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GASOLINE RATIONING

The Economic Effects of Rationing on New England

Submitted to
The New England Regional Commission
Boston, Massachusetts

Submitted by
Charles River Associates, Incorporated
Cambridge, Massachusetts

January 1974

This report was prepared by professional consultants under the supervision and direction of, and under contract with, the New England Regional Commission. The statements, findings, and recommendations contained in the report are solely those of the consultants and do not necessarily reflect the views of the New England Regional Commission.

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Executive Summary

Gasoline consumption in New England will fall by at most 3 to 5 percent as a result of lower speed limits and Sunday closing of gasoline stations. If there is a substantial shortage, gasoline will be rationed haphazardly unless some more formal rationing scheme is adopted. Drivers will curtail demand somewhat as the inconvenience of purchasing gasoline grows. They will also shy away from long-distance trips for fear of being unable to fill up en route. As a result, the impact of a substantial gasoline shortage would fall heavily on the New England tourist industries. Lower speed limits and added inconvenience of getting gasoline will lengthen delivery times and increase trucking costs. Business and industry in New England are likely to respond by carrying larger inventories, which will add further to their costs.

Longer waits at filling stations and higher inventory costs are examples of inefficiencies which arise when direct restrictions on gasoline consumption are imposed. If there is a substantial shortage, rationing gasoline by making it more costly has the advantage for New England of avoiding the inefficiencies associated with direct controls. Several rationing schemes which have this advantage are examined in this report.

For any given supply of gasoline, each scheme examined has the same set of effects on the private and business uses of gasoline and on industries and activities affected by motor vehicle travel in New England. The important differences among these schemes lie in the costs of administering them and in how higher costs of purchasing gasoline are reflected in the distribution of income.

Allowing price to rise until desired gasoline consumption equals available supply is the simplest scheme to administer but it involves a substantial transfer of income from New England consumers to the petroleum industry. Coupon rationing can prevent or control this income transfer but it involves substantial administrative costs. This makes it a less desirable alternative if the duration and size of the shortage are not expected to be large. Controlling the income transfer through excise taxes or excess profits taxes would be difficult because of uncertainty about the size of price increase needed to bring desired consumption of gasoline down to the levels of available supply.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

INDEX OF TABLES

INDEX OF TABLES (Continued)

INDEX OF TABLES (Continued)

INDEX OF FIGURES

Introduction and Summary

This report presents the results of our examination of the probable impacts of alternative gasoline rationing schemes on the New England Region. In particular, we examined the impacts of schemes which are designed to constrain gasoline consumption to a level 15 percent below the amount consumers would be willing to buy at current prices.

Wherever possible we have attempted to provide at least crude quantitative estimates of the impacts of alternative schemes. However, in view of lack of data in some cases and lack of reliable estimates of important economic parameters in others, the estimates presented should be viewed as our best considered judgment and not as firm predictions of the course of future events.

We have analyzed the effectiveness of restriction schemes, such as that currently in force, which calls for reduced speed limits and Sunday closing of gasoline stations. In Chapter 1 we estimate that these two measures can at best achieve a 3 to 5 percent reduction in gasoline consumption. As a result, under this scheme gasoline will get rationed on a first come first serve basis, through added inconvenience of purchasing it, and through drivers' fear of making long trips.

Restriction rationing will have little direct effect on commuter travel. However, the inability to purchase gasoline at times may affect automobile commuters, particularly, those who drive relatively long distances to work. The impacts of restriction rationing on commuting will be greater among the higher income groups since commuting by automobile is more frequent among such groups. Within any income group, whether high or low, the impacts will be highly uneven since there are wide variations in the distances travelled to work within income groups. A detailed examination of commuting patterns is contained in Chapter 2.

The analysis in Chapter 3 indicates restriction rationing will, in the short run, increase trucking costs by 1 to 1.5 percent for trucks operating in short-and long-range intercity traffic. Longer delivery times will lead industries to carry higher inventories causing an increase in costs of doing business over and above higher freight costs.

Restriction rationing will have its greatest impacts on recreational and vacation travel and thus on the tourist industries in the New England states and in particular the skiing industry in northern Vermont and New Hampshire. While skiing is an important tourist industry in Maine, the majority of skiers in Maine are state residents so the Maine industry should be less effected than Vermont and New Hampshire. Even though the overall annual reductions in tourist expenditures might not have serious effects on the region as a whole or even on individual states, the data reported in Chapter 4 indicate the impact on various localities within the northern states could be quite severe.

In addition to restriction rationing schemes, Chapter 1 examines various schemes in which the price of gasoline is allowed to increase in order to equate demand with a supply 15 percent less than would be bought at current prices. The various schemes differ as to how the increase in the price of gasoline is brought about and who gets the increased revenue resulting from higher prices. However, the impacts of higher prices on the sectors identified above is the same for all plans. We analyze these effects on the basis of our calculation as reported in the technical appendix, that a roughly 60 percent increase in gasoline prices would equate supply and demand within the framework studied.

As reported in Chapter 2, we estimate that such a price rise would, in the short run, lead to almost a 15 percent reduction in vehicle miles travelled on trips to work in metropolitan areas. In the longer run, switches to automobiles with better gasoline economy might lead to some restoration of vehicle miles travelled in metropolitan areas.

We estimate that a 60 percent gasoline price increase would lead in the short run to an increase in trucking costs of between 2 and 3 percent. On balance we estimate this increase will result in a smaller increase in total shipping and related costs than would take place with restriction rationing.

The analysis of tourism expenditures and tourist travel to New England in Chapter 4 suggests that a 60 percent gasoline price increase would decrease tourist expenditures by 5 to 10 percent. There would probably be a tendency for tourist business to shift away from the extreme northern parts of the northern states toward their southern areas. In our judgment the seasonal pattern of tourist expenditures is unlikely to be substantially altered by the estimated price increase and expenditure reduction.

On the basis of the examination of sources of state revenue presented in Chapter 5 we estimate that a 15 percent reduction in the quantity of gasoline sold coupled with a reduction in tourist expenditure would have its greatest effect on state revenues in New Hampshire, Connecticut, and Maine since these states derive a larger percentage of their revenue from taxes on fuels than do the other states.

Of the rationing schemes in which the price of gasoline rises, the non-coupon schemes present the fewest administrative burdens especially at the state level. Nevertheless, these schemes raise important and difficult policy questions. Allowing the price to gasoline to rise is administratively simple but would, result in an income transfer from New England residents to petroleum companies of $1.2 to $1.4 billion annually according to the analysis presented in Chapter 1. The alternative of raising gasoline prices by placing an excise tax on it seems administratively unfeasible in view of the lack of reliable estimates of the elasticity of demand.

Coupon rationing schemes overcome many of the problems associated with the other schemes but raise particular problems of their own, such as how to allocate coupons, in particular how to treat the commercial sectors as opposed to the private and public sectors and how to organize markets in which coupons can be exchanged. The discussion in Chapter 1 suggests that the administrative machinery likely to be needed to start up coupon rationing schemes makes such schemes unattractive if the rationing problem is expected to be of short duration.

Chapter 1
The Mechanics and General Effects of Alternative Rationing Schemes

It is convenient to distinguish two types of rationing schemes; restriction rationing and price rationing. Rationing schemes are designed to restrict total consumption to some fraction of the amount consumers want to buy at prevailing prices. They differ as to how they bring about reductions in consumption and as to which of the different users reduce their consumption of gasoline and by how much.

Restriction rationing schemes aim at reducing consumption by mandating behavior which, it is thought, will reduce consumption. For example, under the present system reductions in consumption are to be achieved by imposing a 55 mile per hour speed limit and by closing gasoline stations on Sundays. If the reduction in consumption achieved by mandated restrictions is insufficient to equalize the quantity of gasoline demanded at prevailing prices with the available supply, there will be shortages. Consumers will find that at times they simply cannot get gasoline so they will have no choice but to curtail consumption. The initial impact of reduced consumption will be borne by those users whose behavior is most affected by lower speed limits and Sunday closings and by those unfortunates who find they cannot buy gasoline.

Price rationing schemes all aim at reducing consumption by raising the price which must be paid for gasoline. These schemes differ in how the rise in gasoline prices is achieved and in how the impact of higher gasoline prices is reflected in the distribution of income. However, the rise in price needed to achieve a given reduction in the quantity of gasoline demanded can be taken to be approximately the same regardless of how the increase is effected or how its impact on income distribution is dealt with. Because of this property of price rationing schemes, all such schemes which seek to achieve the same reduction in consumption will have identical effects on gasoline consumption by individual users; that is, on the commercial transportation sector, on tourism, and on commuting patterns. Those users who are more willing to pay higher prices will reduce their consumption less. In general these will tend to be the users with higher incomes or with inferior alternatives to motor vehicle usage.

The next section of this chapter outlines in greater detail the ways in which the present restriction rationing scheme will affect gasoline consumption in the short and long runs. The following sections identify some alternative price rationing schemes and the factors which determine the effects of these schemes on various users and uses of gasoline.

Restriction Rationing Schemes

The present scheme combines a reduction in the speed limit with Sunday closing of gasoline stations. Reducing the speed limit has two effects. First, to the extent that lower speeds bring greater fuel economy, less gasoline is consumed in driving a given number of vehicle miles. Second, lower speeds increase the time required to travel a given distance. Sunday closing of gasoline stations limits the amount of travel by any vehicle over the duration of the closing to that which can be achieved on a single tankful of gasoline.

Effects on the Commercial Transportation Sector

To the extent that fuel economy is increased, lower speed limits lead to lower fuel consumption per truck-mile. However, lower speeds and restricted travel on Sunday reduce the number of ton-miles of freight which a given fleet of trucks and drivers can provide. In the longer run, the reduction in available ton-miles can be offset by increasing the capacity of the truck fleet and, perhaps, by driving each truck longer hours.

Lower speeds translate into longer delivery times. In the short run, producers may suffer shortages of raw materials and intermediate products and wholesalers and retailers may suffer stock shortages as a result of longer delivery times by holding larger inventories.

The overall effect of reduced speed limits on the commercial transportation sector is to decrease gasoline consumption to the extent that fuel economy is improved. Whatever the saving in gasoline consumption that is achieved in this manner, it will be purchased at the price of higher cost per ton-mile because more trucks must be used or trucks must be driven longer in order to produce a given number of ton-miles. The saving in gasoline consumption will also be reflected in higher inventory carrying costs throughout the economy as business firms attempt to compensate for longer delivery times.

Effects on Private Automobile Use

The effect of reduced speed limits will be greatest on high-speed automobile travel, especially over longer distances. Since most automobile trips for commuting to work, shopping, or performing other family business are short, such travel will be little effected by the reduced speed limit. Likewise, both because such trips are short and tend to occur during the week, Sunday closing in itself should have little impact on travel to work, shopping, and other family business. However, the shortages that may develop in a restriction scheme may very well force curtailment of automobile work trips and other personal automobile trips.

Longer traveling times caused by lower speed limits will reduce total vehicle miles traveled by eliminating some longer automobile trips, changing trip routing and causing some travelers to shift to other modes of travel. Closing gasoline stations will affect personal automobile usage by eliminating week-end trips whose one-way distance is greater than can be driven on a single tankful of gasoline. Thus, the primary impact of the present restrictions will fall on longer trips and on medium length weekend trips. These impacts should be reflected most heavily in recreational and vacation travel and hence have important effects on tourism.

The data in Table 1-1 indicate that the impact of reduced week-end travel by automobiles, trucks, and campers is likely to fall predominantly on the middle- and upper-income families. Families with less than $5,000 annual income are estimated to have accounted for less than 11 percent of week-end motor trips while those earning $10,000

TABLE 1-1

ESTIMATED WEEK-END-AUTO/TRUCK/CAMPER TRIPS

BY INCOME GROUP

(1) Family Income ($000)	(2) Total A/T/C Trips (000)	(3) Total Trips (000)	(4) Proportion A/T/C Trips	(5) Total Week-End Trips (000)	(6) Estimated Week-End A/T/C Trips (000)	(7) Distribution of Week-End A/T/C Trips (000) (%)
Less than 5	18,049	22,809	.79	10,082	7,964	10.5
5 - 7.5	24,334	28,496	.85	13,465	11,445	15.1
7.5 - 1.0	30,208	34,860	.87	16,027	13,943	18.4
10.0 - 15	60,206	73,614	.82	29,034	23,807	31.4
15 and over	44,105	66,116	.67	22,816	15,287	20.2
Not reported	8,368	11,044	.75	4,474	3,356	4.4

SOURCE: Columns (1), (2), (3) and (5) from U.S. Bureau of Census, National Travel Survey, *Travel During 1972*, Tables 2, 3 and 11. Column (4) equals column (3)/column (2). Column (6) equals column (4) x column (5). Column (7) computed from column (6).

to $15,000 accounted for over 30 percent of such trips in 1972.[1]

The net reduction in consumption which will be achieved by the present restrictions is likely to fall far short of the reduction in gasoline supply which is being contemplated. Reducing speed limits to 55 miles per hour might achieve a 3 percent reduction in gasoline consumption.[2] Sunday closings of gasoline stations would preclude weekend trips which are more than 200-300 miles each way. Based on an analysis of data from the 1972 Travel Survey, we estimate that if Sunday closings were to eliminate all week-end round trips by automobiles, trucks, and campers which were 400-600 miles round trip, gasoline consumption might fall by at most 1 percent.[3]

To the extent that gasoline production were cut by more than around 3 to 5 percent, gasoline stations would have less to sell. As a result the chance of being unable to buy gasoline would rise and/or the expected number of stops for gasoline per mile driven would rise. Both of these effects can be viewed as rises in the cost of automobile trips. The increased probability of being unable to find

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[1]The distribution of week-end motor trips must be estimated from data on the distribution of motor trips by income group and data on week-end travel by income group. For each income group the proportion of week-end trips which were motor trips was taken to be the same as the proportion of all trips by that income group which were motor trips.

[2]See the technical appendix for details of this estimate.

[3]Weekend trips with round trip distances of 400-600 miles accounted for almost 8 billion trip-miles as computed from data in the 1972 National Travel Survey. Total vehicle miles by private automobiles in 1971 were almost 940 billion miles. Thus, even if all weekend trips in the 400-600 mile range were automobile trips, they would account for less than 1 percent of automobile vehicle miles and a similar percent of gasoline consumption by automobiles.

gasoline means a higher probability of suffering the monetary costs and discomforts associated with running out of gasoline. The increase in expected number of station stops means more time must be allocated to travel given distances.

Price Rationing Schemes

In addition to schemes designed to reduce gasoline consumption by non-market means (such as lowering speed limits or closing gasoline stations), a number of alternative schemes can, in principle, accomplish the desired reduction through the market mechanism. Some of these schemes involve coupons while others do not. In all of them, however, the price of gasoline plays a central role in allocating the available gasoline among competing users.

Because the price of gasoline at which consumers will use only as much as is being produced (called, for convenience, the equilibrium price) is central to all of the schemes discussed in this chapter, it may be worthwhile to consider here its role in general. This role is most clearly defined for the schemes that do not involve coupons. Each of these schemes involves a rise in the price of gasoline sufficient to reduce consumption to the mandated level of gasoline production. In the first two schemes, the price is allowed to find the market-clearing level by the free play of market forces. That is, as long as consumers are demanding more gasoline than is being produced, there will be upward pressure on gasoline prices. When consumers are buying as much as they want at the new, higher prices, prices will stabilize at that level. In the third scheme, an excise tax accounts for much if not all of the increase in price needed to ration demand.

These non-coupon schemes use the price of gasoline explicitly to allocate the scarce supplies of gasoline among the many consumers. Those who want the gasoline most badly -- and are able to buy it -- will be able to buy it, while others may make fewer trips, car pool, or drive shorter distances to save on gasoline expenses.

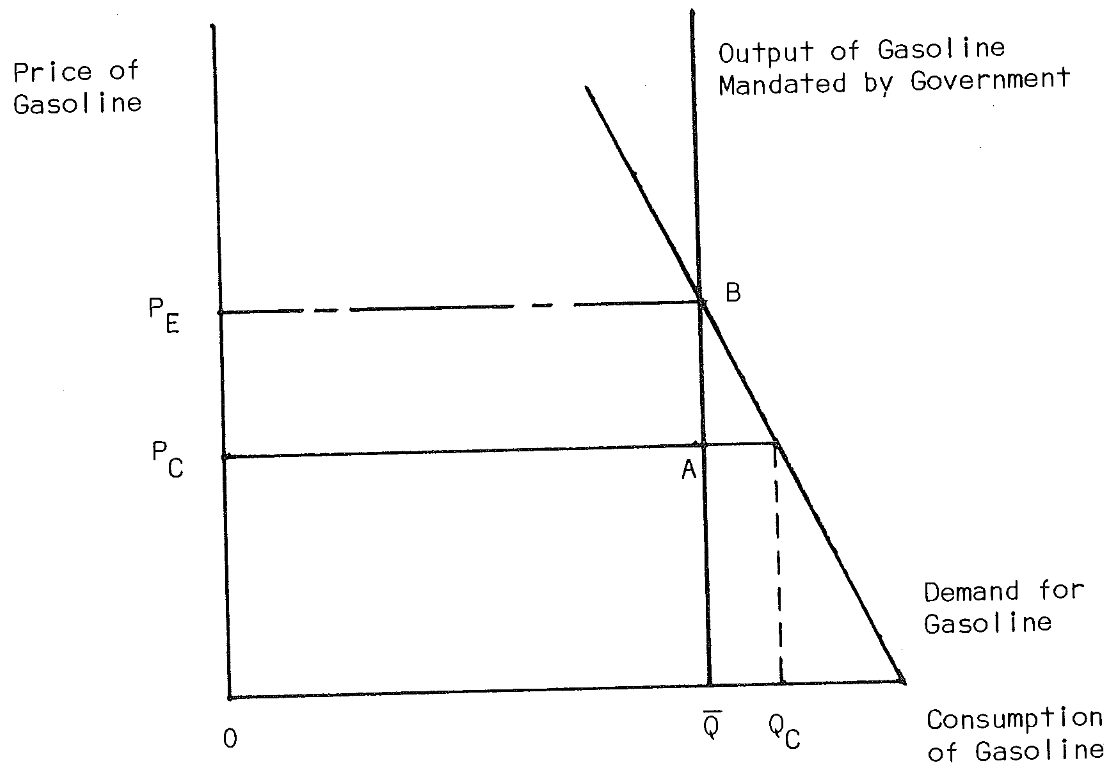
The essential properties of price rationing schemes can be seen with the aid of Figure 1-1 which portrays a simplified supply and demand situation in the market for gasoline. It is helpful for the moment to ignore the variety of uses and users of gasoline. The demand curve for gasoline -- that is, the amount that consumers would want to buy at each price can then be represented simply by the line DD in Figure 1-1. The current market situation is shown as a price of P_C and consumption (for simplicity assumed equal to production) of Q_C gallons.

If the government could completely control the availability of gasoline and if it decided that only $\bar{Q}$ gallons of gasoline should be produced, the price must rise to P_E before consumers would demand only as much gasoline as was being produced.[1] The resulting increase in revenues, shown here as the rectangle ABP_EP_C, is the total amount of additional money that will be spent buying $\bar{Q}$ gallons of gasoline at P_E instead of P_C. These revenues can be distributed to various groups -- tax-payers (via a reduction in tax rates to compensate for an excise tax of $P_E - P_C$), the oil industry

[1]The assumption that the government can completely control the availability of gasoline permits the supply curve for gasoline to be depicted as a vertical line in Figure 1-1. In practice, the quantity of gasoline that will be supplied increases as the price increases. This is true even if availability from U.S. refineries is fixed because at some price foreign refineries would find shipping to the U.S. profitable.

FIGURE 1-1

SCHEMATIC OF THE EFFECT OF CONSTRAINING 1974 GASOLINE CONSUMPTION TO $\overline{Q}$, WHEN, AT PRICE P_C, Q_C GALLONS WOULD BE CONSUMED



(if the free market price is allowed to rise), or gasoline users themselves (if a mandatory coupon scheme is implemented). How this rectangle is sliced up is an issue of income distribution discussed later in this chapter.

