Measures of the Impacts of Changes in Motor-Fuel Supply in Massachusetts

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During the past decade, a number of significant changes have occurred with respect to the supply of gasoline. Most notable of these changes have been price, which has increased dramatically, and availability, which has become less secure as a result of political developments. The impacts of these changes on the demand for motor fuel in Massachusetts over the 1967-1979 period are examined. The relation between gasoline sales and price, registered automobiles, fuel efficiency, income, and a number of other variables is analyzed, and statistical formulations are developed to express these relations. The analysis indicates that the principal response to these supply changes has been increased fuel efficiency, which results from both improved driving efficiency and higher mechanical efficiency. Only during periods of fuel shortages and substantial price increases have there actually been decreases in the amount of fuel sold. Otherwise, the rate of increase in fuel consumption has slowed down. The work to date suggests that further analysis would be useful to determine the specific impact of supply changes on the type and distribution of trips and to determine the ways in which travelers have accommodated themselves to such changes.

This study examines the impact of changes in gasoline supply and demand during the 1967-1979 period and pays particular attention to the effects of price increases. By reviewing the impact of previous changes, the effects of future changes and policy actions can be better understood. There has been much debate concerning whether regulation of supply or decontrol of price is the better way to deal with energy shortages. The argument for price decontrol states that, if price is allowed to be determined by supply and demand, then all but the most drastic shortages can be resolved in the "marketplace" and neither rationing nor any other regulatory approach would be required. The argument for government intervention is that the behavioral response to price changes (elasticity) is small and that the impacts of shortages will not be efficiently distributed throughout society. This study addresses the issue by examining in detail the effects of past price increases and supply restrictions in Massachusetts to determine consumer response.

MEASUREMENT OF IMPACTS

A number of factors connected to both the supply of motor fuel and consumer demand have been investigated. These factors include gasoline price, population, the number of licensed drivers, the number of registered vehicles, vehicle miles of travel (VMT), income, and vehicle fuel efficiency. Some factors are used as corrective factors to make possible a proper understanding of a particular measurement, such as the population that uses motor fuel. Where appropriate, the factors were adjusted to account for inflation.

Motor-Fuel Sales

Motor-fuel sales, used here as a measure of consumer demand, are the focus of this study. This examination will deal with the actual amount of motor fuel purchased in Massachusetts during the 1967-1979 period. Table 1 gives annual fuel sales during this period taken from the Federal Highway Administration (FHWA) (1) and monthly sales reports of the Massachusetts Department of Revenue.

According to the data presented in Table 1, an upward trend in motor-fuel sales is evident until 1974. The amount of motor fuel purchased during 1974 was lower than that purchased the previous year because of the Arab oil embargo of 1973-1974. Sales increased in 1975, but it was not until 1976 that motor-fuel purchases reached preembargo levels. Sales increased between 1975 and 1978 but at a slower rate than between 1967 and 1973. Sales dropped in 1979 with the gasoline shortage during the summer.

Motor-fuel sales are certainly not a perfect indicator of consumer demand during a period of actual shortage; however, for most of the period under consideration, a shortage did not exist. It is therefore appropriate to compare motor-fuel sales with other indices, such as price and income, and to examine their relations.

Gasoline Prices

The average price of regular gasoline in the Boston metropolitan area is given in Table 2 (2) for the month of October for 1967 to 1979. October was selected because it is a fairly typical driving month in terms of weather conditions and has only minor vacation and holiday travel. An average annual price would tend to hide the significance of monthly price increases. The price of gasoline is used to represent the price of motor fuel throughout this paper, since approximately 95 percent of the motor fuel sold in Massachusetts is gasoline.

Until the Arab oil embargo of 1973-1974, gasoline prices experienced a long period of stability. In 1974, the price of gasoline increased by more than 25 percent; this was followed by a period of moderately increasing prices--on the average, less than 5 percent/year. In 1979, after a period of political instability in Iran, substantial price rises by the Organization of Petroleum Exporting Countries (OPEC), and the dissolution of the unified OPEC pricing structure, the cost of crude oil took the significant leap that brought gasoline prices to more than $1/gal.

