanism modeled after vanpooling is suggested. In many vanpooling schemes, a driver contracts with the employer to drive an established pool of employees to and from work. The driver is compensated for this with limited use of a subsidized vehicle (and such a van would itself have the potential of preferential ration rights). The nondriving members of the pool are usually charged a fixed price through payroll deduction, regardless of whether the van is used. An analogous situation could be developed in which a private automobile could be guaranteed extra ration rights (or better, gasoline supplied directly to this vehicle) if a minimum number of employees agreed to pay for a shared

ride via payroll deduction. This would require that the price of the ride be high enough to discourage bogus riders, that necessary changes to insurance practices be made, and that certain checks be made to verify the commuter-pool use of the vehicle, perhaps in connection with priority parking. Another related incentive would be to supply limited extra ration coupons as a bonus to anyone purchasing a monthly bus or rail pass for use between home and work.

For smaller cars, a large-scale mechanism would be the use of a vehicle-based allocation, but one in which more ration rights were distributed to cars getting high mileage per gallon. This is likely to be very unpopular. Perhaps more palatable would be to give a ration-rights bonus on purchase of a new small car; the bonus would be given even if a small car were replaced, as this might accelerate the release of a fuel-efficient vehicle to the used market.

For the overall speed limit, a disincentive is proposed. Especially considering the political resistance in some areas to assessing penalty points toward license suspension for energy speed, a conviction for violating the 55- or 50-mph limit would result in a partial loss of ration rights. To the extent that the driver and vehicle licensing agency would frequently update the lists for mailing ration rights, some flag for disqualification (perhaps for a limited period) is feasible.

Various recent proposals would facilitate the use of ration rights as efficiency incentives, including the possibility that the federal government would buy and sell coupons on the white market (as a regulatory mechanism), as well as the banking of ration rights (which would allow fractional distributions). Also, the trend toward group automobile insurance or leased vehicles as an employee fringe benefit may create some additional opportunities for efficiency incentives.

For organized end users, such as commercial fleets, the same principle could be applied. Instead of merely indexing distributions to historic use, efficiency targets could be established. Occupancy would be less relevant in most situations than commercial-activity vehicle miles per gallon. Thus, targets could be analogous to the corporate average fuel-efficiency standards used by the automobile manufacturing industry.

To protect favored automobile-dependent industries, such as tourism, fleet-based mechanisms could not be used. Instead, it may be feasible to allow ration rights to be distributed by tourist businesses, perhaps indexed to sales tax revenues. Although this would not directly improve occupancy, it would encourage ridesharing because a group of people could conceivably spend enough to obtain ration rights to cover a trip (especially in a small car). This has a considerable advantage over merely allocating extra gasoline supplies to tourist regions. Such a plan would give the motorist control over supply and reduce anxiety about venturing to distant resorts. This last mechanism is of special relevance to Michigan, which would prefer to assign some portion of a limited gasoline supply to support its northern regions—even at the cost of some percentage of local travel.

Finally, all of the mechanisms operate under the assumption that the cost of gasoline will not increase substantially above a free-market level, either directly by pricing or indirectly through white-market-coupon prices. This in itself implies that a shortage situation is moderate (perhaps a 10-25 percent shortfall) and that the government does not attempt to constrain demand by raising gasoline to a multiple of its preshortage price. Under severe shortages or such government intervention, most methods of improving occupant miles per gallon would be supply-constrained, and the incentive mechanism would not be needed.

Future Role of Disaggregate Data in Planning Energy Conservation

The case for a micro data base that covers the travel activity of an entire state has been amply demonstrated in these studies. It is relevant to other states, not only because Michigan covers a comprehensive range of human settlement types, but because it is the state level at which most of the allocation decisions must be made. Several points should be made about future applications of this methodology.

First, there may be problems in the relation between future survey data and future policy decisions. If gasoline allocations are known to be based on information volunteered by people about their travel behavior, the results may be biased either by the respondents or by those collecting and assembling the data. However, various checks can be made. Of the two components of occupant miles per gallon, vehicle size is relatively simple to validate from other sources, including vehicle records. Occupancy levels may be augmented by observation if required. It would in fact require considerable sophistication to circumvent data-quality checks of the type used in the MDES to detect administrative cheating.

Second, the first observation is one example of the need for the data design and collection to be controlled by someone with considerable sensitivity to the policy issues at stake.

Third, the collection of this type of data should be placed into a monitoring system that would ensure at least repeated, if not continuous, measurement of gasoline use. This would initially include a variety of measurement forms at different scales, including aggregate data such as gasoline tax revenues, and would use several different survey techniques. A major consideration here is overcoming the limitations of individual driver or vehicle data. Policymakers are accustomed to images of individuals as the decision-making units (or voters) for which they must plan, whereas it is clear that many energy-related decisions are made at the household level. A further need is to collect data that reveal behavioral trends not only for population subgroups or constituencies but also for activity in different types of space, such as corridors, sectors of conurbations, and isolated settlements. Such a multilevel system can be achieved at reasonable cost with careful sampling. This amounts to simultaneously applying several different and up-to-date research methods to the needs of transportation energy planners and policymakers.

Finally, it must be noted that the MDES data base was established for the most stable year in the last seven in terms of energy price and availability. It thus has value as a baseline of relatively unconstrained driving behavior against which assertions about normality may be tested in the future. It also demonstrates that in usable planning research, as elsewhere, luck has 51 percent of the votes.

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