Coupon schemes which provide for the legal exchange of coupons achieve essentially the same results. There are costs of administering coupon schemes and problems of deciding on what basis and to whom coupons are to be allotted. Nevertheless, except for an allowance for costs involved in buying and selling coupons, the value of a coupon will be equal to the difference between the same market-clearing price as under the non-coupon schemes and the price at which coupon holders are entitled to purchase gasoline. This means that the marginal price of gasoline -- the price paid by those who buy more than their coupon allotment -- will be roughly the same as that which will clear the market under the non-coupon schemes. With a market price for coupons, the coupons initially issued to a consumer are just as valuable as those he might choose to buy in addition to his allotment. Consequently, every user of gasoline would, rationally at least, consider the price of gasoline to include the market price of a coupon as well as the price at the pump.

The important point here is that the effective price of gasoline is determined by the demand curve for gasoline and the quantity of gasoline available to be rationed. The effective price is not influenced by whether or not coupons are used or how coupons are distributed if they are used so long as the demand curve for gasoline and the amount available for rationing are given.[1]

Allowing for a variety of uses of gasoline does not alter the conclusion that the effective price in all price rationing schemes is determined by the overall market demand curve and the amount of gasoline available for rationing. This point can be seen with the aid of Figure 1-2, which differs from Figure 1-1 in that there are assumed to be two types of demand for gasoline. For simplicity assume there are some uses of gasoline, such as for trips to work or to hospitals, which are viewed as being essential in the sense that the quantity of gasoline used for these purposes is the same no matter what the price of gasoline.[2] The quantity demanded for essential uses is thus represented by the vertical line EE in Figure 1-2. As before P_C and Q_C represent the current price and total quantity of gasoline sold. Essential uses of gasoline account for Q_E gallons

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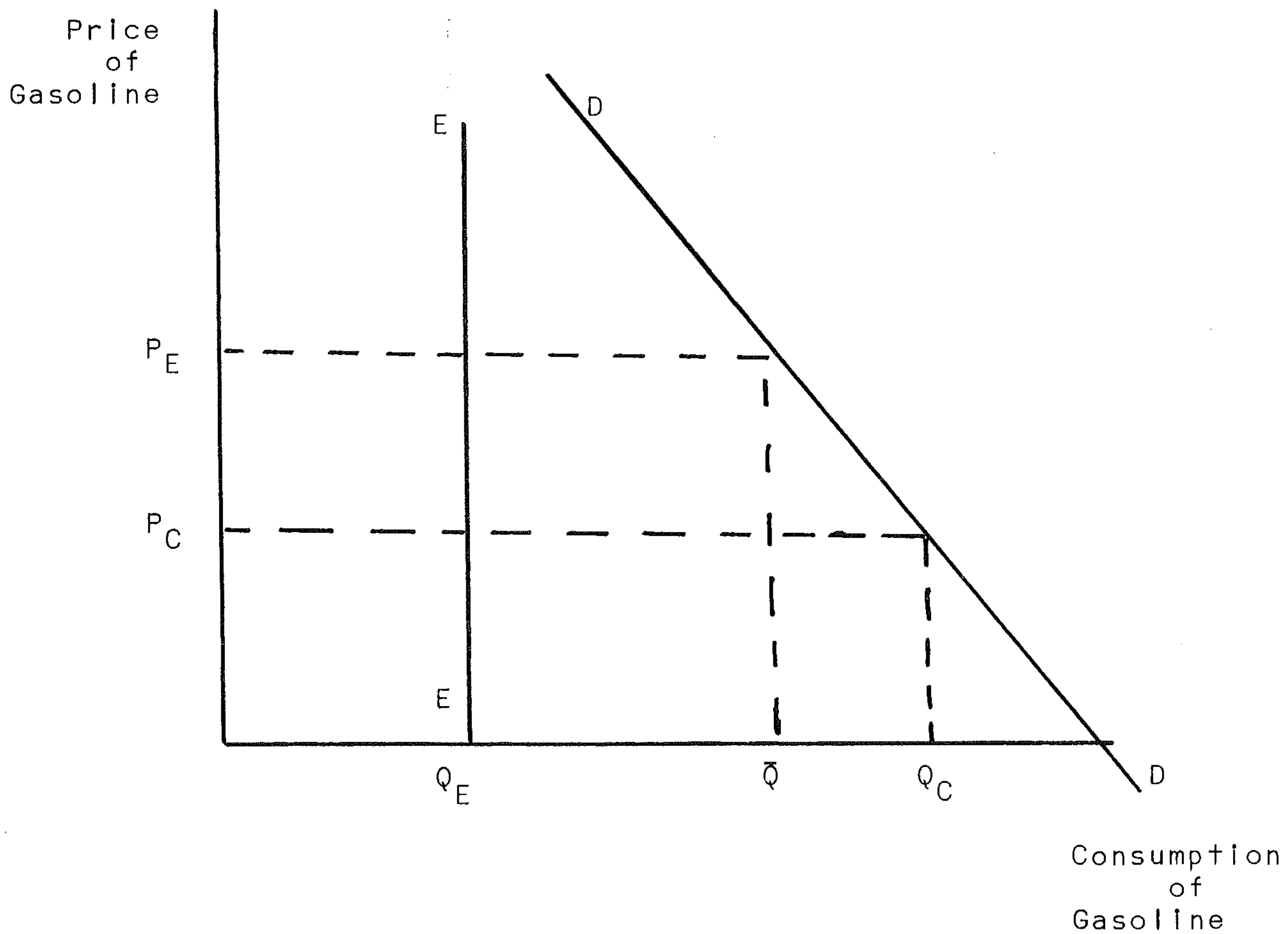
[1]This conclusion must be modified to the extent that there are reasons to expect the demand curve for gasoline to change as rationing schemes are introduced. For example, if a coupon rationing scheme were coupled with a campaign to encourage conservation of gasoline, the amount of gasoline consumers would want to buy at each price might be less than the amount they were willing to buy before the campaign. The effective market clearing price would then be lower in this scheme than the market clearing price under a policy of decontrolled gasoline prices with no campaign to urge gasoline conservation.

[2]This is obviously an extreme and unrealistic assumption since even if trips to work are essential there are usually ways of reducing the amount of gasoline used in making such trips, for example, by car pooling.

FIGURE 1-2
SCHEMATIC EFFECT OF RATIONING WHEN THERE ARE DIFFERENT TYPES OF GASOLINE DEMAND



while $Q_C - Q_E$ gallons are consumed in other uses, recreation trips for example.

Now, if the mandated level of gasoline production is $\bar{Q}$, consumption in essential uses will continue at Q_E gallons, and only $\bar{Q} - Q_E$ gallons will be available for other uses. The market price must rise so that the amount demanded for other uses is equal to the amount of gasoline available after essential needs have been met. In the figure the new market-clearing price is P_E, just as before. Even though consumers would be willing to pay a higher price than P_E for gasoline for essential uses, the price will not rise above P_E. If the price were to rise above P_E, the amount of gasoline demanded for other uses would be less than $\bar{Q} - Q_E$. Producers of gasoline would find that the quantity of gasoline sold was less than $\bar{Q}$. In order to sell their total output of $\bar{Q}$ gallons, price cannot be higher than P_E.

As before, if price were maintained at P_C and coupons permitting purchase of $\bar{Q}$ gallons in total were issued, the price of coupons would be $P_E - P_C$, ignoring transaction costs. Alternatively, the price might be allowed to rise while coupons were issued which permitted Q_E gallons to be purchased at price P_C. Once again, the market-clearing price would be P_E and the value of coupons would be $P_E - P_C$ per gallon, ignoring transaction costs. The price of coupons could not rise to a higher level for no one would be willing to pay more than $P_E - P_C$. Paying more than $P_E - P_C$ for coupons would mean paying more than P_E for gasoline. But no one will pay more than P_E if gasoline can be purchased for P_E and the price must be P_E in order that the quantity of gasoline demanded equals $\bar{Q}$, the quantity supplied.

One other underlying issue should be mentioned here. In normal competitive markets, a rise in the market price of gasoline would tend to discourage consumption and encourage production of gasoline at the same time. In the current energy situation, however, it appears that output of gasoline will be determined by a federal agency. For the purposes of this study, therefore, it is assumed that, for the period these schemes might be in effect, gasoline production will be at levels fixed by the government. The current proposal limits gasoline production to 95 percent of output in the corresponding month of 1972. This implies roughly a 15 percent decrease in the amount of gasoline that would have been consumed in 1974 if the gasoline were available at current prices.

Under all of the schemes, then -- coupon and non-coupon alike -- there is an effective price, above the current market price, that rations the available gasoline among consumers. The schemes differ, however, as to who receives the difference between the new market-clearing price and the previous price. The rest of this section explores the income distribution effects for New England of the different schemes and also indicates the administrative costs and difficulties associated with each scheme.

Schemes That Do Not Use Coupons

We consider three different schemes -- simple decontrol of gasoline prices, that is, allowing them to be raised until consumption is reduced to the mandated production level; simple decontrol coupled with an excess profits tax that would apply to oil companies; and imposition of an excise tax sufficiently large that, added to current prices, the new tax-inclusive price would be high enough to reduce gasoline consumption to the mandated production level. It would be desirable for this last-named policy to be coupled with an appropriate reduction in the personal income tax to offset the additional tax payments.

Simple Decontrol

This plan is the simplest to implement and administer. With gasoline output fixed at 95 percent of 1972 consumption, the price ceiling on gasoline would be removed and the price of gasoline allowed to rise until the amount demanded by consumers of gasoline equaled production.[1]

It is possible to estimate how high a price would reduce consumption to the available supply, by use of the elasticities of demand reported in the technical appendix to this study. The size of this price increase, as discussed above, is central to all five of the schemes considered in this chapter.

The price elasticity of demand (including both automobiles and trucks) is estimated to range between -0.275 and -0.80. The price increase that would clear the market under the assumption of relatively inelastic demand would be between $0.25 and $0.28 per gallon, depending on the growth in gasoline use that would have occurred in 1974 if the gasoline had been available at current prices.[2] The price

[1]The figure 95 percent of 1972 production is the amount mentioned officially, so we will use it in this report. If the actual output is above or below this figure, however, the equilibrium price rise will be less or more than that estimated here.

[2]The details of these calculations are shown in the technical appendix, along with the assumptions about the base price of gasoline in effect currently.

increase implied by the assumption of relatively elastic demand would range between $0.08 and $0.10 per gallon.

These estimates of the increase in the equilibrium price can be used to estimate how much more New England consumers of gasoline would have to spend for their total purchases of gasoline in 1974 if the plan of simple decontrol were put into effect. Table 1-2 shows estimates of the additional payments, by state and by vehicle class, for the different assumptions about the price elasticity of demand and the magnitude of the short-fall in supply.

Table 1-2 shows that the additional payments for gasoline in 1974, if demand is inelastic, are estimated to range between $1.2 and $1.4 billion. If demand is elastic (which is the case when automobile users can easily reduce the distances traveled and increase average car occupancy and gasoline mileage), the additional costs are estimated to range between $0.4 and $0.5 billion. The costs in individual states in New England are proportional to estimated gasoline consumption in those states. As a result, the estimated costs are highest for Massachusetts and Connecticut, lowest for Rhode Island and Vermont.

These sums would, under the scheme of simple decontrol, be paid by consumers to the oil industry.[1] It is far too

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[1]The profits, as distinct from the revenues, of this industry would, other things equal, increase by at least as much as these revenues. If the cost of producing an additional gallon of gasoline is constant over the range of output in question, profits will rise by the amount of additional revenues. If additional costs of producing gasoline at 1973 levels are higher than at the reduced levels being considered, profits will increase even more. It should be noted that the figures discussed refer only to New England. For the country as a whole they would be much greater.

TABLE 1-2
INCREASE IN ANNUAL EXPENDITURES DUE TO HIGHER COSTS OF GASOLINE[1]
(Millions of Dollars)

	Desired 1974 Consumption 10 Percent Higher Than 1972 Actual Consumption Assuming Price Rises by $0.25			Desired 1974 Consumption 15 Percent Higher Than 1972 Actual Consumption Assuming Price Rises by $0.28		
	Autos	Trucks	Total	Autos	Trucks	Total
Connecticut	240.5	72.5	312.9	265.6	84.8	350.5
Maine	93.1	28.1	121.2	102.9	32.9	135.7
Massachusetts	416.4	125.5	541.9	460.0	146.9	606.9
New Hampshire	69.9	21.1	91.0	77.3	24.7	101.9
Rhode Island	67.8	20.4	88.2	74.9	23.9	98.8
Vermont	44.1	13.3	57.3	48.6	15.6	64.2
New England Total	931.8	280.8	1,212.6	1,029.3	328.8	1,358.1
	Assuming Price Rises by $0.08			Assuming Price Rises by $0.10		
Connecticut	77.0	23.2	100.1	94.9	30.3	125.2
Maine	29.8	9.0	38.8	36.7	11.7	48.5
Massachusetts	133.3	40.2	173.4	164.3	52.5	216.8
New Hampshire	22.4	6.7	29.1	27.6	8.8	36.4
Rhode Island	21.7	6.5	28.2	26.7	8.5	35.3
Vermont	14.1	4.2	118.3	17.4	5.6	22.9
New England Total	298.2	89.9	388.0	367.6	117.4	485.0

[1]The increase in expenditures is equal to the increase in the price of gasoline multiplied by the quantity of gasoline bought at the higher price. It does not take into account the "savings" from buying fewer gallons than would have been bought at the pre-shortage price. The costs are annual costs for 1974.

complicated here, and not of particular use for the present purposes, to estimate how these additional revenues would be divided among gasoline station franchise holders, refiners and producers, although it seems probable that most of the revenues would accrue to the major integrated oil companies. This scheme would, therefore, redistribute income from gasoline users to the oil industry (and, eventually, to the individuals who own equity in the companies in that industry).

This plan, of course, involves essentially no administrative costs or difficulties, either at the state or federal level. The only action required is lifting of price controls on gasoline, coupled with the mandated production levels.

Decontrol with an Excess Profits Tax

This plan, from the point of view of the states, is equally simple, as it is merely the preceding plan coupled with an excess profits tax on the oil companies, administered by the federal government. There are, of course, difficulties in structuring and implementing such a tax in ways which do not provide incentives for producers to be wasteful or inefficient.

The income distribution aspects of this scheme are also very similar to those of the simple decontrol scheme. The amounts paid by gasoline users would be exactly the same as in Table 1-2. If the excess profits tax were correctly designed, however, the federal government, rather than the oil industry, would garner the excess amounts. The federal government might therefore lower the personal income tax rates, for example, to redistribute the revenues from the excess profits tax to taxpayers in general.

A Substantial Increase in the Federal Excise Tax

The two schemes just discussed assume that free market forces are allowed to push the price of gasoline up to the point where consumers want to buy only as much as is being produced. The price could also reach this level if the federal excise tax on gasoline were increased by the necessary amount. It might, of course, be difficult to determine the amount of the increase, as the rough calculations made in this report range between $0.08 and $0.28 per gallon. In principle, however, a tax equal to the difference between P_E and P_C in Figure 1-1 would accomplish the same reduction in demand.[1]

Such a plan would generate tax revenues from consumers in the New England states in the amounts shown in Table 1-2. These tax revenues, cumulated for the United States, might be on the order of $7 to $25 billion, depending on the elasticity of demand and the size of the shortage. Such revenues would, unless offset by reductions in other taxes (such as the personal income tax), tend to cause a substantial fall in employment and national income. If offset by a reduction in the personal income tax rate, however, the increase in disposable income might cause the equilibrium price of gasoline to rise above P_E, necessitating a further increase in the gasoline excise tax.[2] These sorts of

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[1]If the (unconstrained) supply curve of gasoline is not horizontal but rising between Q and Q_C, then the excise tax would need to be even greater to allow for the reduction in cost below P_C.

[2]Domencich, Kraft, and Valette found, for example, that the number of work auto trips increases as income increases, and the elasticity of auto shopping trips with respect to median income is about 0.30. (T.A. Domencich, G. Kraft, and J.P. Valette, "Estimation of Urban Passenger Travel Behavior: An Economic Demand Model," *Highway Research Record*, Number 238, 1968, pp. 76-77). Even aside from the income effects of gasoline price changes, therefore, changes in national income might well change the equilibrium price.

difficulties can be resolved in principle. However, there are formidable obstacles to determining the market-clearing price in practice if the tax level cannot be readily adjusted to changes in market conditions.

This scheme would be easy to administer, as the mechanism for collecting a federal excise tax on gasoline is already in existence, and the redistribution of income from consumers of gasoline to taxpayers in general is reasonably equitable. The difficulties lie primarily in estimating a level of the excise tax that would at least approximate the increase in price required to clear the market.

Coupon Schemes

Some General Considerations

The coupon schemes examined in this section share two important characteristics. First, it is assumed that coupons are legally transferable. Permitting coupons to be bought and sold is an essential feature of the schemes, for it, in effect, allows the price system to allocate the available gasoline to the users who are most willing to pay for it. The essential role of coupons is thus, as a device for dealing with the income distribution effects of the non-coupon schemes discussed in the previous section. For instance, distributing coupons that enable the bearer to purchase gasoline at a price below the equilibrium price means that the transfers of income (implicit or explicit) occur between the holders of coupons and the consumers of gasoline.

Second, it is assumed that coupons do not expire. This provision is necessary to ensure that people do not alter their consumption patterns merely because the coupons will no longer be valid. It also permits consumers to fit their consumption patterns over time to their own preferences.

If, for example, a family wishes to save up its coupons over the course of a year in order to avoid uncertainty about what the market price of coupons will be when it wishes to go on its summer vacation by automobile, the non-expirability feature permits it to do so.

There are a number of practical drawbacks to coupon rationing schemes. First is the problem of printing and policing the coupons. Since coupons would have a market value (estimated to be between $0.08 and $0.28 per gallon), there would be an incentive for counterfeiting. Second, a distribution network would have to be established, with provisions to ensure that people who were entitled to receive coupons were able to get their allotment and no more. Third, since the coupons would be legally transferable, there would have to be a means of ensuring that, once used to buy gasoline, they could not be re-used. (This difficulty could be surmounted by requiring gasoline stations to turn in coupons corresponding to their sales, but the point is that still another agency would be needed to collect and audit the cancelled coupons.) Fourth, there would need to be a market for the coupons; that is, some institution that could efficiently handle the exchange of coupons. Fifth, it would be necessary to decide how the coupons should be allocated. Should they be allocated on a per-vehicle basis or on a per-driver basis? If the latter, what treatment should be accorded drivers who become licensed after the initial distribution of coupons has been decided upon? Should coupon rights be transferable by bequest? These questions may seem frivolous, but they illustrate the numerous kinds of questions that might arise. A more serious question concerns the allocation of coupons between automobile operators and truck operators. Since many trucks are used both for personal transportation and for business purposes, the practical problems of apportioning coupons seem very difficult.

No doubt, all of the above questions can, with considerable effort, ingenuity and a spirit of cooperation, be resolved, but they suggest that the administrative costs and problems associated with coupon schemes are much more severe than with non-coupon schemes.

It is difficult to know with any certainty just what the administrative costs of a coupon rationing scheme would be. The coupon rationing scheme presently under consideration by the Federal government has been estimated to have an annual cost of at least $1.5 billion. This is roughly equivalent to a surcharge of $0.015 to $0.02 per gallon or, on another basis, an annual cost of between $12 and $13 per licensed driver per year. The current proposal is to cover the administration costs of the scheme by charging each licensed driver $1 for each monthly coupon allotment. However, to the extent that a coupon rationing scheme imposes administrative burdens on state governments, the simplest way to cover the administrative costs would be an increase in state gasoline taxes. Thus, for example, if administrative costs amounted to $0.015 per gallon, the state gasoline tax would be increased by that amount. Such an increase in taxes increases the price of gasoline at the pump by an equivalent amount and would <u>decrease</u> the value of ration coupons by the same amount per gallon.