The real price of gasoline, which is the pump price of gasoline adjusted by the consumer price index (CPI) for the Boston area, is also given in Table 2 for the month of October during 1967-1979 (2,3).

The real price of gasoline declined until late 1973 and then increased for the next few years. Prices declined again in 1976, rose slowly over the next few years, and then surged dramatically in 1979. The effects of the first OPEC price rise were almost negated by inflation in 1976, 1977, and 1978; however, the price increase during 1979 was much greater than even the high rate of inflation experienced during that year.

Although the pump price increased more than 200 percent between 1967 and 1979, when corrected for inflation, the price increased by only 38 percent.

Per Capita Income

Although per capita income has increased significantly, real income has gone up only slightly during the period. In some years--1974, 1975, and 1979--per capita income rose more slowly than inflation, and therefore real income dropped (4). It is expected that, as income rises, travel, and therefore gasoline consumption, will increase. Automobile ownership is also expected to increase.

Population and Licensed Drivers

Table 3 gives data from various sources on annual population and number of licensed drivers for Massachusetts. Population growth has been quite slow during the period and is therefore unlikely to have affected motor-fuel sales. The rate of growth bears little relation to either the number of licensed drivers or the number of registered vehicles, which have both increased substantially during the period. Since the population has remained essentially the same, it is not used as a factor to explain or to correct motor-fuel sales.

The number of licensed drivers has generally increased over the period, which probably reflects demographic trends whereby the number of persons 16 years and older had been increasing faster than the population as a whole (this trend has now slowed down). It is also reflective of higher income, which has translated into increasing numbers of automobile drivers. In Massachusetts, the trend appears to have peaked in 1974 and in recent years shows signs of leveling off.

Vehicle Registrations

Another factor that may influence motor-fuel purchases is the number of registered automobiles and registered vehicles (registered automobiles represent approximately 88 percent of registered vehicles), as presented in Table 4 (1). Vehicle registrations show an upward trend since 1967, increasing at a rate significantly faster than the number of licensed drivers. Slowdowns in both vehicle registrations and driver licensing occurred in 1975 and 1979.

This information is used to translate motor-fuel sales into sales per unit. Table 5 gives data from FHWA (1) and the Massachusetts Department of Public Works on sales of fuel per registered vehicle. Fuel sales per registered vehicle increased slightly between 1967 and 1973 and decreased sharply thereafter. Since travel (which will be discussed below) has not decreased as much, the decreased fuel consumption must be related to both increased fuel efficiency and reduced travel per vehicle.

Vehicle Miles of Travel

VMT, which is given in Table 6 for Massachusetts from 1967 to 1979 (data of the Massachusetts Department of Public Works), is related to both fuel consumption and vehicle efficiency. Although total statewide VMT has generally increased, VMT per registered vehicle, also given in Table 6, increased only until 1973 and has generally decreased thereafter. This indicates that reduced travel has played a role in the reduced demand for gasoline.

Fuel Efficiency

Increased fuel efficiency also explains part of the reduction in gasoline consumption per vehicle. According to data from FHWA (1) and the Massachusetts Department of Public Works, given in Table 7, vehicle fuel efficiency in Massachusetts has been increasing slowly since the early 1970s.

As consumers replace their cars with newer, more fuel-efficient cars, average fuel efficiency automatically improves. In addition, consumers may choose to trade in older, less efficient cars sooner or purchase new cars that have especially good fuel consumption as a means of enabling themselves to purchase less motor fuel without decreasing their travel. This explains the fact that fuel consumption per vehicle has slowed down much more than travel.

DISCUSSION OF TRENDS

In this section, trends in the relation among motor-fuel sales and price, income, automobile registra-

Table 1. Annual sales of motor fuels in Massachusetts: 1967-1979.