In addition to administrative costs associated with distributing coupons and policing their use, costs will be incurred in order to set up and operate facilities for exchanging coupons. Markets for buying and selling coupons will not arise and function smoothly without some individuals or agencies undertaking what amounts to a brokerage function, that is, standing ready to buy or sell coupons. It is obviously impossible to predict the costs of organizing and operating a system of coupon exchanges and hence what the costs of coupon transactions will be. However, it is perhaps worth noting in this context the costs of transactions for exchanges with some similarities to coupon exchanges.

At one extreme, transactions costs may be independent of the size of the transaction. An example of such a transaction is the purchase of postal money orders for which the current charge is $0.25 per order. At the other extreme, charges for transactions are often a simple percentage of the value of the transaction. Examples of such charges are the 1 percent service charge for American Express Travellers checks and the 2 to 3 percent service charge to buy or sell small quantities of foreign currencies at commercial banks. Intermediate between these extremes are instances where the transaction charges are a flat fee plus a percentage of the value of the transaction.

Although it is difficult to estimate the administrative and transactions costs of a coupon rationing scheme, the foregoing considerations suggest the costs could be substantial and much greater than the costs of non-coupon schemes. This in turn suggests that if rationing is expected to be required only for a short period of time, the costs of mounting the necessary administrative machinery may detract seriously from the benefits of coupon rationing relative to alternative schemes. On the other hand, if it is expected that rationing will be necessary for an extended period of time, say substantially more than a year, then the benefits of coupon rationing may well be worth its administrative burden.

A Partial Coupon Scheme

One approach is to issue a total number of coupons sufficient to permit "essential" trips to be made. Gasoline in excess of this amount would be bought at the equilibrium price (as discussed above, this price might range between $0.56 and $0.73 per gallon in New England). This scheme has all the drawbacks of coupon schemes discussed above. One possible advantage is that, if the number of licensed drivers increased during the year, new drivers could receive coupons without the number of coupons exceeding the available supply of gasoline.

Suppose, for example, that it was decided to issue coupons in the amount of one-half the amount of gasoline that is to be produced. The equilibrium price would be the same as in all of the schemes (P_E in Figure 1-1), but one-half of the gasoline sales would take place at the price in effect before rationing (P_C in Figure 1-1). The oil industry would receive additional revenues that are only one-half those shown in Table 1-1, with the coupon holders sharing the other half among themselves.[1] As mentioned earlier, the main difference between this scheme and non-coupon schemes is that the gasoline users do not make as large transfers of money to the oil industry or (in the case of an excise tax) to the Treasury.

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[1]Suppose a coupon recipient uses exactly his allotment of coupons and neither buys nor sells coupons in the market. Then, in effect, he is still "sharing" (with himself) the value of those coupons. He is merely both the seller and the buyer, but the value of the coupons is what could be obtained for them in the coupon market.

A Full Coupon Scheme

Another scheme is tc issue as many coupons as gallons of gasoline available. To purchase a given quantity of gasoline, a customer would have to pay an equivalent number of coupons as well as the pump price (assumed here to be the price in effect at the time the rationing scheme is instituted). Coupons would still have a price -- the difference between the equilibrium price and the pump price -- but the proceeds from the sales would accrue to the seller of the coupons. In this way, the recipients of the coupons would be implicitly receiving the income shown in Table 1-1, which they would be free to spend on gasoline at the implicit equilibrium price. That is, since the value of a coupon would be between $0.08 and $0.28 per gallon, using a coupon would effectively cost as much as if it was bought on the open coupon market.

Under this scheme, then, the oil industry would receive none of the windfall revenues from the shortage of gasoline. That is, the pump price would remain unchanged, and the additional value of the scarce gasoline would be shared among the recipients of the coupon allotments. All of the difficulties of coupon schemes discussed above would, of course, still need to be resolved. The administrative costs of this scheme would probably be the greatest of the schemes considered here.

Chapter 2

CHARACTERISTICS OF WORK TRIPS IN NEW ENGLAND

In this chapter, we examine characteristics of the journey to work in New England. We find that the work trip length and the modal split between automobile and public transportation in New England are similar to that found in the United States as a whole. In addition, we provide some evidence from the U.S. Census and from a recent survey by the U.S. Department of Transportation which indicates that automobile ownership and the frequency of using an automobile to commute increase with the level of personal income.

Choice of Mode and Length of Travel

Commuting by automobile is the most common method of getting to work in the United States. According to the 1970 United States Census, 77.7 percent of commuters were either drivers or automobile passengers. In the New England states, 78.4 percent commuted by automobile. Table 2-1 shows the percentage of automobile commuters and drivers in the United States and in the six New England states.

Table 2-1

MEANS OF TRANSPORTATION TO WORK:
NEW ENGLAND STATES COMPARED TO U.S.

Area	Percent Drivers	Percent Passengers	Total Percent Auto Commuters
UNITED STATES	66.0	11.7	77.7
NEW ENGLAND	65.1	13.3	78.4
MAINE	64.4	15.0	79.4
NEW HAMPSHIRE	67.1	15.4	82.5
VERMONT	61.8	15.2	77.0
MASSACHUSETTS	62.1	12.9	75.0
RHODE ISLAND	67.2	14.6	81.8
CONNECTICUT	70.2	12.3	82.5

SOURCE: U.S. Department of Commerce, Bureau of the Census, *1970 Census of Population - General Social and Economic Characteristics - United States Summary*

In general, auto commuters in the United States travelled longer distances than commuters using public transportation (9.4 miles for auto, 8.7 miles for bus and streetcar). However, Tables 2-2 and 2-3 reveal a wide distribution in length of trip. The average auto-trip length is 9.3 miles in S.M.S.A.'s and 9.4 miles in the entire United States. However, roughly 10 percent of the trips are over 20 miles in one direction, while 17 percent of the total trips are less than 1 mile. The wide variation in commuting distances means there would be similar variations in the impact of gasoline rationing among individuals.

Although it is desirable to know the distribution of work trip distances for New England, the requisite data are unavailable. Unfortunately, the Department of Transportation Survey is based upon too small a sample to allow valid tables to be published on a regional level. The U.S. Census, which has much regional data did not determine distances travelled to work. Crude origin-destination matrices of work trips from Census data were examined in preparing this report. However, the origin and destination areas are generally too large, e.g. counties, to permit reasonable estimates of average distances travelled. We have isolated some examples of what must be very long or very short trips and these are discussed further below.

Two factors might make New England average auto trip-lengths different from the national average. First, it is

Table 2-2

PERCENT OF PRIVATE AUTOMOBILE, TAXI AND
MOTORCYCLE TRIPS BY LENGTH OF TRIP IN VARIOUS SIZED S.M.S.A.'s

	SMSA Population Groups						
One Way Home to Work Length Miles	Under 250,000	250,000 -499,999	500,000 -999,999	1,000,000 -1,999,999	2,000,000 -2,999,999	Over 3 mill	All SMSA's
Less than 1/2	3.1	2.3	2.2	3.1	0.6	1.2	2.1
1	9.3	8.1	11.9	4.1	7.5	7.8	8.1
2	11.9	14.1	10.6	6.7	4.9	8.2	9.5
3	11.9	7.9	10.8	10.6	7.6	6.0	9.1
4	9.7	8.6	3.8	5.3	6.4	7.8	6.9
5	9.5	10.8	10.3	10.1	12.2	10.6	10.5
6	5.4	4.2	6.6	3.7	3.3	5.2	4.8
7	5.4	5.2	4.3	6.1	6.0	5.3	5.4
85	5.1	6.1	3.9	4.3	7.2	4.7	5.1
9	4.1	3.0	1.6	2.0	1.7	1.8	2.5
10	5.3	6.0	10.1	10.4	8.5	8.0	8.2
11	1.1	0.5	1.6	1.6	3.3	1.4	1.5
12	2.5	4.8	4.0	4.9	2.9	5.0	4.1
13	0.4	0.7	1.1	3.7	1.9	1.2	1.5
14	0.6	1.2	1.1	2.1	2.3	1.6	1.5
15-19	6.0	8.8	6.5	11.5	9.3	9.9	8.7
20-24	4.3	1.7	5.7	5.3	5.2	7.0	5.0
25+	3.5	6.0	3.7	3.6	8.5	6.9	5.3
Unknown	0.9	0.0	0.2	0.0	0.7	0.4	0.2
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Median Trip Length	6	5	6	8	8	7	6
Average Trip Length	7.4	10.1	8.1	8.4	9.7	11.3	9.3

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study - Home to Work Trips and Travel.*

Table 2-3

PERCENT OF HOME TO WORK AUTOMOBILE TRIPS
BY TRIP LENGTH AND PLACE OF RESIDENCE

One Way Trip Length In Miles	Un-incorporated Areas	Incorporated Places: Under 5,000	Incorporated Places: 5,000-24,999	Incorporated Places: 25,000-49,000	Incorporated Places: 50,000-99,999	Incorporated Places: 100,000-999,999	Incorporated Places: Over 1 Mill	Incorporated Places: All Incorporated	All Areas And Places
Less than 1/2	3.3	17.3	6.4	4.6	4.1	4.0	5.6	6.6	5.5
1	7.7	18.2	16.5	14.4	12.3	9.1	9.3	13.5	11.5
2	9.6	7.9	12.9	12.1	12.3	8.9	8.0	10.7	10.3
3	7.7	7.7	8.1	14.3	15.9	13.9	6.2	10.6	9.7
4	5.8	3.0	5.0	9.5	9.1	8.5	5.5	6.6	6.4
5	8.0	5.1	7.7	8.5	0.4	13.3	9.3	9.2	8.8
6-10	22.7	13.0	17.6	14.4	19.5	23.4	26.2	19.3	20.4
11-15	13.5	9.5	10.9	10.3	7.3	9.2	10.3	9.8	11.1
16-20	8.6	7.1	7.2	3.3	2.4	6.1	7.1	6.0	6.8
21 and over	15.1	11.2	7.7	8.6	7.7	4.4	12.5	7.7	9.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Average Trip Length	11.0	8.4	8.2	8.6	8.0	7.8	13.2	8.6	9.4
Distribution of Trips	33.9	7.6	21.6	6.5	7.7	16.3	6.5	66.1	100.0

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Survey - Home to Work Trips and Travel.*

possible that commuting patterns are different in similar-sized S.M.S.A's in New England from the rest of the country. Second, it is possible that the distribution of the population in New England among different sized metropolitan areas, and between people within and outside of S.M.S.A's is different from that in the United States as a whole. Making allowances for differences of this second kind, we have estimated the average length of work-trip in New England to be 8.9 miles.[1] This turns out to be 5 percent lower than the national average and results from two factors: (1) more New Englanders live in S.M.S.A's, where the average commuting trip is shorter, and (2) there are no S.M.S.A's over size 3 million in New England. (The average trip length in the largest S.M.S.A. class is 11.3 miles.)

An attempt was made to examine lengths of trips in New England by studying matrices of auto passenger-trips by origin and destination where the points of origin were cities of 50,000 or more in each of the seven New England S.M.S.A's with

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[1]To derive the estimate we assumed that average trip length was determined by the size and S.M.S.A.-non-S.M.S.A. status of a population center. Using the average trip length data in Table 2-2 by size of S.M.S.A. we computed a weighted average of average trip lengths in New England S.M.S.A's with the weights being the proportion of metropolitan area population in different sized S.M.S.A's in New England. This gave an estimated average trip length of 8.66 miles for New England S.M.S.A's. We then used the fact that 68.61 percent of the U.S. population is in S.M.S.A's along with average trip-length data for all S.M.S.A. commuters and for all commuters in Tables 2-2 and 2-3 to compute an average work-trip length of 9.62 miles for all U.S. commuters not in S.M.S.A's. Assuming that non-S.M.S.A. commuters travel the same distance in New England as elsewhere, and using the fact that 72.13 percent of New England residents live in S.M.S.A's, we computed a weighted average of non-S.M.S.A. and S.M.S.A. commuters in New England to arrive at a final estimated average trip-length of 8.93 miles.

population over 250,000. The percent distribution of those auto trips by destination category for each city of origin were computed, but the origin and destination zones in general are too large to make meaningful estimates of trip-length between them. However, some trips, for example, from Lynn to Quincy, are obviously long distances. Table 2-4 shows some characteristics of trips which are known to be at least 17 miles in length. The number of these known trips is small and almost all of them are made by auto. The majority of trips over 17 miles cannot be isolated because of the size of zones given in the data. Table 2-5 also shows that trips within a city are less likely to be made by auto. The income distribution implications of Table 2-5 are discussed below.

Income Distribution and Work Trips

Commuting by auto is the most common single way of getting to work for Americans in all income classes. However, Table 2-6 shows that the percentage of commuters using an automobile, either as driver or passenger, increases with income level. It is also worth noting that the average number of commuters per automobile falls from 1.79 in the lowest income class to 1.28 in the highest income class. The cost-savings from car pooling are apparently less important relative to the convenience of driving alone for higher income individuals.

Table 2-7 shows that automobile ownership is greater among high income families. While the majority of families in all income classes except the lowest own at least one car, multiple car ownership, especially three or more, increases sharply with level of family income. It is easy to see from Table 2-7 that car ownership does not rise proportionately with the level of income, e.g. families with incomes of $10,000-

Table 2-4

LONG DISTANCE COMMUTES IN LARGE NEW ENGLAND S.M.S.A.'s
(17 miles or more - one way)

Origin-Destination	Number of Commuters	Number of Auto Commuters	Percent Auto Commuters	Median Income	Median Income (Males)
Lynn-Newton	66	60	90.9	N.A.	N.A.
Lynn-Quincy	54	54	100.0	N.A.	N.A.
Newton-Lynn	68	68	100.0	N.A.	N.A.
Quincy-Lynn	69	63	91.3	N.A.	N.A.
Cambridge-Plymouth Co.	33	33	100.0	N.A.	N.A.
Malden-Plymouth Co.	8	8	100.0	N.A.	N.A.
Medford-Plymouth Co.	13	13	100.0	N.A.	N.A.
Somerville-Plymouth Co.	50	26	52.0	N.A.	N.A.
Plymouth Co.-Lynn	54	48	88.9	N.A.	N.A.
Plymouth Co.-Cambridge	764	659	86.3	11,917	12,872
Plymouth Co.-Malden	47	47	100.0	N.A.	N.A.
Plymouth Co.-Medford	37	30	81.1	N.A.	N.A.
Plymouth Co.-Somerville	39	39	100.0	N.A.	N.A.
ALL BOSTON SMSA	1,122,516	743,810	66.1	N.A.	8262

Continued on the next page.

Table 2-4 (Continued)

LONG DISTANCE COMMUTES IN LARGE NEW ENGLAND S.M.S.A.'s

(17 miles or more - one way)

Origin-Destination	Number of Commuters	Number of Auto Commuters	Percent Auto Commuters	Median Income	Median Income (Males)
Worcester Co.-Chicopee	5	5	100.0	N.A.	N.A.
Worcester Co.-Holyoke	16	16	100.0	N.A.	N.A.
Worcester Co.-Springfield	44	44	100.0	N.A.	N.A.
ALL SPRINGFIELD SMSA	209,815	173,876	82.9	N.A.	7834
Norfolk Co.(Mass)-Cranston	8	8	100.0	N.A.	N.A.
Norfolk Co.(Mass)-Warwick	3	3	100.0	N.A.	N.A.
Warwick-Norfolk Co.(Mass)	8	8	100.0	N.A.	N.A.
Cranston-Norfolk Co.(Mass)	17	17	100.0	N.A.	N.A.
ALL PROVIDENCE SMSA	374,636	311,663	83.1	N.A.	7290

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, *Journey to Work*.

Table 2-5

SHORT DISTANCE COMMUTES IN LARGE NEW ENGLAND S.M.S.A.'s

City of Origin	People Working in City of Origin: No. of Workers	No. of Auto Commuters	Percent of Auto Commuters	Median Income	Median Income (Males)	All Workers in City of Origin: No. of Workers	No. of Auto Commuters	Percent of Auto Commuters	Median Earnings (Males)
Lynn	19,051	12,579	66.03	5,236	7,065	35,669	25,802	72.34	7,363
Cambridge	22,074	7,958	36.05	4,622	5,739	46,090	19,320	41.92	6,369
Malden	7,406	3,973	53.65	4,750	7,283	23,420	15,252	65.12	7,829
Medford	5,658	3,324	58.75	4,735	7,128	26,476	17,283	65.28	8,122
Newton	11,274	7,073	62.74	4,817	7,920	38,429	28,764	74.85	10,545
Somerville	6,808	3,228	47.41	4,552	6,728	36,660	20,353	55.52	7,232
Waltham	13,624	9,871	72.45	5,439	7,436	26,216	20,232	77.17	7,850
Quincy	13,290	9,001	67.73	4,999	7,692	37,270	28,062	75.29	8,317
Boston	174,183	63,567	36.43	5,491	6,986	259,781	113,154	43.56	6,830
Worcester	55,140	39,445	63.72	5,514	7,630	70,892	50,838	71.71	7,423
Chicopee	12,826	10,172	79.31	4,806	6,121	28,062	23,704	84.47	7,601
Holyoke	10,593	7,317	69.07	5,080	6,920	19,059	14,468	75.91	7,234
Springfield	38,505	28,519	74.07	5,315	7,365	63,296	49,729	78.57	7,402
Warwick	11,328	9,900	87.39	4,885	7,324	34,198	31,114	90.98	8,031
Cranston	7,669	5,205	80.91	5,022	7,307	29,467	25,905	87.91	7,876
Pawtucket	14,429	11,116	77.04	4,512	6,355	32,393	27,158	83.84	6,875
Providence	4,614	4,092	88.69	6,110	7,790	72,738	51,888	71.34	6,236
Bridgeport	37,771	27,100	71.75	5,930	7,583	64,419	49,152	76.30	7,560
Hartford	33,382	16,861	50.51	5,539	6,981	66,514	38,869	58.44	6,890
New Haven	31,149	18,825	60.44	5,334	6,907	54,800	36,799	67.15	6,863
West Haven	5,406	4,159	76.93	5,679	7,975	22,743	19,200	84.42	8,212

SOURCES: U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, *Journey to Work*; U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, *General Social and Economic Characteristics*, Massachusetts and Connecticut.

Table 2-6

PERCENT OF WORKERS USING VARIOUS MODES OF TRANSPORTATION TO TRAVEL FROM HOME TO WORK BY INCOME CLASS

	Automobile							
Annual Income	Driver	Passenger	Commuters Per Auto	Total	Public Transportation	Public Transport and Auto	Walking	Other
Under $3,000	25.6	20.1	1.79	45.7	12.8	1.5	11.9	28.1
3,000-3,999	29.7	18.8	1.63	48.5	12.5	2.1	12.7	24.2
4,000-4,999	34.7	21.4	1.62	56.1	11.6	1.9	7.0	23.4
5,000-5,999	45.2	18.5	1.41	63.7	9.4	1.3	5.5	20.1
6,000-7,499	46.4	20.8	1.45	67.2	6.9	3.1	5.3	17.5
7,500-9,999	49.8	20.5	1.42	70.3	5.9	2.4	4.5	16.9
10,000-14,999	54.9	19.2	1.35	74.1	5.1	3.3	2.9	14.6
15,000 and Over	58.8	16.4	1.28	75.2	6.5	4.5	3.3	10.5
ALL	48.4	19.1	1.39	67.5	7.2	2.9	5.0	17.4

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Survey - Home to Work Trips and Travel.*

Table 2-7

AUTOMOBILE OWNERSHIP BY INCOME CLASS

Annual Household Income	Zero	One	Two	Three	At Least One	Average Number of Cars Per Household[1]
Under $3,000	63.1	33.6	3.3	0.0	36.9	0.402
3,000-3,999	34.8	56.5	8.4	0.3	65.2	0.742
4,000-4,999	25.0	62.3	11.3	1.4	75.0	0.891
5,000-5,999	16.8	64.7	16.5	2.0	83.2	1.037
6,000-7,499	13.0	57.8	25.6	3.6	87.0	1.198
7,500-9,999	5.9	59.2	30.8	4.1	94.1	1.331
10,000-14,999	2.8	44.0	46.0	7.2	97.2	1.576
15,000 and Over	1.2	27.4	55.2	16.2	98.8	1.864
ALL GROUPS	20.6	48.4	26.4	4.6	79.4	1.150

[1]Computed by assuming that households with three or more cars own three cars.

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Survey - Home to Work Trips and Travel*, August 1973.

$15,000 do not tend to own two-three times as many cars as families with incomes in the range of $4,000 - $6,000. Thus a coupon rationing scheme which divided total coupons equally among automobiles would provide a *proportionately* greater subsidy in relation to income to low-income automobile owners. Such a subsidy would create horizontal inequities within income classes, because, for example, two-car families would be receiving twice as large a subsidy as one-car families. Such a subsidy would also be an ineffective way of helping low-income families as the subsidy would be received only by automobile owners.

Table 2-8 shows that commuting time exhibits no systematic relationship with household income, except for a tendency for the highest income class to make slightly more very long trips.

In conclusion, the national data show that automobile ownership, the propensity to use autos for commuting, and the number of autos used per auto commuter rise with the level of income, but that all income groups spend about the same amount of time getting to work.

It is impossible to compare between local and national data directly on the relationship between commuting behavior and income. Published data from the U.S. Census of 1970 do not cross-classify the mode of commuting and the level of income, and give no direct information on distance (or time) of work trips. The only evidence on the relationship between mode of travel and income level can be found by examining the relationship between mode and income across cells in an origin-destination matrix. Table 2-9 presents the percent of commuters using auto and median earnings of workers for commuters in the Boston Metropolitan area residing in Lynn, the remainder of Essex county, and Cambridge. It shows for example, that for

Table 2-8

COMMUTING TIME BY HOUSEHOLD INCOME IN 1969 - 70

Annual Household Income	Home to Work Commuting Time in Minutes: 1-15	16-35	36-55	56 and over	Total	Average Time
Under $3,000	62.0	24.5	7.1	6.4	100.0	20
3,000-3,999	57.7	31.8	6.1	4.4	100.0	19
4,000-4,999	55.3	28.8	7.1	8.8	100.0	22
5,000-5,999	49.8	33.6	8.3	8.9	100.0	23
6,000-7,499	57.1	32.1	6.9	3.3	100.0	20
7,500-9,999	51.2	36.3	8.0	4.5	100.0	21
10,000-14,999	52.9	32.4	8.7	6.0	100.0	22
15,000 and Over	47.4	32.9	10.8	8.9	100.0	25
ALL GROUPS	52.4	33.1	8.4	6.0	100.0	22

SOURCE: U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Survey - Home to Work Trips and Travel*, August 1973.

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Table 2-9

INCOME DISTRIBUTION AND JOURNEY TO WORK

I. LYNN RESIDENTS

Destination	Number of Commuters	Number of Auto Commuters	Percent Using Auto	Median Earnings	Median Earnings (Males)
Lynn	19,051	12,579	66.97	5236	7065
Other Essex County	4,346	3,922	90.24	5614	7429
Cambridge	329	283	86.02	8042	8903
Malden	201	186	92.54	6449	7703
Waltham	162	155	95.68	9294	9691
Other Middlesex	1,671	1,622	97.07	7309	8286
Boston	4,035	2,696	66.82	6827	8612

II. OTHER ESSEX COUNTY RESIDENTS

Destination	Number of Commuters	Number of Auto Commuters	Percent Using Auto	Median Earnings	Median Earnings (Males)
Lynn	10,662	9,620	90.23	7650	9334
Other Essex Co.	52,670	42,013	79.77	5339	7847
Cambridge	1,402	1,294	92.30	11,211	12,376
Malden	830	738	88.92	7598	9610
Medford	380	365	96.05	9388	9772
Newton	248	219	88.31	8938	9977
Somerville	279	254	91.04	9567	10,057
Waltham	917	901	98.26	11,128	11,864

Table 2-9 (Continued)

INCOME DISTRIBUTION AND JOURNEY TO WORK

II. OTHER ESSEX COUNTY RESIDENTS - Continued

Destination	Number of Commuters	Number of Auto Commuters	Percent Using Auto	Median Earnings	Median Earnings (Males)
Other Middlesex	6,158	6,034	97.99	8956	10,536
Other Norfolk	580	546	94.14	11,098	11,644
Boston	12,817	9,995	77.98	9611	11,513
Other Suffolk	1,706	1,663	97.48	8679	10,516

III. Cambridge Residents

Destination	Number of Commuters	Number of Auto Commuters	Percent Using Auto	Median Earnings	Median Earnings (Males)
Cambridge	22,074	6,958	31.52	4622	5739
Newton	588	524	89.12	7086	7421
Somerville	762	412	54.07	5091	6896
Waltham	903	753	83.39	7514	8234
Other Middlesex	2,752	2,268	82.41	6913	8260
Other Norfolk	797	657	82.43	7090	8004
Boston	11,256	4,479	39.79	5750	7107
Other Suffolk	287	229	79.79	6623	7103

SOURCE: U.S. Census of Population, *Social and Economic Characteristics, Massachusetts*

Lynn to Lynn trips 66.97 percent use autos and median earnings of male workers is $7065, while for Lynn to Waltham trips 97.07 percent use automobiles and median earnings of male workers[1] is $9691. Closer examination of Table 2-9 indicates a positive relationship between median earnings and percent using automobiles.[2] The same positive relationship can be seen by examining the data in Table 2-5. It appears that the local relationship between income and percent using auto is qualitatively similar to the national relationship, although a more precise statement cannot be made in the absence of data from a sample of individuals.[3]

Finally Table 2-5 indicates that short distance commuters (who reside in the city in which they are employed) earn higher incomes, on the average, than all residents of the same city for some of the central cities (Boston, Worcester, Providence, Bridgeport, and New Haven) and lower incomes relative to all residents, in all the other cities. A probable

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[1]Male workers are shown in the table because median earnings of all workers is affected by the proportion of workers who are male by large differences in annual earnings of males and females.

[2]The correlation coefficient between percent using auto and median earnings of males is .44 for Lynn residents and .71 for Cambridge residents.

[3]If high income individuals in low income communities are heavy users of public transport in work trips, one might observe a low evidence of auto usage in low income cells even though there is no relationship between income of individuals and propensity to drive to work. There is no reason to believe, however, that this distortion is present in the Massachusetts data.

explanation of this phenomenon is that jobs in the central cities are, on the average, higher paying than jobs in surrounding cities. This may reflect a tendency for jobs in higher paying occupations, to be concentrated in central cities, a tendency for similar jobs in the central city to offer higher wages to compensate for commutation costs, or a tendency to compensate employers who live in the central city where rents per unit of housing quality are higher. Table 2-5 also shows that short-distance commuters in all the cities except Newton have lower median earnings than all workers in the Boston S.M.S.A. The short-distance commuters in Newton have lower median earnings than all *Newton* residents. The short-distance commuters have a lower percent of auto usage than all workers in the Boston S.M.S.A. in all cities except Waltham and Quincy, where short-distance commuters have a lower percentage of auto usage than all local residents.

Thus, the limited evidence points to a positive relationship between income and auto usage in work trips, and between income and distance commuted. Data for more precisely defined origin and destination zones, if available, would offer an opportunity for a much better test of this tentative conclusion.

Finally, we should note that the income effect of a rise in gasoline prices is not large for the average New England commuter. Assuming an average daily commute of 8.95 miles with 1.20 passengers per car, we have 7.46 miles worth of gasoline consumed by the representative commuter per day. Assuming an average mileage of 12 miles to the gallon, this is equivalent to 6.22 gallons per commuter per week. Using our estimated price increase range of 10¢ to 30¢ per gallon, we find that the weekly cost increase is between 62.2¢ and $1.87. Assuming 48 work weeks per year, this amounts to an annual increase of between $29.86 and $89.76. These numbers exaggerate the increase in annual cost, since they do not allow for the possibility of reducing costs by switching to public transport or by increasing the number of passengers per vehicle. The income effects will be large only for the 10 percent of the tail of the commuting distance distribution, which appears from the data to be mostly concentrated in the upper income classes.

Effect of Gasoline Price Increase on Work Trips

The rise in the relative price of gasoline under coupon rationing systems will reduce the number of commuting trips by automobile in the short-run by encouraging commuters to form car pools or to switch to public transportation. In the long-run, gasoline savings in commuting can be increased through a gradual shift of the stock of automobiles towards smaller cars with better gasoline mileage, and through technological change in the design of automobiles to economize on the use of gasoline. In addition, individuals can select residential locations closer to their places of work, although it is unlikely that gasoline price changes will be of sufficient magnitude to induce drastic changes in residential location patterns.

If we take the price elasticity of demand for gasoline in commuting uses to be -.247 as derived in the technical appendix, a 60 percent rise in the price of gasoline implies a reduction of almost 15 percent in the quantity of gasoline used for work trips. In the short-run with gasoline mileage of automobiles relatively fixed, a 15 percent reduction in gasoline consumed for work trips would imply a similar reduction in the number of vehicle miles travelled in commuting to work.[1] In the longer run, however, as the fuel economy of automobiles used for commuting improved, the number of vehicle miles travelled in commuting might begin to return to a higher level.

[1]There are, of course, means of improving gasoline mileage in the short-run, such as getting a tune-up, driving slower, and avoiding quick starts. For some multiple car families effective miles per gallon may be improved by using the more economical vehicle more intensively.

Chapter 3

COMMERCIAL TRANSPORTATION

This chapter examines the effect of alternative rationing schemes on intercity and intracity trucking. The first section describes the characteristics and uses of trucks registered in the New England states and presents information on the reliance of New England industries on motor freight[1]. The second section examines the impact of alternative rationing schemes on trucking costs and the third section identifies differential impacts of the rise in trucking costs associated with alternative rationing schemes.

Uses of Trucks in New England

Gasoline powered trucks account for approximately 20 percent of total gasoline consumption nationally. Such trucks account for 76 percent of total truck-miles logged by trucks registered in the New England states, the same proportion as for the country as a whole. Table 3-1 shows that the regional average is typical of the individual states.

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[1] The term "truck" is used here as in the Census of Transportation, Truck Inventory and Use Survey, that is, a property carrying motor vehicle used in public highways and streets.

TABLE 3-1

PERCENT TRUCK-MILE DISTRIBUTION BY MAJOR USE AND TYPE OF FUEL

Use	Mass.	R.I.	Conn.	Maine	N.H.	Vt.	All New England
Agriculture	3.5	4.2	8.4	9.2	8.1	10.8	6.3
Forestry and Lumbering	0.7	---	0.7	4.2	1.8	3.5	1.4
Mining	---	---	0.2	---	---	---	0.1
Construction	16.3	11.6	16.2	13.2	16.1	11.9	15.1
Manufacturing	5.5	3.9	5.8	3.1	2.4	3.5	4.7
Wholesale and Retail Trade	23.1	22.9	19.8	15.9	11.6	13.0	18.7
For Hire	16.7	23.3	10.6	10.4	14.9	11.2	14.5
Personal Transportation	19.3	18.1	22.8	29.9	32.5	28.4	23.3
Utilities	2.8	2.6	3.8	3.8	2.8	4.2	3.2
Services	9.6	11.6	9.9	7.1	7.7	11.7	9.4
All Other	2.3	1.6	2.0	2.9	1.8	1.7	2.2
Type of Fuel							
Gasoline	76.5	69.5	75.2	79.2	74.2	77.8	75.9
Diesel	18.9	26.6	16.8	15.4	19.2	18.0	18.6
Not Reported	4.6	3.9	8.1	5.4	6.6	4.3	5.6
	100	100	100	100	100	100	100

SOURCE: U. S. Census of Transportation, Truck Inventory and Use Survey, 1972.

Gasoline trucks are of particular importance for local transportation but they are also used extensively in short-range and long-range service[1]. Table 3-2 shows that over 90 percent of the trucks used for local transportation in each of the states are gasoline powered. Gasoline trucks account for over two-thirds of trucks in short-range service in every state and for over three-quarters in most states. While reliance upon gasoline trucks is lower in long-range service, in three states over one-half of long-range trucks are gasoline powered.

Personal transportation is a major use of trucks in all states. Table 3-1 shows that for the region as a whole about 23 percent of all truck-miles are logged by trucks used primarily for personal transportation. The use of trucks for personal transportation is greatest in the three northern states where over 28 percent of truck-miles are logged by trucks used mainly for personal transportation. The other major uses of trucks are in wholesale and retail trade, construction, and for hire trucking. When pickup and panel trucks are eliminated the distribution of trucks by type of use changes, as is shown by the figures in Table 3-3. The most pronounced change is the reduction in the percentage of truck-miles logged by trucks used mainly in personal transportation.

Additional insights into the role of trucking in New England are provided by examining the reliance of manufacturing industries on motor carriers. Tables 3-4 and 3-5 indicate that over 80 percent of shipments by

[1] See the note to Table 3-2 for definitions of local, short-range, and long-range service.

TABLE 3-2

GASOLINE-FUELED TRUCKS AS A PERCENTAGE OF ALL TRUCKS, BY RANGE OF OPERATION

State	Range of Operation			
	All Ranges	Local	Short Range	Long Range
Connecticut	87.7	93.3	72.7	59.8
Maine	90.3	96.2	87.8	43.7
Massachusetts	85.9	90.1	78.4	51.1
New Hampshire	86.7	95.0	80.7	57.8
Rhode Island	85.9	92.2	67.7	25.8
Vermont	89.5	95.4	83.3	21.8

SOURCE: 1972 Census of Transportation, "Truck Inventory and Use Surveys," Table 7, page 9.

NOTE: Local Service covers trucks used mostly in or around the city and suburbs, or within a short distance of the farm, factory, mine or place vehicle is stationed.

Short Range Service covers trucks used mostly over the road but usually not more than 200 miles one way to the most distant stop from the place vehicle is stationed.

Long Range Service covers trucks used mostly over the road usually more than 200 miles one way to the most distant stop from the place vehicle is stationed.

TABLE 3-3

PERCENT TRUCK-MILE DISTRIBUTION BY MAJOR USE, EXCLUDING PICKUPS AND PANELS

Major Use	Connecticut	Maine	Massachusetts	New Hampshire	Rhode Island	Vermont	All New England
Agriculture	13.0	10.5	2.4	5.5	3.5	13.3	6.7
Forestry and Lumbering	0.7	10.3	1.4	3.7	--	--	2.4
Mining	--	--	--	--	--	--	--
Construction	17.6	14.5	14.7	18.3	10.4	16.1	15.2
Manufacturing	8.5	5.2	7.8	5.1	5.2	6.6	7.1
Wholesale and Retail Trade	24.6	21.6	29.3	20.1	21.5	21.8	25.4
For Hire	21.2	23.2	32.6	38.5	44.7	27.0	30.2
Personal Transportation	2.6	1.8	1.3	--	--	2.8	1.5
Utilities	2.8	5.8	3.3	2.9	2.5	5.2	3.5
Services	5.9	5.2	4.5	5.9	9.5	7.1	5.6
All Other	3.1	1.8	2.6	--	2.7	--	2.3
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: 1972 Census of Transportation, "Truck Inventory and Use Surveys," Table 2, Page 2.

TABLE 3-4

DISTRIBUTION OF TONS SHIPPED BY INDUSTRY AND MEANS OF TRANSPORT FOR THE BOSTON PRODUCTION AREA[1] (1967)

INDUSTRY	Tons (000)	Rail (%)	Motor Carrier (%)	Private Truck (%)	Other (%)
Food & Kindred Products	11,561	9.9	66.1	21.5	2.5
Textiles	499	1.3	79.8	17.4	1.5
Apparel	48	-	74.5	14.4	11.1
Pulp, Paper, etc.	842	10.1	46.0	43.5	0.4
Chemicals	3,433	8.6	76.0	13.8	1.6
Rubber, etc.	278	7.6	76.1	10.0	7.3
Leather	112	1.2	83.4	1.6	14.0
Stone, Clay, etc.	779	16.3	61.9	21.7	0.1
Primary Metals	605	21.5	70.8	5.9	1.8
Fabricated Metals	375	5.8	73.7	19.3	2.2
Machinery	296	4.6	88.7	4.6	2.1
Electrical Equipment	351	17.5	77.3	2.5	2.7
Instruments	32	17.7	77.0	0.8	4.5
Misc.	161	30.0	61.6	2.0	6.4

SOURCE: U.S. Census of Transportation, 1967 Commodity Transportation Survey.

Note: [1] Consists of the SMSA's of Boston, Worcester, Providence, Brockton, Lawrence, and Lowell.

TABLE 3-5

Distribution of Tons Shipped by Industry and Means of Transport for the Hartford Production Area,[1] 1967

Industry	Tons (000s)	Rail %	Motor Carrier %	Private Truck %	Other %
Food & Kindred Products	4866	20.0	57.3	19.6	3.1
Basic Textiles	23	3.1	79.3	12.6	5.0
Pulp. paper, etc.	851	23.9	39.7	34.8	1.6
Chemicals	699	31.5	58.7	7.7	2.1
Rubber, etc.	327	28.6	68.1	2.1	11.2
Primary Metals	1011	20.6	65.1	12.9	3.4
Fabricated Metals	601	11.3	67.7	9.7	13.3
Machinery, except electrical	239	6.7	89.1	2.2	2.0
Electrical equipment	149	5.7	78.0	11.9	4.4
Transport equipment	58	11.6	77.1	3.9	7.4
Instruments, Photo, etc.	41	0.6	78.5	3.8	17.1
Miscellaneous	74	26.0	61.4	1.6	11.0

[1]Consists of the SMSA's of Hartford, New Britain, Meridan, Waterbury, New Haven, Bridgeport, Norwalk, Stanford, and Springfield.

most manufacturing industries in Eastern Massachusetts move by truck. Shipments from Central Connecticut are less likely to move by truck; for most industries, between 70 and 80 percent of shipments go by truck.

The data in Tables 3-6 and 3-7 provide indicators of the distances which products manufactured in New England travel to their destination. Forty-nine percent of shipments from Eastern Massachusetts but only 27 percent of shipments from Central Connecticut are to destinations in the New England region. Although there is considerable variation from industry to industry in the extent to which destinations are in the New England region, it is generally true that the preponderance of shipments are to destinations in the Northeast and Atlantic Coast regions.

Table 3-8 provides information on the points of origination of shipments of manufactured products into New England. The most striking feature of this table is the dominance of the flow from the West South Central region. This largely represents shipments of petroleum products which move primarily by barge from the Houston production area. Beyond the flows from the Houston area, the most important in the aggregate are those from the Middle Atlantic and East North Central regions.