Year	Annual Motor-Fuel Sales[a]: Gallons (000 000s)	Change (%): From Previous Year	Change (%): From Base Year
1967	1844.2	-	-
1968	1961.9	6.4	6.4
1969	2047.4	4.4	11.0
1970	2174.3	6.2	17.9
1971	2255.7	3.7	22.3
1972	2391.7	6.0	29.7
1973	2483.5	3.8	34.7
1974	2380.9	-4.1	29.1
1975	2412.5	1.3	30.8
1976	2500.3	3.6	35.6
1977	2528.1	1.1	37.1
1978	2587.5	2.3	40.3
1979	2557.6	-1.2	38.7

[a]Includes all highway gasoline and diesel fuel.

Table 2. Average price and real price of regular gasoline in Boston in the month of October: 1967-1979.

Year	Pump Price: Price (cents/gal)	Pump Price: Change (%) From Previous Year	Pump Price: Change (%) From Base Year	Real Price: Price[a] (cents/gal)	Real Price: Change (%) From Previous Year	Real Price: Change (%) From Base Year
1967	32.9	-	-	32.6	-	-
1968	33.9	3.0	3.0	31.1	-4.6	-4.6
1969	34.9	2.9	6.1	31.0	-0.3	-4.9
1970	35.9	2.9	9.1	30.1	-3.0	-7.7
1971	37.9	5.6	15.2	30.5	+1.3	-6.4
1972	37.9	0.0	15.2	29.4	-3.6	-9.8
1973	40.9	7.9	24.5	29.5	+0.3	-9.5
1974	51.7	26.4	57.1	33.9	+14.9	+4.0
1975	58.9	13.9	79.0	35.7	+5.3	+9.5
1976	59.9	1.7	82.1	34.0	-4.8	+4.3
1977	61.9	3.2	88.1	33.3	-2.1	+2.1
1978	63.9	3.2	94.2	32.3	-3.0	-0.9
1979	98.9	54.8	200.6	44.9	+39.0	+37.8

[a]Obtained by dividing pump price by CPI and multiplying by 100.

Table 3. Population and licensed drivers in Massachusetts: 1967-1979.

Year	Population Number	Population Change (%) From Previous Year	Population Change (%) From Base Year	Licensed Drivers Number	Licensed Drivers Change (%) From Previous Year	Licensed Drivers Change (%) From Base Year
1967	5 594 000	-	-	2 791 000	-	-
1968	5 619 000	0.4	0.4	2 850 000	2.1	2.1
1969	5 650 000	0.6	1.0	2 901 000	1.7	3.9
1970	5 704 000	1.0	2.0	2 988 000	3.0	7.1
1971	5 768 000	1.1	3.1	3 060 000	2.4	9.7
1972	5 789 000	0.4	3.5	3 141 000	2.6	12.5
1973	5 805 000	0.3	3.8	3 209 000	2.2	15.0
1974	5 800 000	−0.1	3.7	3 567 000	11.1	27.8
1975	5 818 000	0.3	4.0	3 554 000	−0.4	27.3
1976	5 792 000	−0.4	3.5	3 644 000	2.5	30.6
1977	5 777 000	−0.3	3.3	3 652 000	0.2	30.8
1978	5 774 000	−0.1	3.2	3 726 000	2.0	33.5
1979	5 770 000	−0.1	3.1	3 700 000	−0.7	32.6

Note: Data on population are from the Survey of Current Business (4) and the Survey of Buying Power, and data on licensed drivers are from the Massachusetts Registry of Motor Vehicles and FHWA (1).

Table 4. Automobile and vehicle registrations in Massachusetts: 1967-1979.

Year	No. of Registered Automobiles	No. of All Registered Vehicles[a]	Change in Registered Vehicles (%) From Previous Year	Change in Registered Vehicles (%) From Base Year
1967	2 002 000	2 256 000	-	-
1968	2 104 000	2 367 000	4.9	4.9
1969	2 182 000	2 459 000	3.9	9.0
1970	2 312 000	2 620 000	6.5	16.1
1971	2 432 000	2 752 000	5.0	22.0
1972	2 543 000	2 877 000	4.5	27.5
1973	2 653 000	3 020 000	5.0	33.9
1974	2 726 000	3 125 000	3.5	38.5
1975	2 776 000	3 188 000	2.0	41.3
1976	2 865 000	3 273 000	2.7	45.1
1977	3 110 000	3 520 000	7.5	56.0
1978	3 190 000	3 636 000	3.3	61.2
1979	3 220 000	3 720 000	2.3	64.9

[a]Refers to all registered vehicles publicly and privately owned, excluding motorcycles and buses.