TABLE 3-6

PERCENT DISTRIBUTION OF COMMODITIES SHIPPED FROM THE BOSTON PRODUCTION AREA

BY GEOGRAPHIC DIVISION OF DESTINATION: 1967

Commodity	Number	Percent Distribution by Geographic Division[1] of Destination									
		All means of trans-port	New Eng-land	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Moun-tain	Paci-fic[2]
TONS OF SHIPMENTS	(thousand of tons)										
Production area 01, total	11,561	100.0	49.0	17.7	7.6	1.1	18.2	2.1	1.4	0.3	2.6
Food and kindred products	1,709	100.0	60.1	25.4	4.7	.6	6.8	.3	.8	.1	1.2
Basic textiles	499	100.0	28.0	37.7	14.8	.6	12.3	3.1	1.4	.2	1.9
Apparel, including knit apparel, and other finished textile products	48	100.0	34.7	38.7	12.8	2.4	6.4	1.5	1.8	1.0	.7
Pulp, paper, and allied products	842	100.0	69.7	17.8	5.6	1.4	2.4	.5	.9	-	1.7
Chemicals and allied products	3,433	100.0	30.8	10.4	4.8	.3	48.0	4.3	.7	-	.7
Rubber and miscellaneous plastics products	278	100.0	29.0	28.2	20.9	4.3	7.5	1.8	2.2	.5	5.6
Leather and leather products	112	100.0	35.2	27.6	8.5	9.4	4.9	2.8	2.3	.7	8.6
Stone, clay, and glass products	779	100.0	70.1	17.3	8.6	.4	.9	.7	1.6	-	.4
Primary metal products	605	100.0	26.4	32.9	16.4	2.5	9.5	1.3	2.5	1.8	6.7
Fabricated metal products	375	100.0	35.7	15.9	12.7	2.1	10.8	3.8	9.9	1.8	7.3
Machinery, except electrical	296	100.0	22.5	29.8	12.0	4.7	15.9	4.5	4.9	1.1	4.6
Electrical machinery & equipment	351	100.0	7.9	12.3	39.0	4.4	7.2	1.6	1.8	1.8	24.0
Instruments, photographic goods, optical goods, watches, & clocks	32	100.0	12.2	34.9	11.5	2.5	17.4	.7	3.6	.9	16.3
Miscellaneous products of manu-facturing	161	100.0	10.0	29.9	14.2	4.6	9.0	8.2	7.2	1.0	15.9

TABLE 3-7

PERCENT DISTRIBUTION OF COMMODITIES SHIPPED FROM THE HARTFORD PRODUCTION AREA

BY GEOGRAPHIC DIVISION OF DESTINATION: 1967

Commodity	Number	Percent Distribution by Geographic Division[1] of Destination									
		All means of transport	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific[2]
TONS OF SHIPMENTS	(thousand of tons)										
Production area 02, total	4,866	100.0	27.4	33.6	15.5	4.4	7.8	3.2	3.7	0.4	4.0
Food and kindred products	353	100.0	34.3	56.6	3.8	-	3.8	.7	.8	-	-
Basic textiles	23	100.0	19.2	27.5	10.0	2.7	32.1	1.7	.9	1.3	4.6
Pulp, paper, and allied products	851	100.0	28.4	46.5	7.7	3.8	8.4	1.8	1.7	.1	1.6
Chemicals and allied products	699	100.0	28.8	34.4	12.2	1.7	8.4	5.2	3.6	.4	5.3
Rubber and miscellaneous plastics products	327	100.0	23.1	32.9	23.4	3.0	10.2	1.2	3.6	.2	2.4
Primary metal products	1,011	100.0	24.1	27.3	21.8	8.3	5.2	2.8	4.0	.1	6.4
Fabricated metal products	601	100.0	38.3	19.5	13.1	6.5	8.0	6.2	3.2	.6	4.6
Machinery, except electrical	239	100.0	20.2	24.3	23.0	5.8	12.4	2.3	5.6	1.3	5.1
Electrical machinery & equipment	149	100.0	5.8	33.6	22.9	4.6	9.1	8.8	4.3	2.1	8.8
Transportation equipment	58	100.0	21.8	27.4	10.5	3.8	25.1	-	3.7	.2	7.5
Instruments, photographic goods, optical goods, watches, & clocks	41	100.0	8.4	51.3	6.5	4.4	20.6	1.7	3.1	.4	3.6
Miscellaneous products of manufacturing	74	100.0	8.5	19.4	11.4	6.3	10.7	6.1	25.7	2.1	9.8

TABLE 3-8

PERCENT DISTRIBUTION OF INCOMING SHIPMENTS OF MANUFACTURED GOODS TO NEW ENGLAND FROM OTHER REGIONS IN 1967 BY COMMODITY

Commodity	TCC Code	Region	Middle Atlantic	South Atlantic	East North Central	West North Central	West South Central	Moun-tain	Paci-fic	Total
Food and kindred products	20		71.4	2.2	17.0	5.9	0.5	0.2	2.8	100.0
Basic textiles	22		100.0	-	-	-	-	-	-	100.0
Apparel, including knit apparel, and other finished textile products	23		96.1	2.4	1.6	0.1	-	-	-	100.0
Lumber and wood products, except furniture	24		-	-	2.3	-	-	-	97.7	100.0
Furniture and fixtures	25		47.1	-	51.8	-	-	-	1.1	100.0
Pulp, paper, and allied products	26		81.4	3.7	10.1	-	0.1	-	4.6	100.0
Chemicals and allied products	28		52.9	4.2	8.0	2.3	32.5	0.01	0.1	100.0
Petroleum and coal products	29		0.5	-	0.01	0.03	99.5	-	0.02	100.0
Rubber and miscellaneous plastic products	30		69.9	1.8	26.3	0.1	-	-	1.9	100.0
Leather and leather products	31		59.2	-	40.8	-	-	-	-	100.0
Stone, clay, and glass products	32		94.2	-	5.0	0.3	-	-	0.5	100.0
Primary metal products	33		75.9	-	20.6	1.6	1.4	-	0.5	100.0
Fabricated metal products	34		61.9	8.0	28.6	0.3	0.5	-	0.6	100.0
Machinery, except electrical	35		35.4	1.2	50.5	3.4	4.7	1.2	3.6	100.0

Table continued on following page

TABLE 3-8 (Continued)

PERCENT DISTRIBUTION OF INCOMING SHIPMENTS OF MANUFACTURED GOODS TO NEW ENGLAND FROM OTHER REGIONS IN 1967 BY COMMODITY

Commodity	TCC Code	Region	Middle Atlantic	South Atlantic	East North Central	West North Central	West South Central	Moun-tain	Paci-fic	Total
Electrical machinery and equipment	36		51.4	0.5	41.3	2.6	-	-	4.2	100.0
Transportation equipment	37		19.6	-	75.5	4.4	-	-	0.5	100.0
Instruments, photographic goods, optical goods, watches and clocks	38		68.0	-	28.7	-	-	-	3.3	100.0
Miscellaneous products of manufacturing	39		76.1	-	20.0	-	-	-	3.9	100.0
All manufactured goods			16.0	0.6	4.3	0.7	78.0	0.02	0.5	100.0

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The Effect of Rationing on Trucking and Motor Freight Costs

Both restriction rationing schemes and price rationing schemes lead to higher trucking costs. The impact of these higher costs depends in part on regulatory policy since a substantial portion of trucking is performed by regulated common carriers and regulated contract carriers. If regulatory policy does not permit higher costs to be reflected in higher rates or does not adjust to enable truckers to offset higher costs through more efficient operation, the response of the regulated portion of the industry to higher fuel costs is virtually impossible to predict. Rather than speculate on likely regulatory responses and industry reaction to them this analysis assumes that higher fuels costs will be reflected in higher trucking costs and higher rates for truck movements by regulated truckers.

As was discussed in the first chapter restriction systems, such as the present one, have two primary effects on trucking. First, lower speed limits induce fuel economies. Second, to the extent actual speeds are reduced, average trip times are increased and therefore the number of miles driven by a given truck fleet must fall unless driving times are increased sufficiently to offset the effect of slower speeds.

Analysis of existing data on fuel economy, truck usage and average speed suggest that lowering the speed limit might reduce fuel consumption by trucks by as much as 4 to 5 percent. This estimate assumes that the 55 mile per hour speed limit reduces the average speed of trucks on main rural roads from its recent level of 55 miles per hour to 50 miles per hour.[1] This speed reduction translates into a 10 percent increase in travel time for trucks on main rural roads. Since almost 50 percent of total truck miles are on main rural roads overall, running time of trucks would have to rise by 5 percent in order to maintain the existing level of truck miles. Increased hours of truck operation would be reflected primarily in higher labor costs. Labor costs would rise by 5 percent or more if cost per hour were greater for the additional hours. Considering both effects of the reduced speed limit, then, there is an estimated fuel cost saving of 4 to 5 percent to be weighed against at least a 5 percent increase in labor costs. The net effect will be an increase in costs per vehicle mile which depends upon the proportions of total cost accounted for by labor as opposed to fuel.

ICC statistics on common carrier truck operations indicate that costs of drivers and helpers varies from 26 to 34 percent of total cost depending upon the region of the country while fuel costs vary between 3 and 5 percent of truck operations.[2] These figures suggest that the net effect of lower speed limits might be to increase costs by from 1 to 1.5 percent for the country as a whole. For trucks operating mainly in New England, costs of drivers and helpers are 34 percent of the total, while fuel costs are 4 percent indicating an overall cost increase of 1.5 percent.

As noted in Chapter 1 the price of gasoline might rise by as much as 63 percent per gallon in the short-run if

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[1] For details of the estimation procedure see the technical appendix.

[2] These figures have been computed from ICC statistics for 1972 as reported in *Trinc's Blue Book of the Trucking Industry*, Trinc Associates, Washington, D.C., 1973, pp. S-1 and S-2.

market prices for gasoline were allowed to rise to clear the market. Taking the fuel costs to be from 5 to 10 percent of total cost the rise in gasoline price would translate into an increase in trucking costs of between 3 and 6 percent.

While this analysis suggests that allowing the price to rise will result in a larger increase in trucking costs, the result needs to be interpreted carefully. First, no allowance has been made for the higher inventory carrying costs associated with times under the speed limit reduction. In addition, if reduced speed limits and Sunday closings are not effective in equating supply and demand at current prices the resulting shortages may lead to further increases in trucking costs as trucks must wait longer at filling stations or stop more often because of limitations on quantities sold per customer at filling stations.

Equally important, the differential cost impact reported above considers only short-run effects. In the longer run, under the price rationing scheme, trucking costs would tend to fall back toward their earlier level, other things equal. This long-run decline would occur because gasoline prices would tend to fall as automobile users found ways of economizing on gasoline use. At the same time trucks might be adapted to improve fuel economy. In contrast, the long run adjustment that truckers would make to reduced speed limits would be to increase the number of trucks used to carry a given total amount of freight.

Thus, once the increased trucking and inventory costs of a restriction scheme are compared with the likely long-run cost increase due to price rationing, it is no longer clear that the restriction scheme will lead to smaller cost increases.

The Impacts of Higher Truck Operating Costs

The cost increase associated with restriction rationing schemes will be borne primarily by trucks operating in long- and short-range service since it is these trucks which tend to use main rural roads and whose operation is thus affected by lowerspeed limits. For trucks registered in New England, long-and short-range range use tends to be greatest in for-hire trucking. However, construction, manufacturing, and wholesale and retail trade each account for substantial shares of total trucks used in short- and long-range service. In all states, the leading users of trucks in short-and long-range operations (personal use aside) are for-hire trucking, wholesale and retail trade, and construction. In Maine, the agricultural sector is also a large user of trucks operating in these ranges.

The effects of an increase in costs per vehicle mile will of course be most important for those industries which tend to ship their products the greatest distances and those whose materials come from more distant areas. The information on intercity and interregional flows of manufactured goods in Tables 3-6 through 3-8 suggest that the increases in transportation costs for outbound shipments tend to be fairly evenly spread throughout the manufacturing industries with the exception of the metals, machinery, and electrical equipment industries in Eastern Massachusetts. Increases in transport costs on inbound shipments would also appear to be broadly spread except that inbound shipments of products of the texile and apparel industries tend to originate from less distant production areas than do shipments of products of other manufacturing industries.

In contrast to restriction rationing schemes, the transportation cost increases arising from price rationing schemes affect truck operations in all ranges of service. The impact of higher fuel prices on trucking costs will nevertheless vary among types of service to the extent that the proportion of fuel costs to total costs varies among types of service.

Chapter 4

The Effect of Gasoline Rationing on the New England Tourist Industry

Gasoline rationing, or other policies aiming to conserve fuel by restricting automobile usage, will reduce tourism in New England by increasing the cost and inconvenience of travel. This potential reduction in tourism is of concern to local policy makers for two reasons. First, since much of the tourist traffic originates from outside the region, a reduction in tourism will lead to an immediate loss in income for the region, rather than a reallocation of expenditures among activities within the region. The special advantages of New England states in scenic attractions, state parks and ski facilities, especially those which are most distant from major population centers, will command a lower return because of increased travel costs. Second, in some local areas within Northern New England, a large fraction of the population is employed in tourist-related activities. Where other local industries are not present, or cannot quickly absorb an increased labor supply, the reduction in tourism may lead to very high unemployment rates. In this section of the report, we review available data on the New England tourist industry, and present crude estimates of the effect of an increase in the price of gasoline on tourist expenditures.

Dimensions of the Tourist Industries

The share of the tourist industry in total employment and total income varies greatly among the New England states and among counties within the states. Defining tourist-related industries as eating and drinking places, hotels and other lodging, and amusement and recreation, we find that tourist employment as a percentage of state employment varies from 5.3 percent in Rhode Island to 10.5 percent in Vermont in the New England states excluding Connecticut. At the county level, the variation in tourist employment percentage is even greater, ranging from 1.4 percent in Sagadahoc County, Maine to 27.0 percent in Lamoille County, Vermont (home of Stowe, Vermont). Tables 4-1 through 4-6 show March 1972 employment in tourism industries related to total employment and first quarter 1972 tourism payrolls for counties in each of the New England states.

The numbers in the tables on employment in tourist-related industries do not give an exact figure on jobs created by tourism. On the one hand, some employees in restaurants, hotels and places of amusement are required to meet the demands of local customers to the figures in the table overstate the un-importance of tourism as a source of employment. On the other hand, the demands of tourists create employment in other industries (gas stations, grocery stores, laundry, etc.) which cater primarily to local residents. Since the employment figures are for March they may portray a different picture of the importance of tourism than would annual average employment

Table 4-1

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1] IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties of Maine)

County	Tourist Employment	Tourist Payrolls
Androscoggin	5.8	2.7
Aroostook	5.0	2.3
Cumberland	6.6	2.9
Franklin	8.5	4.4
Hancock	4.9	2.4
Kennebec	4.4	1.8
Knox	4.5	2.2
Lincoln	5.0	2.4
Oxford	5.6	2.5
Penobscot	6.6	2.8
Piscataquis	5.7	3.9
Sagadahoc	1.4	0.5
Somerset	4.3	1.8
Waldo	3.1	1.3
Washington	4.0	1.6
York	6.4	3.2
TOTAL MAINE	5.8	2.7

SOURCE: Calculated from data in *Maine County Business Patterns*, 1972, Tables 1B, 1F, and 2, pp. 16-18, 21, 23-46.

[1]Employment as of mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: eating and drinking places, hotels and other lodging places, and amusement and recreation services.

Table 4-2

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1]
IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties of New Hampshire)

County	Tourist Employment	Tourist Payrolls
Belknap	6.9	3.1
Carroll	24.7	16.1
Cheshire	5.3	2.3
Coos	5.2	2.2
Grafton	10.2	6.6
Hillsborough	5.7	2.2
Merrimack	6.8	3.0
Rockingham	12.3	7.5
Strafford	5.4	2.4
Sullivan	3.5	1.1
TOTAL NEW HAMPSHIRE	7.5	3.6

SOURCE: Calculated from data in *New Hampshire County Business Patterns,* 1972, Tables 1B, 1F, and 2, pp. 16-18, 21, 23-41.

[1]Employment as of mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: eating and drinking places, hotels and other lodging places, and amusement and recreation services.

Table 4-3

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1]
IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties in Vermont)

County	Tourist Employment	Tourist Payrolls
Addison	5.7	2.4
Bennington	11.6	6.5
Caledonia	6.3	2.5
Chittenden	7.1	2.4
Essex	---	---
Franklin	5.2	2.4
Grand Isle	---	---
Lamoille	27.0	19.0
Orange	6.7	3.4
Orleans	6.7	3.2
Rutland	10.9	4.6
Washington	10.4	6.3
Windham	17.0	12.0
Windsor	11.4	5.6
TOTAL VERMONT	10.9	5.6

SOURCE: Calculated from data in *Vermont County Business Patterns, 1972,* Tables 1B, 1F, and 2, pp. 15-16, 19, 20-35.

[1]Employment as of mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: eating and drinking places, hotels and other lodging places, and amusement and recreation services.

Table 4-4

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1]
IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties of Massachusetts)

County	Tourist Employment	Tourist Payrolls
Barnstable	14.9	8.0
Berkshire	7.6	3.2
Bristol	4.8	2.2
Dukes	7.0	2.3
Essex	7.5	3.2
Franklin	6.5	2.6
Hampden	6.2	2.7
Hampshire	8.4	3.5
Middlesex	5.2	2.0
Nantucket	---	---
Norfolk	8.0	3.5
Plymouth	8.3	3.9
Suffolk	6.2	3.3
Worcester	5.3	2.1
TOTAL MASSACHUSETTS	6.3	2.8

SOURCE: Calculated from data in *Massachusetts County Business Patterns*, 1972, Tables IB, IF, and 2, pp. 20-22, 27, 29-86.

[1]Employment as of Mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: Eating and drinking places, hotels and other lodging places, and amusement and recreation services.

Table 4-5

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1]
IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties of Rhode Island)

County	Tourist Employment	Tourist Payrolls
Bristol	3.5	1.6
Kent	6.9	3.1
Newport	13.8	6.8
Providence	4.4	2.3
Washington	9.0	4.2
TOTAL RHODE ISLAND	5.3	2.6

SOURCE: Calculated from data in *Rhode Island County Business Patterns*, 1972, Tables 1B, 1F, and 2, pp. 17-18, 22, 23-36.

[1]Employment as of mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: Eating and drinking places, hotels and other lodging places, and amusement and recreation services.

Table 4-6

PERCENTAGE OF TOTAL EMPLOYMENT AND PAYROLLS[1]
IN TOURIST RELATED INDUSTRIES,[2] 1972

(Counties of Connecticut)

County	Tourist Employment	Tourist Payrolls
Fairfield	5.0	2.3
Hartford	4.9	2.1
Litchfield	4.1	1.7
Middlesex	6.5	2.4
New Haven	4.6	2.0
New London	6.1	2.6
Tolland	9.3	4.6
Windham	4.2	1.8
TOTAL CONNECTICUT	5.0	2.2

SOURCE: Calculated from data in *Connecticut County Business Patterns*, 1972, Tables 1B, 1F, and 2, pp. 19-21, 25, 31-60.

[1]Employment as of mid-March, 1972 and payrolls for first quarter, 1972.

[2]Industries included are: Eating and drinking places, hotels and other lodging places, and amusement and recreation services.

figures. Nevertheless, differences in the percentage employed in tourist-related industries among the counties and states give one important indication of the intra-regional differences in the importance of tourism. Tables 4-1 through 4-6 show that the potential adverse effect of a reduction of tourism is concentrated in a few Northern New England Counties.

Two recent state-published studies give further estimates of the impact of tourism on employment. The Vermont Economic Development Commission estimated that tourism employs 16,000 out of a total of 184,000 employees in the state in 1971 (8.7 percent). The Connecticut Development Commission estimated tourism-generated employment as 26,000 in 1972. This amounts to 2.2 percent of total employment in Connecticut for the month of September, 1972.

An alternative measure of the overall importance of tourism is the relationship between expenditures by tourists and state personal income. The National Travel Data Center has recently released estimates of expenditures by domestic travellers, who are defined to be U.S. citizens on trips of greater than 100 miles. It is estimated that domestic travellers spent $2.189 billion in New England in 1972. Table 4-7 shows that spending by travellers as a percentage of state personal income ranged from 1.7 percent in Connecticut to 12.0 percent in Vermont. The expenditure percentages reported in Table 4-7 generally support the picture of the importance that was given by the employment data.

Seasonal variation is an important feature of New England tourism. Tourism is still largely a summer industry, although winter tourism has become a moderately large industry in Vermont and New Hampshire. Tables 4-8 through 4-14 present scattered evidence on the seasonal variation in tourism.

Table 4-7

Expenditures by Travellers in New England States, 1972

State	($ million) Travellers' Expenditures	($ million) State Personal Income	Expenditures as % of State Personal Income
Maine	352.5	3,714.0	9.5
New Hampshire	297.5	3,270.0	9.1
Vermont	204.2	1,703.0	12.0
Massachusetts	956.9	28,096.0	3.4
Rhode Island	93.4	4,340.0	2.2
Connecticut	285.1	16,421.0	1.7
All New England	2189.6	57,545.0	3.8

Table 4-8

Seasonal Estimates of Tourist-Related Employment: Vermont (1971)

Season	Tourist-Generated Employment	% of Annual Employment
only summer	9,050	66.42
only autumn	400	2.94
only winter	3,325	24.40
Year Round	850	6.24
TOTAL	13,625	100.0

Table 4-9

Selected Employment and Payrolls in Lodging, Eating and Drinking, and Entertainment in Massachusetts, 1970

	Employment, Annual Average	Employment, February	Employment, July	Payroll ($000)
Hotels, Motels, Tourist Courts	15,510	13,488	18,268	$56,838
Rooming and Boarding Houses	658	513	976	1,976
Trailer Parks and Camps	591	268	1,993	2,406
Eating and Drinking Places	90,735	80,838	96,624	n.a.
Amusement and Recreation Services	11,731	8,212	14,626	52,994
Summary of Major Tourist Related Industries	119,115	103,319	132,490	$397,505

SOURCE: Massachusetts Department of Commerce and Development, The Tourism and Recreation Story in Massachusetts.

Table 4-10

Estimate of Private Employment Directly Generated By Overnight Tourist Travel in Massachusetts February - August of Selected Years

Year	February	August	Total Employment	% Employment Tourist-Related February	% Employment Tourist-Related August
1972	16,800	58,840			
1971	16,500	58,400			
1970	16,120	57,710	1,371,867	1.18	4.21

SOURCE: Massachusetts Department of Commerce and Development, Division of Tourism, The Tourism and Recreation Story in Massachusetts

Table 4-11

Monthly Lodging Sales -- Maine, 1972

Month	Lodging Sales (Millions of Dollars)	Percent of Total
January	1.1	2.47
February	1.3	2.89
March	1.9	4.19
April	1.6	3.55
May	2.1	4.62
June	4.1	8.80
July	11.7	25.38
August	11.3	24.31
September	4.9	10.76
October	2.7	5.80
November	1.8	3.85
December	1.7	3.57
TOTAL	46.3	100.00

SOURCE: "Current Trend of Maine Lodging Sales, 1972-73," data supplied by Maine Bureau of Taxation.

Table 4-12

Monthly Sales Tax Revenues in Tourist-Related Industries:
Maine (1972) and Massachusetts (1971)

Maine Sales & Use Tax

	Restaurants (% of annual)	Roadside Eating Places (% of annual)	Lodging Places (% of annual)	Massachusetts Room Excise Tax (% of annual)
January	$ 270,115 (5.32)	$ 58,235 (4.41)	$ 94,892 (3.25)	$ 329,877 (4.66)
February	268,895 (5.29)	58,383 (4.42)	94,849 (3.25)	358,803 (5.07)
March	303,731 (5.98)	73,123 (5.53)	131,497 (4.50)	392,885 (5.55)
April	317,394 (6.25)	95,908 (7.25)	123,468 (4.23)	438,175 (6.19)
May	379,546 (7.47)	126,703 (9.58)	155,769 (5.33)	503,286 (7.11)
June	470,059 (9.25)	141,829 (10.73)	261,461 (8.95)	648,715 (9.17)
July	733,057 (14.43)	198,884 (15.04)	660,472 (22.61)	1,035,523 (14.64)
August	728,424 (14.34)	185,363 (14.02)	644,896 (22.08)	1,134,121 (16.03)
September	545,063 (10.73)	122,016 (9.23)	292,340 (10.01)	765,404 (10.82)
October	400,531 (7.89)	93,379 (7.06)	202,921 (6.95)	661,585 (9.35)
November	334,402 (6.58)	81,467 (6.16)	128,481 (4.40)	460,530 (6.51)
December	327,874 (6.46)	86,669 (6.56)	130,245 (4.46)	345,307 (4.88)
TOTAL	$5,079,091	$1,321,959	$2,921,291	$7,074,211

SOURCES: Maine Bureau of Taxation, "State and Use Tax Assessment by Type of Business, 1972".

Massachusetts Department of Commerce and Development, Division of Tourism, *The Tourism and Recreation Story in Massachusetts*.

Table 4-13

Reported Taxable Sales by Quarter:

Tourist-Related Business in New Hampshire, 1969
Sales in Thousands of Dollars
(% of Annual)

Months	Lodging Places	Seasonal Home Rentals	Eating and Drinking Places
January - March	6,311 (12.92)	142 (8.60)	10,552 (13.05)
April - June	7,429 (15.20)	82 (4.97)	13,934 (17.24)
July - September	26,721 (54.69)	1,281 (77.59)	34,973 (43.27)
October - December	8,400 (17.19)	146 (8.84)	21,370 (26.44)
Whole Year	48,861 (100.0)	1,651 (100.0)	80,829 (100.0)

SOURCE: Office of State Planning, State of New Hampshire, *Impact of Recreational Vacation and Travel on New Hampshire - 1954, 1958, 1963, 1967, 1970*.

Table 4-14

Estimated Distribution of Visitors by Month,
Vermont (1972) and Rhode Island (1968 - 1969)

	Vermont		Rhode Island	
Month	Estimated No. of Visitor - Days (000)	Monthly % of Total Visitor - Days	No. of Visitors (from sample data)	Monthly % (of Total)
January	350	5.22	3	0.21
February	400	5.97	2	0.14
March	300	4.48	1	0.07
April	200	2.99	10	0.70
May	550	8.21	35	2.47
June	650	9.70	149	10.50
July	1,100	16.42	451	31.78
August	1,150	17.16	446	31.43
September	700	10.45	121	8.53
October	750	11.19	81	5.71
November	250	3.73	11	0.78
December	300	4.48	4	0.28
Unclassified			105	7.40
TOTAL	6,700	100.00	1,419	100.00

SOURCES: State of Vermont, Economic Development Department, Development and Community Affairs Agency, *Vermont Skiing Survey*, 1972-73.

State of Vermont, Economic Development Department, Development and Community Affairs Agency, *The Vermont Summer Tourist Industry*, 1972.

Rhode Island Development Council, *Rhode Island Tourist Survey*, 1969.

The Rhode Island data is from a survey questionnaire in which people indicated what month (or months) they were in the state. In cases of two-month visits individuals are classified as having visited in both months. Thus, the total visitors in coumn three exceeds the total number of individuals in the sample.

It can be seen from Tables 4-8 to 4-14 that tourist-related industries, and direct estimates of the number of visitors are all at a peak during July and August. Data from Maine and New Hampshire provide no evidence of a bulge in revenues of tourist-related industries during the winter months. On the other hand, Table 4-14 shows that visitors to Vermont in January and February exceed the numbers for November and April, reflecting the effects of winter skiing. Even so, Vermont has three times as many visitors in July and August as in January and February. Table 4-14 also provides evidence of a fall foliage season. More people visit Vermont in October than in September, in contrast with the continuing increase in tourism with the warmer months in May, June and July.

Scattered available evidence on the skiing industry is presented in Table 4-15. Vermont and New Hampshire are the two most important skiing states, followed by Maine. The Maine skiing industry appears to be primarily local; the Maine department of Commerce and Development attributes 82.6 percent of skier days to day (i.e. non-overnight) skiers. However, Vermont skiers are mostly from out-of-state. The Vermont Agency of Development and Community Affairs estimates that 80 percent of the skier days and 92 percent of ski-related revenues are attributable to out-of-staters.

Table 4-16 presents evidence on the origins of visitors to New England. The Vermont and New Hampshire data were collected from tourists stopping at information booths. The data may overstate the number of long-distance visitors since visitors from nearby are more likely to be familiar with the area, and hence have less cause to stop at information booths. The Rhode Island data are from a survey of people who had written to the Rhode Island Development Council for tourist information, so it too may exaggerate the percent of visitors from distant points.

Table 4-15

Estimates of Economic Impact of Skiing: Maine, New Hampshire and Vermont (1972)

	At Slope Ski Revenue	Total Ski Revenue[1]	Ski Revenue as % of Annual Personal Income	At Slope Skiing Jobs	Total Skiing Jobs
Maine	4,190,335	11,020,000	0.30	840	N.A.
New Hampshire	18,000,000	60,000,000	1.84	3,500	10,000
Vermont	16,600,000	48,400,000	2.84	N.A.	N.A.

SOURCES: Maine Department of Commerce and Industry, "Maine Ski Area Income".

Press release, "New Hampshire Ski Areas Quietly Optimistic", Summarizing findings of study by New Hampshire Ski Area Operators Association.

Planning Division, Vermont Agency of Development and Community Affairs, *Vermont Skiing Survey*, Economic Research Report, No. 73-3.

[1] Includes food, drink and lodging revenue estimated to be directly attributable to skiers.

Table 4-16

Origin of New England Tourists
(% from State of Origin)

State or Province of Origin	1972 New Hampshire Summer Tourists	1972 Vermont Summer Visitors	1969 Rhode Island Tourists	1972 Connecticut Tourists
All New England	52.6	34.3	24.1	23.2
Maine	4.9	1.4	0.3	N.A.
New Hampshire	10.2	3.5	0.3	N.A.
Vermont	1.8	...	0.6	N.A.
Massachusetts	23.7	16.4	13.4	14.9
Connecticut	8.5	10.8	9.5	....
Rhode Island	3.5	2.2	....	5.3
Middle Atlantic	22.5	33.1	41.2	N.A.
New York	12.3	20.1	19.5	31.1
New Jersey	5.9	8.5	8.6	12.2
Pennsylvania	4.4	4.5	9.8	7.2
Maryland	1.7	....	2.4	N.A.
Other	0.2	....	0.9	N.A.
Eastern Canada	8.5	14.8	3.4	N.A.
Ontario	3.7	N.A.	N.A.	N.A.
Quebec	2.8	7.8	N.A.	N.A.
Maritime Provinces	2.0	N.A.	N.A.	N.A.
Midwestern	6.8	6.3	17.85	6.8
Ohio	2.4	2.7	3.9	N.A.
Michigan	2.1	N.A.	2.7	N.A.
Illinois	1.3	N.A.	3.9	N.A.
Other	1.0	N.A.	7.35	N.A.
Southern States	5.1	5.8	8.15	14.1
Pacific and West	1.1	2.2	4.75	1.5

(Sources on next page)

Table 4-16 (Continued)

SOURCES: New Hampshire Division of Economic Development, "Origin of Cars at Tourist Information Booths, Summer Season, 1972".

Economic Development Division, Agency of Development and Community Affairs, *The Vermont Summer Tourist Industry, 1972*, Economic Research Report No. 73-1.

Rhode Island Development Council, *Rhode Island Tourist Survey*, 1969.

Connecticut Development Commission, *Connecticut's $385,000,000 Tourist Industry*.

Table 4-17

Index of Tourists Per Capita Originating From New England and Middle Atlantic States

(Tourist per Capita Index)

State	Population Index	New Hampshire Summer	Vermont Summer	Rhode Island	Connecticut
Maine	5.45	0.899	0.257	0.055	N.A.
New Hampshire	4.04	2.525	0.866	0.074	N.A.
Vermont	2.44	0.738	...	0.246	N.A.
Massachusetts	31.19	0.760	0.526	0.430	0.478
Connecticut	16.62	0.511	0.650	0.572	...
Rhode Island	5.20	0.673	0.423	...	1.019
New York	100.00	0.123	0.201	0.195	0.311
New Jersey	39.31	0.150	0.216	0.219	0.310
Pennsylvania	64.67	0.068	0.070	0.152	0.111
Maryland	21.51	0.079	N.A.	0.112	N.A.

The data in Table 4-16 indicate that most tourists in New England are from the Northeastern states. Massachusetts and New York are the largest states of origin for visitors to New Hampshire, Vermont, Rhode Island, and Connecticut. To adjust for scale effects, the tourism data from Table 4-16 divided by the population of originating states relative to New York, is presented in Table 4-17. Table 4-17 shows that states attract more visitors as a percentage of population from closer states.

The tourism data presented above indicates that tourism, while important, accounts for only a small fraction of *total* economic activity in New England. However, in selected localities at peak season, tourism accounts for a large share of economic activity. The relative economic importance of tourism is highest during the summer months, and greatest in Vermont, New Hampshire and Maine.

Effect of Gasoline Rationing on Tourism

The impact of gasoline rationing on tourism arises from the impact of higher gasoline prices on travel costs or from the increase in the inconvenience of driving from uncertainty about gasoline availability. Fortunately, most tourists and travellers to New England travel rather short distances. This is evidenced by the data on individual states presented in the last section and in the data in Tables 4-18 and 4-19, which provide information on the distances travelled and the regions of origination for trips to New England during 1972.

As the price of gasoline rises and the costs of making trips to New England rises a number of responses will come into play. First, tourists may reduce the lengths of trips they are willing to take with the result that the number of tourists coming to New England may decrease and those who do come may travel to destinations closer to their point of origination.

Table 4-18

DISTRIBUTION OF TRIPS TO NEW ENGLAND
BY ROUND TRIP DISTANCE

Miles	Trips Percent	Person Trips Percent
200- 399	49.7	49.9
400- 699	21.5	23.4
600- 799	8.8	8.3
800- 999	5.8	5.9
1000-1999	7.9	6.7
2000-and over	6.4	5.6

SOURCE: Computed from data in U.S. Census Bureau, *National Travel Survey, Travel During 1972*, Table 13, pages 30-31.

Table 4-19

DISTRIBUTION OF TRIPS TO NEW ENGLAND
BY REGION OF ORIGIN

Region of Origin	Trips Percent	Person Trips Percent
NEW ENGLAND	60.1	60.0
NEW YORK-NEW JERSEY	23.9	24.9
MID-ATLANTIC	7.5	6.8
SOUTH	2.7	2.2
NORTH CENTRAL	4.6	3.9
NORTHWEST	---	---
SOUTHWEST	1.2	1.1
PACIFIC	1.1	1.0

SOURCE: Computed from data in U.S. Census Bureau, *National Travel Survey, Travel During 1972*, Table 13, pages 30-31.

Second, tourists who do come to New England may reduce the amount they are willing to spend once in New England. Both of these responses tend to reduce total tourist expenditures in New England and to redistribute expenditures within the region. On the other hand, some tourists may react to higher travel costs by making fewer trips to New England but staying longer in the region. To the extent tourists increase length of stay per trip or otherwise economize on the costs of getting to New England, they may be willing to spend more once in the region.

It is clear from the foregoing that beyond saying that higher gasoline costs makes a trip to New England more expensive, it is very unclear what the eventual impact on tourist expenditures will be because of the complex and varied ways in which tourists can respond to higher travel costs. Although it is difficult and hazardous to predict the impact of higher gasoline prices, it is possible to derive a useful benchmark estimate of the response of tourism expenditures to higher gasoline prices.

If the price of gasoline rose by 60 percent, in the face of 15 percent shortage relative to desired consumption at current prices, the average cost per person trip to New England would rise by an amount equal to roughly 6.3 percent of expenditures per person trip in New England. On the other hand, if gasoline prices were to rise by 30 percent, the average cost per person trip would increase by about 2.6 percent.[1]

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[1]These cost increases are calculated as follows. Assuming that the price of gasoline rises by 60 percent the increase in cost of travelling to New England can be estimated for various distances, using average prices of gasoline, average miles per gallon and distance travelled. Using the fact that, on average each trip consists of a party of two the increase in trip costs can be translated into the increase in cost per person-trip for the various distances. Dividing these by average expenditures per person trip gives the percentage increase in the cost per person trip for trips of each distance. Finally, the weighted average percentage increase is determined by weighting each increase by the percent of person trips of corresponding trip length. The result is the percentage increase in cost for the average person trip to New England.

If we then assume that on average tourists to New England will offset the higher costs of getting here by reducing their expenditures in New England by exactly the amount by which travel costs rise, tourist expenditures would fall by 6 to 7 percent in response to a 60 percent gasoline price rise and by 2 to 3 percent in the face of 30 percent increase in gasoline prices. In view of the varied responses to higher prices discussed above it is certainly true that not all individuals will react to higher costs of travel to New England in the manner assumed in the derivation of these estimates. Thus, the reductions estimated here should be taken as a rough measure of the likely average reduction in tourism expenditures and some variation from this coverage figure is quite likely. In view of the assumptions made to derive the expected reduction it might be advisable to place the estimated reduction in the face of a 30 percent price increase at between 2 and 5 percent and the reduction in the face of a 60 percent increase at between 5 and 10 percent.

It is of course likely that some states and some regions of some states would experience decreases greater or smaller than seven percent. Although it is not feasible to attempt specific estimates on a state by state or region by region basis, it seems probably that the northern parts of the northern states would probable experience larger reductions while the southern states and the southern portions of the northern states would probably experience smaller reductions.

It is difficult to say whether the reduction in total expenditures would lead to a substantial change in the seasonal pattern of tourism expenditures. However, to the extent that the average person trip is longer for some seasons, the seasons in which people come relatively farther will experience relatively larger reductions. There is also some reason to expect the impact of reduced expenditures under a price rationing scheme to fall less heavily on the winter tourist business of the Northern states in view of their special attraction to skiers.

Chapter 5
The Impact of Gasoline Rationing on State Revenues

In this chapter we derive crude estimates of the direct impacts of gasoline rationing on state revenues from gasoline taxes and other taxes and fees related to tourist travel. It must be emphasized that these estimates are not representative of the eventual effects of gasoline rationing. For instance, if reduced expenditures on gasoline or tourism create unemployment, that unemployment will be reflected in lower personal incomes and retail sales and hence in additional losses in tax revenues. These multiplier effects may be important; estimating their impact, however, is beyond the scope of this study.

The most direct effect of gasoline rationing on state revenues is a reduction in fuel taxes. Clearly if gasoline consumption is to be reduced by 15 percent, 15 percent less gasoline tax revenues will be received, assuming no change in the level of state gasoline tax per gallon.

The next most direct effect of reduced consumption of gasoline will arise through its impact on tourist travel, and hence on the tax revenues most closely related to tourist and recreational travel. These taxes include such items as meals and room taxes, recreation area receipts, fish and game licenses and so on. Not all tax receipts for these items arise from tourists (especially out-of-state ones). Nevertheless, it is probable that a very high percentage of them do, and an upper limit of the impact of rationing can be derived by assuming that taxes from these sources might fall in proportion to the reduction in tourist expenditures, that is, by about 7 percent.

Finally, there are tax revenues that arise in part from tourist expenditures but in which expenditures by state residents are probably the major factor. Included in this group are sales and use taxes, cigarette taxes, alcohol taxes and so on. To estimate the direct impact of reduced tourist expenditures on such tax receipts, we have assumed that tourists' proportion of total expenditures on the taxed items is equal to the ratio of total tourist expenditures to state personal income.

Even though the percentage reduction in tourist expenditures is assumed the same for each state, the overall impact of the reductions varies from state to state. This is because the states differ in the extent to which they rely on various types of taxes to generate revenues. Table 5-1 shows the variation in the New England states.

Estimates of the direct impacts on total state revenues for each state are presented in Table 5-2. The biggest reductions occur in New Hampshire, Connecticut and Maine primarily because these states rely more heavily on fuel taxes as a source of revenue than do the other states.

TABLE 5-1

PERCENT DISTRIBUTION OF REVENUES FOR THE NEW ENGLAND STATES AMONG CATEGORIES VARYING IN SENSITIVITY TO GASOLINE CONSUMPTION AND TOURIST EXPENDITURES

Revenue Category	Maine 1972	N.H. 1969	Vt. 1970	Mass. 1972	R.I. 1972	Conn. 1970
FUEL TAXES	9.8	13.3	5.5	5.6	5.7	10.9
TAXES, FINES AND FEES RELATED TO TRAVEL & TOURISM[1]	5.3	19.8	8.7	4.6	2.7	8.0
GENERAL SALES TAXES AND FEES[2]	29.4	18.5	20.5	10.7	22.4	38.3
ALL OTHER REVENUES[3]	55.5	48.4	65.3	79.1	69.2	42.8
TOTAL STATE REVENUES	100.0	100.0	100.0	100.0	100.0	100.0

[1] Includes Motor Vehicle License and Registration Taxes, Recreation Vehicle Licenses and Fees, Motor Vehicle Sales Taxes (for Mass and Vt), other Highway Fund Revenues (excluding Interest or Federal Grants), Meals and Rooms Taxes, Recreation Area Receipts, Fish and Game Department, License Fees, Taxes, etc. (exluding Federal Grants), and Ferry and Airport Revenues -- all when figures available.