Table 5. Annual motor-fuel sales per registered vehicle in Massachusetts: 1967-1979.

Year	Motor Fuel per Registered Vehicle Gallons	Change (%) From Previous Year	Change (%) From Base Year
1967	817	-	-
1968	829	1.5	1.5
1969	833	0.5	2.0
1970	830	−0.4	1.6
1971	820	−1.2	0.4
1972	831	1.3	1.7
1973	822	−1.1	0.6
1974	762	−7.3	−6.7
1975	757	−0.7	−7.3
1976	764	0.9	−6.5
1977	718	−6.0	−12.1
1978	712	−0.8	−12.9
1979	688	−3.4	−15.8

Table 6. Vehicle miles traveled in Massachusetts: 1967-1979.

Year	Annual VMT for All Vehicles Number (billions)	Change (%) From Previous Year	Change (%) From Base Year	Annual VMT per Registered Vehicle Number	Change (%) From Previous Year	Change (%) From Base Year
1967	21.769	-	-	9 649	-	-
1968	23.223	6.7	6.7	9 811	1.7	1.7
1969	25.378	9.3	16.6	10 320	5.2	7.0
1970	26.072	2.7	19.2	9 951	−3.6	3.1
1971	28.030	7.5	28.8	10 185	2.4	5.6
1972	29.442	5.0	35.2	10 234	0.5	6.1
1973	30.319	3.0	39.3	10 039	−1.9	4.0
1974	30.001	−1.0	37.8	9 600	−4.4	−0.5
1975	30.652	2.2	40.8	9 615	0.2	−0.4
1976	31.881	4.0	46.5	9 741	1.3	1.0
1977	33.779	6.0	55.2	9 596	−1.4	−0.5
1978	35.053	3.8	61.0	9 640	0.5	−0.1
1979	35.178	0.4	61.6	9 456	−1.9	−2.0

tions, and fuel efficiency are discussed. Specific attention is given to the trends that have followed supply shortages. The relation between the factors and the demand for motor fuel as quantified through regression analysis is presented, and price elasticities are estimated.

General Trends

The relation of gasoline price to motor-fuel consumption is as follows: As the real price of gasoline increases, consumption decreases; as the price decreases, consumption increases. At times, there may be some lag between the change in price and the change in consumption, although it is difficult to specify the length of delay. Much of the drop in consumption during this time period may be the result of greater fuel efficiency rather than reduced travel.

The relation between income and demand for motor fuel has already been discussed. Between 1967 and 1979, real per capita income increased at a slow but

Table 7. Vehicle fuel efficiency in Massachusetts: 1967-1979.

	Average Vehicle Fuel Efficiency		
		Change (%)	
Year	Miles per Gallon	From Previous Year	From Base Year
1967	11.8	-	-
1968	11.8	0	0
1969	12.4	5.1	5.1
1970	12.0	-3.2	1.7
1971	12.4	3.3	5.1
1972	12.3	-0.8	4.2
1973	12.2	-0.8	3.4
1974	12.6	3.3	6.8
1975	12.7	0.8	7.6
1976	12.8	0.8	8.5
1977	13.4	4.7	13.6
1978	13.5	0.7	14.4
1979	13.8	2.2	16.9

fairly steady pace, except for one or two periods when it dropped. Motor-fuel consumption appears to follow the same general pattern as income, although not as closely as price and consumption. Fuel efficiency has also increased during the period and appears to explain part of the drop in motor-fuel consumption.

Motor-fuel sales have increased at a rate very similar to the rate of vehicle registrations and at a slightly faster rate than licensed drivers until 1973. After 1973, fuel sales have increased at a rate similar to the rate of increase in licensed drivers. Population, which has remained quite stable during the period, is unlikely to have had any effect on sales.