[2] Includes Sales and Use Taxes, Cigarette and Tobacco Taxes, Alcohol Taxes, Racing and Batting Taxex, Amusement Taxes and Admissions Taxes (where available).

[3] Includes Income and all other taxes, Bonds issues, Federal Grants, etc.

SOURCE: Tax reports of the various states.

TABLE 5-2

ESTIMATED DIRECT IMPACTS
ON STATE REVENUES FROM GASOLINE RATIONING

State	Percentage Reduction Due to Decreases in			
	Fuel Taxes	Taxes and Fees Directly Related to Tourism	General Sales Taxes and Fees	Total Reduction In Revenues
MAINE	1.5	.4	.2	2.1
NEW HAMPSHIRE	2.0	1.4	.1	3.5
VERMONT	.8	.6	.2	1.6
MASSACHUSETTS	.8	.3	.03	1.1
RHODE ISLAND	.9	.2	.03	1.1
CONNECTICUT	1.6	.6	.05	2.3

Technical Appendix

The sections of this appendix present the detailed derivations of several other estimates presented in the main body of the report. Section I describes the procedure used to estimate the effect of reduced highway speeds on gasoline consumption. Section II presents the derivation of the elasticities of demand for use in different kinds of trips, such as work trips and shopping trips. Section III presents the methodology used to estimate gasoline consumption and to estimate the overall elasticities of market demand to gasoline used in the text.

I. Estimating Fuel Savings from Reduced Highway Speeds

Assume for automobiles that the reduction in speed limits means a reduction in average speed from 60 to 50 mph on main rural roads and no effect elsewhere. It has been found that such a speed reduction would lead to a reduction of fuel consumption of 10 percent for travel on main rural roads.[1] Such travel amounts to 34 percent of all auto travel.[2] Therefore, estimated fuel economy is .034, say 3 percent of total consumption.

Assume for trucks that the reduction in speed limit means average speed of trucks on main rural roads declines from its present 55 mph to 50 mph.[3] Then, fuel consumption per gallon falls by 11 percent for pickups and 2-axle -- 6-tire trucks and by almost 7 percent for combination

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[1] *Running Costs of Motor Vehicles as Affected by Road Design and Traffic*, National Cooperative Highway Research Program, Report #111, 1971, p. 17.

[2] *Highway Statistics 1971*, U.S. Department of Transportation, Federal Highway Administration, p. 81.

[3] *Ibid.*, p. 84.

trucks.[1] Sixty-six percent of the vehicle miles for combination trucks are on main rural roads.[2] Therefore, the fuel saving for them is estimated at 4.6 percent. Forty-four percent of vehicle miles travelled by single unit trucks are on main rural roads so the estimated fuel saving for them is 4.8 percent. Based on their share in total truck miles the weighted average savings for trucks amounts to 4.7 percent.

Since trucks are estimated to account for at most 2 percent of total gasoline consumption, the overall saving comes to 3.3 percent. Thus, 3 percent is a good approximation to the total reduction in gasoline consumption from reducing the speed limit.

II. Estimation of the Elasticity of Demand for Gasoline

There are a number of ways in which motorists, faced with an increase in the price of gasoline, may cut back on their gasoline consumption. These ways include car pooling, making fewer trips by auto (both by making one trip serve the purposes that previously took several trips and by substituting public transportation for some auto trips), by making shorter trips (for example, by shopping closer to home), and by increasing mileage per gallon (for example, in the short run, by more frequent tune-ups, more intensive use of the smaller car in two-car families, and by driving more slowly; in the long-run, by shifting from big cars to smaller ones).

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[1] *Running Costs of Motor Vehicles as Affected by Road Design and Traffic, op.cit.*, pp. 13, 21, and 27.

[2] *Highway Statistics, 1971, op. cit.*, p. 81.

Economists believe that users of gasoline will, to some extent, respond to an increase in the relative price of gasoline by decreasing their consumption in one or all of these ways. The elasticity of demand is a measure of the decrease in consumption in response to an increase in price, other things equal. More formally, the elasticity of demand, η_g, is the percentage change in consumption in response to a 1 percent increase in the price of gasoline.[1] This measure conveniently summarizes the quantitative importance of the different responses descibed above.

Measurement of the elasticity of demand, however, is a difficult econometric job, since it requires a thorough understanding of the factors that influence trip-making and careful analysis of appropriate data. For example, there is good reason to believe that gasoline consumption for shopping trips will decrease relatively more than for journeys to work, for a given increase in gasoline price. Similarly, the elasticities of demand for gasoline for inter-city travel may differ from those for travel within an urban region, depending on the costs and availabilities of substitute travel modes.

Because of the time and budget limitations of this study, it was not feasible to make new estimates of the price elasticity of demand for gasoline. Instead, it was decided to derive estimates of demand elasticities from

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[1] In symbols,

$$\eta_g = \frac{\Delta G}{G} / \frac{\Delta \Pi}{\Pi}$$

where
G is gasoline consumption, Π is the price of gasoline, and Δ stands for the change in a variable.

extant studies of the demand for auto travel. The study used for urban travel (estimated from Boston data) was "Estimation of Urban Passenger Travel Behavior: An Economic Demand Model," by Thomas A. Domencich, Gerald Kraft and Jean-Paul Valette.[1] The study used for inter-urban travel was *Demand for Inter-City Passenger Travel in the Washington-Boston Corridor*.[2]

These studies provide estimates of the elasticity of demand for automobile trips for different purposes with respect to auto operating costs.[3] The cost of gasoline is only a part, albeit a major one, of the operating cost. The derived elasticity of demand for gasoline depends, in part, on the share of gasoline costs in total operating costs, as perceived by auto users.[4,5]

The studies cited do not directly provide estimates of the elasticity of demand for gasoline, but of the elasticity of the demand for person-trips with respect to

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[1]*Highway Research Record*, Volume 238 (1968), pp.64-78.

[2]Prepared by Systems Analysis and Research Corporation for the Office of the Under Secretary of Commerce for Transportation, U.S. Department of Commerce.

[3]The term "operating cost", as used here, refers to those costs that vary directly with mileage. These include gasoline, oil, tires, and maintenance costs. Depreciation, insurance registration fees and other costs that are not perceived to affect the costs of driving an additional mile are not included.

[4]Note that travellers' perceptions of the importance of gasoline costs are what influence their demand, although we would expect the perceptions to be reasonably close to the measured share.

[5]The mathematical derivations used to estimate elasticities are presented below.

line-haul costs.[1] Translation of this elasticity into the elasticity of demand for gasoline depends also on how car occupancy, average trip distance and miles per gallon change in response to a change in gasoline price. Although estimates of these elasticities were not available, it is possible (as explained below) to set bounds on the permissible values of them. These bounds, along with estimates of the elasticity of trip demands, can then be used to estimate the range within which the elasticity of demand for gasoline is expected to lie.

Table A-1 shows these estimates for different kinds of trip purposes. The estimates are different, of course, for different assumptions about the share of gasoline costs in total line-haul costs and about the other elasticities (car occupancy, average trip distance, and miles per gallon).

The elasticities of demand for gasoline are lowest when it is assumed that gasoline accounts for only 50 percent of line-haul costs and when it is assumed that car occupancy, trip distances and mileage do not respond at all to changes in the price of gasoline. These assumptions are extreme ones, in our opinion, but they set a lower bound to the elasticity of demand. Under these extreme assumptions, the price elasticity of demand for gasoline for intercity business purposes is about -0.2. That is, if the price of gasoline rises by 10 percent, only 2 percent less gasoline will be consumed on intercity business trips. On intercity

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[1]A person-trip is one trip by one person (as distinct from a trip by an automobile, which may carry more than one person). Line-haul costs refer to the operating costs of a trip of specified length. They do not include out-of-pocket costs such as tolls or parking, for example.

Table A-1

Estimates of the Elasticity of Demand for Gasoline, by Trip Purpose

Case 1: Gasoline costs account for 100 percent of automobile line-haul costs

Assumption about value of sum of other Elasticities[1]	Intra-city Trips: Work Trips	Intra-city Trips: Shopping	Intercity Trips: Business	Intercity Trips: Personal
0	- .494	- .878	- .358	- .929
-0.25	- .621	- .909	- .516	- .947
-0.50	- .747	- .939	- .679	- .965
-0.75	- .874	- .970	- .840	- .982
-1.00	-1.000	-1.000	-1.000	-1.000

Case 2: Gasoline costs account for 50 percent of automobile line-haul costs.

Assumption about Value of Sum of Other Elasticities[2]: η_o	η_{sm}	Intracity Trips: Work Trips	Intracity Trips: Shopping	Intercity Trips: Business	Intercity Trips: Personal
0	0	- .247	- .439	- .179	- .465
	0.5	- .624	- .720	- .590	- .732
	1.0[3]	-1.000	-1.000	-1.000	-1.000
-0.25	0	- .374	-0.470	- .340	- .482
	0.5[3]	- .75	-0.75	-.75	-.75
-0.50*	0*	- .50	-0.50	-.50	-.50

Table 1 continued on next page

Table A-1 (Continued)

Source: Text below and sources cited there.

[1]Other elasticities include the elasticities of car occupancy, average trip distance, and miles per gallon with respect to the price of gasoline.

[2] η_o: the sum of elasticities of car occupancy and average trip distance with respect to the price of gasoline.

η_{sm}: the elasticity of mileage (miles per gallon) with respect to the price of gasoline.

[3]Denotes the maximum permissible absolute value of the elasticity, given the other elasticity. The values are derived from the following set of constraints:

$$0 \leq [\gamma(1-\eta_{sm}) + \eta_o] \leq 1$$

where

γ= share of line-haul costs accounted for by gasoline.

personal trips, however, a 10 percent increase would lead to a 5 percent decrease in gasoline consumption. For intracity trips to work, a 10 percent price rise would cause about a 2.5 percent decrease in gasoline consumption, while the decline in gasoline consumption for shopping trips would be about 4.4 percent.[1]

At the other extreme, the price elasticity of demand for gasoline is estimated to be -1.0 for each purpose. This estimate, which arises under extreme assumptions about the sensitivity to gasoline prices of car occupancy, trip distances and mileage, implies that a 10 percent increase in gasoline price would lead to a 10 percent decrease in gasoline consumption.

The actual elasticity of gasoline consumption probably lies somewhere between the values implied by these two sets of extreme assumptions. But it is interesting to note that, even if car occupancy does not increase, trips do not get any shorter, and mileage does not go up in response to an increase in the price of gasoline, fewer trips get made and gasoline consumption decreases.

The overall decrease in consumption depends on the amounts of gasoline used for different trips purposes. For example, suppose that the four kinds of trips shown in Table A-1 adequately represent all trips, from the standpoint of sensitivity to gasoline prices. Suppose further that total gasoline consumption in New England is divided equally among the four kinds of trips.[2] Then, under the assumptions

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[1]All of these price elasticities assume that other things -- such as trip times, public transportation times and costs, and other things that influence trip-making behavior -- are not also changing.

[2]This assumption is solely for illustrative purposes. The overall elasticity is a weighted average of the different elasticities, the weights being the share of gasoline consumption used in each kind of trip.

that lead to the most insensitive price elasticities, the overall price elasticity would be -0.33. If total gasoline consumption must decline by 25 percent (from the amount that would be consumed at current prices), then other things equal, the price of gasoline would have to rise by about 75 percent, or roughly $0.30 per gallon.

On the other hand, if we make the extreme assumption that the elasticity of demand for each kind of trip is -1.0, then the overall elasticity is also -1.0 and the rise in prices needed to equate demand with supply (on the extreme assumption that no additional supply would be forthcoming at the higher prices) would be 25 percent, or roughly $0.10 per gallon.

The assumptions and mathematical derivations of the price elasticities for gasoline reported in the text are as follows.

We start from the fundamental identity that relates gasoline consumption to trips, distances, car occupancy, and miles per gallon (also called gasoline mileage):[1]

$$G = \frac{T \cdot M}{r \cdot Sm} \qquad (1)$$

where

G = gasoline consumption, in gallons;

T = person trips;

M = average distance per trip, in miles;

r = average car occupancy (persons per auto); and

Sm = average miles per gallon

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[1]Throughout this appendix, the analysis is presented for a single kind of trip, as the formal manipulations are the same for all.

Each of these variables -- T, M, r, and Sm -- is assumed to be at least potentially sensitive to the price of gasoline. We assume that the following conditions hold:

$$\frac{dT}{d\pi} \leqq 0, \ \frac{dM}{d\pi} \leqq 0, \ \frac{dr}{d\pi} \geqq 0, \ \frac{dSm}{d\pi} \geqq 0.$$

where

Π = price of gasoline, in cents per gallon. In words, these conditions require that as the price of gasoline increases, the number of person trips decreases, the average distance travelled decreases, car occupancy increases, and gasoline mileage increases.[1]

Trip making by individuals depends on, among other things, the line-haul cost:

$$T = f(p, \mathbf{Z}) \tag{2}$$

where

p = line-haul cost of auto, in cents per trip

$\mathbf{Z}$ = a vector of other influences on auto person-trips.

Line-haul cost per person can be expressed as a function of gasoline and other costs per vehicle mile, persons per vehicle, and miles:

$$p = \frac{\left(\frac{\pi}{Sm} + X\right) \cdot M}{r} \tag{3}$$

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[1]Strictly speaking, we say that, if there are any effects at all, the effects are in the directions stated. These variabiles might, of course, not change at all in response to changes in the price of gasoline.

where

X = operating costs per mile other than gasoline.

As can be seen from looking at equations (1), (2) and (3), the price of gasoline enters the equations directly only in influencing line-haul cost, but it enters indirectly through its effect on r, M, and Sm, which affect both line-haul cost and gasoline consumption (that is, r, M and Sm enter directly into both equations (1) and (3).

The price elasticity of demand for gasoline, ηg, is defined as:

$$\eta g = \frac{dG}{d\pi}\frac{\pi}{G}$$

From equation (1),

$$\frac{dG}{d\pi}\frac{\pi}{G} = \frac{r \cdot Sm\left(T\frac{dM}{d\pi} + M\frac{dT}{d\pi}\right) - T \cdot M\left(Sm\frac{dr}{d\pi} + r\frac{dSm}{d\pi}\right)}{(r\ Sm)^2} \cdot \pi \cdot \frac{r \cdot Sm}{T \cdot M} \qquad (4)$$

Equation (4) simplifies to

$$\eta_g = \eta_T + \eta_M - \eta_{Sm} - \eta_r \qquad (4')$$

where

$$\eta_T = \frac{dT}{d\pi}\frac{\pi}{T}$$

$$\eta_M = \frac{dM}{d\pi}\frac{\pi}{T};$$

$$\eta_{Sm} = \frac{dSm}{d\pi}\frac{\pi}{S_m}; \text{ and}$$

$$\eta_r = \frac{dr}{d\pi}\frac{\pi}{r}$$

The elasticity of person trips with respect to the price of gasoline, η_T, is:

$$\eta_T = \left(\frac{dT}{dp}\frac{p}{T}\right)\left(\frac{dp}{d\pi}\frac{\pi}{p}\right) \qquad (5)$$

We express η_T this way because there are econometric estimates (presented below) of the first part of this expression, $\frac{dT}{dp}\frac{p}{T}$. The second part can be expressed as

$$\frac{dp}{d\pi}\frac{\pi}{p} = \frac{\pi}{p}\left[\frac{r\left(\frac{\pi}{Sm} + X\right)\frac{dM}{d\pi} + M\left(\frac{Sm - \frac{dSm}{d\pi}}{Sm^2}\right) - \left(\frac{\pi}{Sm} + X\right)\cdot M\frac{dr}{d\pi}}{r^2}\right]$$

This equation can be expressed more simply as:

$$\frac{dp}{d\pi}\frac{\pi}{p} = \gamma(1 - \eta_{Sm}) + \eta_M - \eta_r \qquad (6)$$

where

$\gamma = \dfrac{\pi/Sm}{\frac{\pi}{Sm} + X}$, the share of gasoline costs in total line-haul costs .

Note, however, that it must be the case that

$$0 \leq \frac{dp}{d\pi}\frac{\pi}{p} \leq 1.0. \qquad (7)$$

That is, a one percent increase in the price of gasoline can, at most, lead to a one percent increase in the line-haul cost, and it cannot lead to a <u>decrease</u> in line-haul cost.

The constraint expressed by equation (7) implies a constraint on the combined values of γ, η_{Sm}, η_M and η_r as follows:

$$0 \leq (\gamma(1 - \eta_{Sm}) + \eta_M - \eta_r) \leq 1.0 \qquad (8)$$

There are additional constraints that follow from the conditions on the derivatives above that

$$\eta_{Sm} > 0, \; \eta_M < 0, \; \eta_r > 0.$$

For Case 1 of Table 1, $\gamma = 1$, and equation (6) can be written as

$$-1.0 \leq (\eta_{Sm} + \eta_M - \eta_r) \leq 0 \qquad (9)$$

Comparison of equations (8) and (9) shows why, for $\gamma < 1.0$, separate values need to be assumed for η_{Sm} and for $\eta_M - \eta_r$.

Combination of equations (4'), (5) and (6) yields the following expression for the price elasticity of demand for gasoline:

$$\eta_g = \eta_{Tp}(\gamma(1 - \eta_{Sm}) + \eta_M - \eta_r) + \eta_M - \eta_{Sm} - \eta_r \qquad (10)$$

where

$$\eta_{Tp} = \frac{dT}{dp}\frac{p}{T} \cdot$$

The values of $_{Tp}$ for intracity trips are:[1]

	η_{Tp}
Work trips	-.494
Shopping trips	-0.878

For intercity trips, the values of T_p are:[2]

	η_{Tp}
Business trips	-0.358
Personal trips	-0.929

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[1]Domencich, Kraft and Valette, *op. cit.*, p. 72.

[2]*Demand for Intercity Passenger Travel...*, *op. cit.*, p.v-47.

Substitution of these values, plus the assumed values for γ, η_{Sm}, and $(\eta_M - \eta_r)$ yields the values shown in Table A-1 above.

Cross-Elasticities of Demand

As mentioned in the section on the elasticity of demand for gasoline, one of the impacts of an increase in the price of gasoline (other things equal) is an increase in use of public transportation. Transit -- buses or subways, for example -- are substitutes for automobiles on many intra-city trips. On intercity trips, buses, trains, and airplanes can often substitute for automobiles. An increase in the price of gasoline is likely to increase use of all these alternative means of transportation.

Empirically, however, it has proven very difficult to measure the increase in transit ridership and use of other public travel that would result from a gasoline price increase. In the two studies that provided estimates of the elasticity of auto trip demand, for example, the authors were unable to find any effect of auto line-haul costs on the number of trips made by transit, rail or bus.[1] The only effect found was a cross-elasticity of demand for intercity personal trips by air of 0.095.[2] That is, if the price of

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[1]Domencich, Kraft and Valette, p. 72: and Systems Analysis and Research Corporation, *Demand for Intercity Passenger Travel...*, p.V-47.

[2]Cross-elasticity of demand is a unit-free measure of the change in price of another good; in this case, the effect on demand for transit trips of a change in auto costs. In symbols:

$$\eta_{TA} = \frac{\Delta T}{\Delta \pi} \frac{\pi}{T}$$

where η_{TA} is the cross-elasticity of demand for transit with respect to the price of gasoline; T is transit demand; π is gasoline price, and Δ stands for the change in a variable.

gasoline increases by 75 percent, the demand for intercity airplane trips will increase by about 7 percent.[1] It would appear, then, that use of transit and public intercity transportation will increase if the price of gasoline rises to its market-clearing level, but it is very hard to estimate the size of the increase. The increase is not, however, likely to be substantial in percentage terms, or it would have been easier to measure this cross-effect empirically.