Trends Following Supply Changes

Motor-fuel sales, measured in absolute amounts, show two periods of significant decline: following the 1973-1974 embargo and again in mid-1979. An examination of fuel sales per registered vehicle indicates an even more precipitous decline beginning in 1973, much less recovery after 1975, and a drop in 1979 greater than the one for absolute motor-fuel sales.

By 1974, fuel sales per registered vehicle were below the 1967 level. Consumption per registered vehicle dropped by approximately 16 percent between 1967 and 1979. This drop is roughly equivalent to a 17 percent increase in fuel efficiency experienced during this time. VMT per registered vehicle has declined by only 2 percent since 1967, which is not nearly as great as the decline in fuel consumption per registered vehicle during this same time.

Fuel efficiency measures both improved mechanical efficiency and the improved driving efficiency caused by such actions as observance of the 55-mile/h speed limit and more frequent engine tuning. To determine how much of the change in fuel efficiency is the result of choice by consumers and how much is simply the result of changed regulations and changes by the manufacturer requires data that are currently unavailable. What is most important is that increased fuel efficiency plays a greater role than reduced travel in bringing about a decrease in fuel consumption. This fact is important for policymakers because it indicates that consumers will respond to higher prices not by reducing their travel but by more efficient driving. Therefore, the focus of policy should be primarily on improving vehicle efficiency.

Regression Analysis

To determine the relative importance of the various factors related to the demand for gasoline and the magnitude of these relations, a regression analysis was performed. A number of specifications were tested in order to develop an equation that was theoretically sound and statistically significant. Although many of the variables previously discussed are related to the demand for gasoline, because of the strong correlation among groups of variables, very few were used in the same regression equation to avoid the problem of multicollinearity. In the equations, the independent variables, the number of registered vehicles and the cost of driving, were regressed against the dependent variable, monthly motor-fuel sales. Out of the large number of equations tested, the following are preferred:

$$MFUEL_i = 50\,385.3 + \underset{(97.4)}{0.060\,266\,22\ REGVEH_j} - \underset{(15.1)}{69\,145.8\ PPRGAS_i} \quad (1)$$

$$MFUEL_i = 125\,999.2 + \underset{(226.3)}{0.046\,206\,69\ REGVEH_j} - \underset{(21.9)}{2084.5\ RLPRGAS_i} \quad (2)$$

$$MFUEL_i = 166\,730.0 + \underset{(64.1)}{0.061\,143\,33\ REGVEH_j} - \underset{(9.7)}{12\,414.69\ FLFUELEF_j} \quad (3)$$

$$MFUEL_i = 157\,878.3 + \underset{(156.7)}{0.036\,246\,71\ REGVEH_j} - \underset{(15.9)}{26\,494.28\ CENTMILE_j} \quad (4)$$

where

MFUEL = motor-fuel sales to retailers in month i at quarterly intervals (gal 000s),
REGVEH = registered vehicles in Massachusetts in year j,
PPRGAS = pump price of regular gasoline in month i (\$/gal),
RLPRGAS = real price of regular gasoline in month i (¢/gal),
FLFUELEF = average vehicle fuel efficiency in year j (miles/gal), and
CENTMILE = average real cost of fuel per mile of vehicle travel (¢).

The numbers in parentheses are t-scores. Coefficients of correlation and statistics for Equations 1-4 are given in the following table ($r_{x_1x_2}$ represents the correlation coefficient between the independent variables, and DW indicates Durbin-Watson statistics):

Equation	$\bar{R}^2$	F	$r_{x_1x_2}$	DW
1	0.80	104.2	0.88	2.3
2	0.82	117.8	0.48	2.4
3	0.78	93.3	0.92	1.9
4	0.80	105.8	-0.25	2.2

All of the variables in each of the equations are statistically significant at the 0.05 level, as is each of the four equations as a whole. The fact that the $\bar{R}^2$ values, which measure the degree to which the independent variables predict the dependent variable, are all relatively high indicates that the equations have good explanatory ability. The correlation coefficients between the independent variables ($r_{x_1x_2}$) are high in Equations 1 and 3. Although a high $r_{x_1x_2}$ value may indicate that multicollinearity is present, since the variables and equations are statistically significant, it will be assumed that this condition is not creating a serious problem. Serial correlation does not present a problem in these regression equations, as indicated by acceptable Durbin-Watson statistics.

Dependent Variable: Motor-Fuel Sales

MFUEL turned out to be the most successful dependent variable in the equations that were tested. Monthly motor-fuel sales at quarterly intervals (March, June, September, and December) were used. Only quarterly data were used because the method by which suppliers report fuel sales results in large monthly fluctuations, which are unrelated to the independent variables. Other dependent variable specifications that were tried included the total fuel sales in a quarter and the average monthly fuel sales per quarter. MFUEL performed better than any of these. Nonlinear formulations were also tested with no greater degree of success.

Independent Variables: Registered Vehicles and Driving Cost

The variable REGVEH, the number of registered vehicles in the state, appears in each of the equations. It was believed that motor-fuel consumption would be related mainly to some measure of population, whether population of vehicles or population of licensed drivers. Both of these variables were tested for use as the measure of population in the regression. The number of registered vehicles performed slightly better. Another variable highly correlated with both of these, real income, also performed well, although not quite as well as the other two.

In Equation 1, the coefficient for REGVEH means that each additional registered vehicle will result in 60 gal of gasoline sold in a particular month.

The variable PPRGAS, which appears in Equation 1, is the pump price of gasoline in a given month. The equation performs fairly well with regard to the test statistics. The price coefficient indicates that a 1¢ increase in the pump price would result in a decrease of 691 000 gal of gasoline. This is approximately 0.3 percent of monthly fuel sales in December 1979.

Equation 2 is the same except that the real price (RLPRGAS) is substituted for the pump price. The coefficients in Equation 2 are highly significant and have a slightly higher $\bar{R}^2$ than Equation 1. Basically, a 1¢ increase in real price will result in a fuel decrease of 2.1 million gal/month.

In Equation 3, the variable FLFUELEF is used with registered vehicles. Although both price and fuel efficiency would affect fuel consumption, a very high correlation between the two variables prevents their being used in the same equation. Even with the possibility that multicollinearity is present because of the correlation between registered vehicles and fuel efficiency, the variables are all statistically significant. For each mile-per-gallon increase in fleet fuel efficiency, the equation predicts that consumption will decline by approximately 12.4 million gal/month. Each additional registered vehicle still accounts for an increase of 60 gal of gasoline.

In Equation 4, real price and fuel efficiency are combined into one variable, CENTMILE, which is calculated by dividing the real price per gallon by miles per gallon. Therefore, if the real price were 45¢/gal and fuel efficiency were 15 miles/gal, the value for CENTMILE would be 3¢/mile (real cost). The advantage of this equation over Equations 1-3 is that, without introducing multicollinearity into the equation, it is possible to use both real price and fuel efficiency with registered vehicles. For each 1¢ increase in the cost of driving a mile, the equation predicts that approximately 26.5 million gal less would be consumed. A 1¢/mile increase in the cost of driving is a substantial increase. In the above example, where the real price is 45¢/gal and fuel efficiency is 15 miles/gal, it would take a real-price increase of 15¢ to achieve a 1¢/mile increase in the fuel-related cost of driving. This is a fairly substantial increase, achieved only recently.

It should be pointed out that each of these equations contains an error term that relates to the variation explained by variables not included in the equation. Overall, unexplained variation accounts for 20 percent of the variation in the demand for motor fuel according to these regression equations.

Price Elasticity of Gasoline

The relation between gasoline price and motor-fuel consumption was also quantified through the calculation of the price elasticity. An elasticity is a measure of the responsiveness of demand for a particular product (or service) to changes in a characteristic of its supply--in this case, price. It is defined as the percentage change in quantity divided by the percentage change in price. The formula for an arc elasticity, which is commonly used, is as follows:

$$e_{arc} = (q_2 - q_1)/(q_1 + q_2)/2 \div (p_2 - p_1)/(p_1 + p_2)/2 \qquad (5)$$

where

q_1 = quantity of gasoline sold at the beginning of the period being measured,
q_2 = quantity of gasoline sold at the end of the period being measured,
p_1 = price at the beginning of the period, and
p_2 = price at the end of the period.