III. Estimates of Gasoline Consumption and Demand Elasticity

This section presents the assumptions and methods used to estimate desired and permitted gasoline consumption by state in 1974, the overall elasticities of demand reported in the text, the equilibrium price (given the shortage), and the costs of the shortage.

Estimates of Gasoline Consumption

The most recent year for which data on gasoline consumption by state are available is 1971.[2] A figure for 1972 consumption was estimated by applying to the individual state figures the percentage growth in "domestic demand" for motor gasoline from 1971 to 1972.[3] Both sets of figures -- actual 1971 consumption by state and estimated 1972 consumption by state -- are shown in Table A-2.

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[1]The "other things equal" disclaimer seems especially unrealistic in view of the impact of the energy situation on airline flights. A full analysis would, of course, take into account all of these effects. As they are outside the scope of our assignment, however, we can only call attention to them in passing.

[2]U.S. Dept. of Transportation, Federal Highway Administration, *Highway Statistics 1971* (Washington: U.S.G.P.O.), p. 4.

[3]U.S. Bureau of Mines, *Mineral Industry Surveys*, Petroleum, December 1972 Summary, p.2.

Table A-2

New England Gasoline Consumption by State, 1971 and 1972

State	Millions of Gallons of Gasoline Taxes at Prevailing Rates 1971[1]	Estimated Millions of Gallons Taxed at Prevailing Rates 1972[2]
Connecticut	1239.4	1317.6
Maine	480.0	510.3
Massachusetts	2146.3	2281.7
New Hampshire	360.5	383.2
Rhode Island	349.3	371.3
Vermont	227.1	241.4
New England Total	4802.6	5105.6
U.S. Total	89,968.9	95,645.9

U.S. Department of Transportation, F.H.W.A., *Highway Statistics, 1971*, (U.S. Government Printing Office), p.4.

Estimated by multiplying 1971 figure by $\frac{MG_{72}}{MG_{71}}$

where

MG is total "domestic demand" for motor gasoline (U.S. Bureau of Mines, December 1972 Summary, Mineral Industry Surveys, Petroleum, p.2.)

MG_{72} = 2,333,777,000 bbls (1 bbl = 42 gallons)

MG_{71} = 2,195,267,000 bbls (1 bbl = 42 gallons)

$$\frac{MG_{72}}{MG_{71}} = 1.0631$$

Desired consumption in 1974 was estimated simply by using two assumptions. The conservative assumption was that desired consumption in 1974 was 10 percent more than actual 1972 consumption. A more rapid growth in desired consumption -- 15 percent over actual 1972 consumption -- was also assumed as a bound on the size of the shortage. The permitted consumption was, in each case, 95 percent of the estimated 1972 consumption by state.

The estimated permissible consumption levels, on the assumption that the reduction in gasoline consumption applies to all states in proportion to their 1972 consumption, are shown in Table A-3.

Estimate of Elasticity of Demand

The calculations of the elasticity of demand for gasoline for automobile trips, by purpose, were explained in the previous appendix. It is assumed, for simplicity, that the elasticity of demand by trucks is 0.0, and that trucks account for about 20 percent of total gasoline consumption. The only task remaining is to estimate the share of gasoline consumption consumed in the different kinds of automobile trips and to calculate the weighted average, the overall elasticity of demand for gasoline.

No data were available on gasoline consumption by trip purpose. Data were available on vehicle-miles by purpose of trip, however, and we assumed that gasoline consumption was directly proportional to vehicle-miles for all kinds of auto trips. We interpreted the available trip purposes as fitting into the categories for which we have elasticities of demand as shown in Table A-4. Summing up the kinds of trips within each of the four categories shown, we arrived at weights for the auto elasticity of demand. When these

Table A-3

Quantities of Gasoline That Will Be
Consumed Under Alternative Assumptions, By State, 1974
(Millions of Gallons)

I. Consumption is limited to 95 percent of 1972 levels, and desired consumption is 10 percent higher than actual 1972 consumption.

State	Auto Consumption	Truck Consumption[1]	Total
Connecticut	961.9	289.8	1251.7
Maine	372.5	112.3	484.8
Massachusetts	1665.7	501.9	2167.6
New Hampshire	279.7	84.3	364.0
Rhode Island	271.1	81.6	352.7
Vermont	176.2	53.1	229.3
New England Total	3727.0	1123.3	4850.3

II. Consumption is limited to 95 percent of 1972 levels, and desired consumption is 15 percent higher than actual 1972 consumption.

State	Auto Consumption	Truck Consumption[1]	Total
Connecticut	948.7	303.0	1251.7
Maine	367.4	117.4	484.8
Massachusetts	1642.8	524.8	2167.6
New Hampshire	275.9	88.1	364.0
Rhode Island	267.4	85.3	352.7
Vermont	173.7	55.6	229.3
New England Total	3676.0	1174.3	4850.3

[1] It is assumed that trucks accounted for about 20 percent of gasoline consumption during 1973, and that their consumption is totally insensitive to the price of gasoline.

Table A-4

Distribution of Vehicle-Miles by Purpose of Trip, and Classification of MVMA Trip-Purposes Into the Four Categories for Which Elasticities of Demand Have Been Estimated

	Percent of Vehicle-Miles
Intracity Trips	
Work Trips	
To and from work	34.1
Medical & dental (family business trips)	1.6
Educational, civic & religious trips	5.0
Total	40.7
Shopping Trips	
Shopping	7.6
Other family business	10.4
Pleasure rides	3.1
Other social & recreational	15.5
Total	36.6
Intercity Trips	
Business	
Business related to work	8.0
Total	8.0
Personal	
Vacation	2.5
Visit friends or relatives	12.2
Total	14.7

SOURCE: Motor Vehiciles Manufacturers Association, *Automobile Facts and Figures*, 1972 edition, p.35. The classification was performed arbitrarily by CRA.

weights are combined with the two sets of elasticity estimates reported in another appendix, the resulting auto elasticities and overall elasticities are shown in Table A-5.

Estimates of the Equilibrium Price

We are now in a position to estimate the percentage increase in price that will be necessary to reduce consumption to the mandated production levels in 1974.

The two assumptions about the gap between desired and actual consumption (at current prices of gasoline) imply reductions in demand of about 15 and 17.4 percent. Using the estimates of elasticity shown in Table A-5, the percentage increase in price that will bring about equilibrium can be estimated as:

Overall Elasticity	15 Percent Reduction	17.4 Percent Reduction
-0.275	54.6	63.3
-0.80	18.8	21.8

If we assume that the New England price of gasoline is $0.45 per gallon, these percentage price increases imply the following absolute increases and equilibrium prices:[1]

Overall Elasticity		15 Percent Reduction in Demand	17.4 Percent Reduction in Demand
-0.275:	Increase	25¢/gal.	28¢/gal.
	Equilibrium Price:	70¢/gal.	73¢/gal.
-0.80:	Increase	8¢/gal.	10¢/gal.
	Equilibrium Price:	53¢/gal.	55¢/gal.

[1]As reported in the *Oil and Gas Journal*, Dec. 10, 1973, p.174, the Dec. 4, 1973 price of major brand regular gasoline in Boston at the pump (including all federal, state and local taxes) was 44.9¢ per gallon.

Table A-5

Derived Elasticities, Autos, Trucks and Overall

	Inelastic Demand Assumptions	Elastic Demand Assumptions
Auto Elasticity	-0.344	-1.00
Truck Elasticity	-0.00	-0.00
Overall Elasticity	-0.275	-0.80

Sources and methods

1. Auto Elasticity

(i) Inelastic demand assumptions: The most inelastic estimates shown in Table A-1 were weighted by the proportion of trips in each class (shown in Table A-3). Elasticities and weights were thus:

Kind of Trip	Elasticity	Weight
Intracity work	-.247	.407
Intracity shopping	-.439	.366
Intercity business	-.179	.080
Intercity personal	-.465	.147

(ii) Elastic demand assumptions: The most elastic estimates shown in Table A-1 of Appendix II, -1.0 for all kinds of trips.

2. Truck Elasticity

Assumed to be -0.0.

3. Overall Elasticity

In each case, a weighted average of truck and auto elasticity, the respective weights being 0.20 and 0.80 (corresponding to the share of gasoline consumption by each vehicle type).

Costs of the Shortage

The costs of the shortage under the different assumptions about the overall elasticities of demand and the magnitude of the shortage were derived by multiplying the increase per gallon times the number of gallons consumed, under the assumption that consumption was equal to the mandated production, 95 percent of 1972 levels. The resulting costs were shown in Table 1-2 in the text. That is, the figures shown in Table 1-2 were derived by multiplying the increases in price shown above by the consumption figures shown in Table A-2.

Employment and Payroll in New England Tourist Industries, by State

STATE OF CONNECTICUT

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	TOURISM FIGURES: Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Fairfield					
Employees	254,162	8,937	1,933	1,754	5.0
Payroll[1]	529,209	7,574	2,050	2,575	2.3
Hartford					
Employees	325,657	12,139	2,290	1,596	4.9
Payroll[1]	671,341	9,976	2,559	1,602	2.1
Litchfield					
Employees	34,258	918	334	137	4.1
Payroll[1]	61,305	605	312	121	1.7
Middlesex					
Employees	29,736	1,299	421	214	6.5
Payroll[1]	55,202	777	356	206	2.4
New Haven					
Employees	247,551	8,902	1,395	987	4.6
Payroll[1]	479,989	6,889	1,370	1,201	2.0
New London					
Employees	58,740	2,359	1,021	215	6.1
Payroll[1]	117,032	1,836	905	272	2.6
Tolland					
Employees	11,389	847	140	72	9.3
Payroll[1]	17,093	582	118	92	4.6
Windham					
Employees	22,879	731	158	79	4.2
Payroll[1]	38,711	485	131	68	1.8
STATE TOTAL	991,939	36,354	7,693	5,065	5.0
	1,986,485	28,859	7,802	6,139	2.2

SOURCE: Connecticut County Business Patterns, 1972, Tables 1B, 1F, & 2, pp. 19-21,25, 31-60

[1]Payroll in thousands of dollars

STATE OF MAINE

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
		TOURISM FIGURES			
Androscoggin					
Employees	26,606	1,150	256	137	5.8
Payroll[1]	37,046	723	198	67	2.7
Aroostook					
Employees	16,805	519	272	41	5.0
Payroll[1]	22,667	298	187	28	2.3
Cumberland					
Employees	67,267	3,084	1,083	255	6.6
Payroll[1]	108,988	1,935	1,031	231	2.9
Franklin					
Employees	6,476	162	198	189	8.5
Payroll[1]	9,989	109	129	206	4.4
Hancock					
Employees	6,880	137	167	36	4.9
Payroll[1]	9,962	80	127	30	2.4
Kennebec					
Employees	27,531	838	321	44	4.4
Payroll[1]	42,129	481	233	36	1.8
Knox					
Employees	6,430	156	135	Not	4.5
Payroll[1]	8,513	90	97	listed	2.2
Lincoln					
Employees	4,103	104	103	Not	5.0
Payroll[1]	6,747	59	103	listed	2.4
Oxford					
Employees	9,731	250	162	137	5.6
Payroll[1]	14,914	122	135	123	2.5

[1]Payroll in thousands of dollars

(Table continued on following page)

STATE OF MAINE

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972 (continued)

County	County Totals	Eating & Drinking Places (TOURISM FIGURES)	Hotel & Other Lodgings (TOURISM FIGURES)	Amusement & Recreation (TOURISM FIGURES)	Tourism Percentages
Penobscot					
Employees	31,592	1,390	530	153	6.6
Payroll[1]	50,868	970	394	83	2.8
Piscataquis					
Employees	3,569	58	146	Not	5.7
Payroll[1]	4,428	28	145	listed	3.9
Sagadahoc					
Employees	5,444	78	Not	(D)	1.4
Payroll[1]	9,632	47	listed	(D)	0.5
Somerset					
Employees	8,970	312	72	Not	4.3
Payroll[1]	12,428	161	61	listed	1.8
Waldo					
Employees	4,124	129	Not	Not	3.1
Payroll[1]	5,278	69	listed	listed	1.3
Washington					
Employees	5,129	150	55	Not	4.0
Payroll[1]	6,758	73	35	listed	1.6
York					
Employees	22,169	1,008	312	106	6.4
Payroll[1]	30,645	642	261	82	3.2
STATE TOTAL					
Employees	255,346	9,639	3,923	1,320	5.8
Payroll[1]	385,257	5,964	3,231	1,018	2.7

SOURCE: Maine County Business Patterns, 1972, Tables 1B, 1F, and 2, pp. 16-18, 21, 23-46.

[1]Payroll in thousands of dollars

STATE OF MASSACHUSETTS

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	TOURISM FIGURES Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Barnstable					
Employees	23,205	2,290	1,015	156	14.9
Payroll[1]	35,188	1,729	942	157	8.0
Berkshire					
Employees	46,063	1,937	931	615	7.6
Payroll[1]	86,533	1,390	809	552	3.2
Bristol					
Employees	139,571	5,478	728	553	4.8
Payroll[1]	213,249	3,716	588	490	2.2
Dukes					
Employees	1,525	107	Not	Not	7.0
Payroll[1]	2,308	53	Listed	Listed	2.3
Essex					
Employees	180,832	11,311	1,377	931	7.5
Payroll[1]	320,027	8,296	1,129	961	3.2
Franklin					
Employees	14,975	838	136	Not	6.5
Payroll[1]	25,737	573	85	Listed	2.6
Hampden					
Employees	142,846	6,504	1,215	1,103	6.2
Payroll[1]	249,286	4,687	1,150	919	2.7
Hampshire					
Employees	25,275	1,566	486	70	8.4
Payroll[1]	39,049	931	373	51	3.5

[1]Payroll in thousands of dollars

(Table continued on following page)

STATE OF MASSACHUSETTS

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972 (continued)

County	County Totals	TOURISM FIGURES: Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Middlesex					
Employees	437,495	17,935	3,451	1,392	5.2
Payroll[1]	894,673	13,213	3,347	1,507	2.0
Nantucket					
Employees	914	Not	Not	Not	--
Payroll[1]	1,385	Listed	Listed	Listed	--
Norfolk					
Employees	155,656	9,661	1,456	1,268	8.0
Payroll[1]	283,869	7,164	1,195	1,575	3.5
Plymouth					
Employees	65,038	4,603	370	443	8.3
Payroll[1]	99,640	3,115	304	458	3.9
Suffolk					
Employees	449,293	18,125	6,801	2,809	6.2
Payroll[1]	927,435	16,310	9,451	4,726	3.3
Worcester					
Employees	196,981	8,176	1,498	696	5.3
Payroll[1]	343,090	5,420	1,306	586	2.1
STATE TOTALS					
Employees	1,891,109	88,785	19,541	10,152	6.3
Payroll[1]	3,544,940	66,837	20,757	12,067	2.8

SOURCE: Massachusetts County Business Patterns, 1972, Tables IB, LF, and 2, pp. 20-22, 27, 29-86.

[1]Payroll in thousands of dollars

STATE OF NEW HAMPSHIRE

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	TOURISM FIGURES: Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Belknap					
Employees	10,136	413	289	not	6.9
Payroll[1]	15,654	240	245	listed	3.1
Carroll					
Employees	4,885	370	606	231	24.7
Payroll[1]	6,055	223	516	237	16.1
Cheshire					
Employees	15,037	502	300	not	5.3
Payroll[1]	24,642	361	198	listed	2.3
Coos					
Employees	9,098	274	196	(D)	5.2
Payroll[1]	13,886	142	167	(D)	2.2
Grafton					
Employees	17,263	596	775	387	10.2
Payroll[1]	27,079	437	863	500	6.6
Hillsborough					
Employees	81,530	3,229	1,010	432	5.7
Payroll[1]	139,672	1,970	754	407	2.2
Merrimack					
Employees	22,324	724	530	268	6.8
Payroll[1]	36,434	477	397	205	3.0
Rockingham					
Employees	29,257	1,896	917	782	12.3
Payroll[1]	43,453	1,326	754	1,162	7.5
Strafford					
Employees	19,839	876	136	66	5.4
Payroll[1]	29,567	533	109	78	2.4

Table continued on following page.

STATE OF NEW HAMPSHIRE

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

		TOURISM FIGURES			
County	County Totals	Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Sullivan					
Employees	7,547	179	82	not	3.5
Payroll[1]	11,798	94	33	listed	1.1
STATE TOTAL	219,146	9,130	4,847	2,475	7.5
	352,211	5,861	4,041	2,905	3.6

SOURCE: New Hampshire County Business Patterns, 1972, Tables IB, IF, and 2, pp. 16-18, 21, 23-41.

[1]Payroll in thousands of dollars.

STATE OF RHODE ISLAND

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	TOURISM FIGURES: Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Bristol					
Employees	9,837	343	Not Listed		3.5
Payroll[1]	15,184	250			1.6
Kent					
Employees	31,940	1,730	212	247	6.9
Payroll[1]	49,973	1,172	173	229	3.1
Newport					
Employees	12,655	1,045	544	157	13.8
Payroll[1]	19,924	758	435	170	6.8
Providence					
Employees	220,963	7,126	1,171	1,513	4.4
Payroll[1]	372,451	5,225	1,077	2,183	2.3
Washington					
Employees	13,855	900	220	126	9.0
Payroll[1]	21,388	638	130	120	4.2
STATE TOTAL	292,412	11,220	2,193	2,121	5.3
	484,947	8,111	1,845	2,785	2.6

SOURCE: Rhode Island County Business Patterns, 1972, Tables 1B, 1F, and 2, pp. 17-18, 22, 23-26.

[1] Payroll in thousands of dollars

STATE OF VERMONT

MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

County	County Totals	TOURISM FIGURES: Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Addison					
Employees	4,403	107	142	Not Listed	5.7
Payroll[1]	7,040	62	105		2.4
Bennington					
Employees	9,036	382	332	330	11.6
Payroll[1]	12,771	287	229	314	6.5
Caledonia					
Employees	5,985	219	160	Not Listed	6.3
Payroll[1]	9,296	104	132		2.5
Chittenden					
Employees	31,217	1,616	475	119	7.1
Payroll[1]	61,445	911	402	131	2.4
Essex					
Employees	1,032		Not Listed		-
Payroll[1]	1,739				-
Franklin					
Employees	5,484	158	129	Not Listed	5.2
Payroll[1]	7,961	89	104		2.4
Grand Isle					
Employees	231		Not Listed		-
Payroll[1]	264				-
Lamoille					
Employees	3,383	330	585	(D)	27.0
Payroll[1]	4,416	258	583	(D)	19.0
Orange					
Employees	2,892	147	48	Not Listed	6.7
Payroll[1]	3,813	88	42		3.4

Table continued on following page

STATE OF VERMONT (Continued)
MID-MARCH EMPLOYMENT AND FIRST QUARTER PAYROLLS IN TOURIST INDUSTRIES, 1972

		TOURISM FIGURES			
County	County Totals	Eating & Drinking Places	Hotel & Other Lodgings	Amusement & Recreation	Tourism Percentages
Orleans					
Employees	3,952	106	160	(D)	6.7
Payroll[1]	5,360	64	108	(D)	3.2
Rutland					
Employees	13,837	824	689	(D)	10.9
Payroll[1]	21,243	483	500	(D)	4.6
Washington					
Employees	12,635	578	463	271	10.4
Payroll[1]	19,442	402	450	365	6.3
Windham					
Employees	13,037	603	1,100	513	17.0
Payroll[1]	20,330	492	1,250	697	12.0
Windsor					
Employees	11,934	373	642	351	11.4
Payroll[1]	20,003	220	540	361	5.6
STATE TOTAL	120,684	5,559	4,988	2,555	10.9
	197,839	3,525	4,500	3,141	5.6

SOURCE: Vermont County Business Patterns, 1972, Table 1B, 1F, and 2, pp. 15-16, 19, 20-35

[1] Payroll in thousands of dollars