The following table gives several short-term elasticities calculated over one-year periods during which shortages occurred:

	Elasticity	
Time Period	Real Price	Pump Price
June 1978 to June 1979	-0.24	-0.18
December 1978 to December 1979	-0.26	-0.19
March 1973 to March 1974	-0.44	-0.29

Elasticities reported in a number of studies produced between 1973 and 1975 (5) are given below (all of these studies use pre-1972 data; generally, short-term refers to a one-year period):

Study	Year	Elasticity
Data Resources, Inc.	1973	-0.23 to -0.30
McGillivray (Urban Institute)	1974	-0.23
Rand Corporation	1975	-0.26 to -0.43
Charles River Associates	1975	-0.18

As the first table above indicates, the elasticities for real price are somewhat higher than for pump price. This is because the difference in real price from the beginning to the end of a period is always smaller than pump price. The first table also shows that elasticities are generally higher for the 1973-1974 comparison than for 1978-1979. One reason for this could be that the earlier period contained the first major price increase and therefore subsequent price increases, no matter how great, might be expected to have less of an impact. In addition, since the absolute price increase in 1973-1974 was smaller than that in 1978-1979, it would not take such a great change in demand to result in the calculation of a higher elasticity. In other words, although an elasticity may be a good indicator of consumer response, it may fall short when one compares different periods of time with substantially different base prices and base quantities. The elasticities derived in this study, which are based on real price, are quite similar to the real-price elasticities from previous studies.

CONCLUSIONS

The purpose of this paper has been to present the results of an investigation of changes in motor-fuel consumption during a period in which significant changes in the supply of motor fuel have occurred. The examination was performed by using data for the state of Massachusetts during the 1967-1979 period. The focus of the research has been to relate the trends in fuel consumption to a number of factors related to its supply. These factors include price, fuel efficiency, and vehicle registrations. As might be expected, the number of vehicle registrations is the dominant factor, which indicates that the size of the vehicle fleet is the primary determinant of motor-fuel consumption. Price does play a role, and it is estimated that the short-term price elasticity of gasoline is between -0.18 and -0.44, depending on the price definition and the time period studied. Fuel efficiency relates to fuel consumption in that, as fuel efficiency increases, consumers can purchase less motor fuel without limiting the amount of vehicle miles of travel.

It would be useful to investigate further the specific ways in which consumers have changed their behavior in the face of rising gasoline prices and supply uncertainty (6). Monitoring of the overall fuel efficiency of the automobile fleet would be most useful in determining how consumers are adapting to rising fuel prices, and improvements in the procedure for collecting motor-fuel data would make possible a refinement of the analysis. Further research should also be performed by using more refined vehicle registration data. In short, while some conclusions as to the relative impacts of various factors on fuel consumption can be drawn, this study also points the way toward future research.

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Dual Price System for Management of Gasoline Lines

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The problem of crisis management during a shortfall in gasoline supplies is how to distribute the available gasoline in the most efficient and equitable fashion. Several approaches to this problem are reviewed, and particular emphasis is placed on a dual market scheme. The dual market system allows gasoline station operators to charge as much as they want for gasoline as long as for each high-price pump there is one pump operating at the regulated or controlled price. This creates a situation in which customers can either wait in line for the regulated-price gasoline or pay more and avoid queuing. The way in which this system actually creates a continuum of choices for each customer is described. Efficiency and equity criteria are emphasized, and some of the issues that may be associated with implementing the system are reviewed.

Most forecasts of energy availability in the near future include a provision for shortages in gasoline supplies for various periods of time. It is likely that the ongoing research into and development of alternative energy sources will not produce results in time to prevent such shortfalls. Thus, one of the questions confronting planners is how to best accommodate such a shortage. The focus of this paper is on one of the most visible consequences of a petroleum shortage--queues at gasoline stations.