Exchangeable Coupon Gas Rationing

By Clark Edwards

During the gas shortage in the winter of 1973-74, farmers were high on the priority list for gasoline allocations. Under the proposed exchangeable coupon gasoline rationing, this allocative machinery and priority system would be superseded by a coupon resale market. The exchangeable coupon resale market is examined from the perspective of a consuming household and of a producing firm. The conclusion is that the coupon resale market will ration gas among the same users that a higher market price would—the difference being not one of allocation of gas among alternative uses, but one of redistribution of income. The amount of income to be redistributed is estimated in the neighborhood of $28 billion per year.

Key words: Economic theory, Income distribution, Gasoline, Rationing.

Harbingers of a gasoline shortage have been around for a year or two. In the early months of 1974, most Americans became acutely aware of the prospect. Retail outlets started running out of gas, price gouging was reported, a trucker’s strike was declared, limits were placed on sales, and queues at retail outlets grew several blocks long. Speed limits, alternate-day sales, and voluntary rationing helped consumers adjust to the problem.

Before the shortage, the quantity of gasoline supplied to the economy had been increasing around 6 percent per year. Prices were relatively stable until early 1973 when they inched up to around $0.37 per gallon (including taxes) for regular gas. The steady rise in utilization reflected a growing population, rising income, and a changing technology of production and consumption. The trend was halted abruptly in the fall of 1973, and utilization of gasoline during the first quarter of 1974 was around 6 percent below a year earlier. The shortage put a strain on the economy and raised the specter of rationing.

Two events can obviate the need for rationing if demand remains unchanged: Increased supplies and increased prices. Both events were occurring or in prospect by the spring of 1974. In March 1974, the average selling price of gas exceeded $0.50 per gallon, including taxes, and was some 38 percent above a year earlier. The forecast at the time was for some continued upward pressure on prices, possibly to $0.60, and for some increase in supplies through imports and domestic production. The import embargo was relaxed. Utilization was down and prospective supply was up by the first day of spring to make rationing appear unlikely.

Even so, rationing had been a distinct possibility (one which some consumers wished had already been imposed as they waited an hour or two in line for a tankful) and could become one again. Several plans were proposed for dealing with the gasoline shortage. One of the rationing plans considered by the Federal Energy Office was an exchangeable coupon rationing system. It was a contingency plan and, as such, was never formally approved or “endorsed” by the Federal Energy Office. What was this contingency plan like?

The basic ingredients of the planned gasoline rationing program were price controls below the market level, exchangeable coupons, and ration banking. Suppose we are in equilibrium with utilization of 105 billion gallons of gas per year at $0.60 per gallon when a shortage of 10 percent is suddenly experienced. Market forces will immediately exert an upward pressure on prices. Estimates of the price elasticity of demand for gas consistently confirm an inelastic market. Oil companies have promoted supplies over the past half-century to avoid lower prices which could drop total revenue below total costs. With an inelastic demand, a small percentage increase in quantity would induce a relatively large percentage decrease in price and a loss in total revenue. Statistical analyses point to market changes consistent with a short-run price elasticity between −0.10 and −0.25. Assuming a price elasticity of demand of −0.2, the 94.5 billion gallons available would clear the market at $0.90 per gallon.

The proposed rationing program, in this situa-
tion, would freeze prices at $0.60 and distribute exchangeable coupons for 94.5 billion gallons to private and commercial users. These coupons could be used by the recipient or traded in the market. It is shown in a subsequent section that the market might value coupons at about $0.30 per gallon. Post offices could allocate coupons to licensed drivers and to commercial users. (Bulk users might use negotiable drafts instead of small-denomination coupons.) Retailers (or wholesalers to final users) would require coupons (or drafts) to sell gas. The final seller would bank coupons along with cash receipts and use drafts against such coupon bank deposits to obtain gas from wholesalers. Thus coupon banking would move wholesale gas into the regional markets where coupons evidenced demand. Gas would follow coupons as reorders were made by retailers. There would be enough gas to fill such orders because the amount of coupons out would equal the amount of gas available. The $0.90 opportunity cost of a gallon of gas under the proposed rationing program would distribute the available gas among approximately the same uses that an actual pump price of $0.90 would. However, the income distribution would be different.

The Theory of Consumer Demand

From the point of view of an individual, private, licensed driver, the problem may be regarded as one of seeking to maximize utility \( U \) from gas \( G \) and from nongas goods \( M \) subject to a budget constraint reflecting income adjusted for purchase or sale of coupons. That is, maximize:

\[
(1) \quad U = f(M, G)
\]

subject to

\[
(2) \quad M = I - pG + q(R-G)
\]

where \( I \) is income per time period, \( R \) is the ration allotted by coupons under the program, \( p \) is the price of gas, and \( q \) is the price of coupons. If the consumer uses exactly his ration, then \( R - G = 0 \) and \( M \) is independent of \( q \). If the consumer buys coupons, then \( R - G < 0 \) and less money is used for nongas goods \( M \). If the consumer sells coupons and uses less gas then his allotment, then \( R - G > 0 \) and more money is available for nongas goods \( M \). The marginal condition for maximum utility is

\[
(3) \quad \frac{\partial U}{\partial G} = (p + q) \frac{\partial U}{\partial M}
\]

which says that gas is acquired up to the point that the utility of one more gallon equals the marginal utility of \( p + q \). That is, \( p + q \) is the relevant choice indicator regardless of whether the consumer buys or sells coupons or refrains from the coupon market. \( p + q \) reflects the opportunity cost of using a gallon of gas. If \( p \) is $0.60 and \( q \) is $0.30, one gives up $0.90 in purchasing power to gain a gallon of gas.

Without rationing, and with no gas shortage, we may consider \( q \) equal to zero. The consumer allocates his income between \( G \) and \( M \) so that \( \partial U/\partial G = p(\partial U/\partial M) \). This is shown in figure 1 as the point of tangency of the initial budget line \( B_0 \) with the initial indifference curve \( I_0 \). The consumer uses the combination \((M_0, G_0)\).

If there is a shortage and the price of gas is raised until the reduced quantity of gas just clears the market, then the budget line rotates to \( B_1 \) from \( B_0 \) to reflect the higher price (figure 1). Consumption becomes \((M_1, G_1)\). The consumer buys less gas (and with an inelastic demand spends more for it) so that indifference level \( I_1 \) is attained instead of \( I_0 \). The higher gas price achieves the goal of reduced gas consumption, but, as a side effect, real income or purchasing power is reduced.

It is to prevent the hardships of this loss in purchasing power that rationing is imposed (19). For example, if the consumer were given coupons \( R \) with which to buy \( G_1 \) gallons of gas and the price were frozen at the preshortage level, then the consumer could obtain \((M_2, G_1)\) and reach indifference curve \( I_2 \) (figure 1). While this is worse for him than \( I_0 \), it is better than \( I_1 \), and still achieves the program target of reduced gas consumption. This allocative kind of rationing avoids the loss in utility due to the income effect of the gas shortage, but imposes a loss from the substitution effect of using more \( M \) and less \( G \) than is preferred at prevailing market prices. Consumers with other preference patterns might find that \( R > G_0 \), in which case they would continue to consume \((M_0, G_0)\).

This allocative form of rationing with nonnegotiable coupons is the type imposed during World War II. Reder (20) discusses the welfare economics of rationing. He points out that the
combination achieved under allocative rationing \((M_2, G_1)\) is superior to that under higher market prices \((M_1, G_1)\) but inferior to the initial equilibrium \((M_0, G_0)\). Reder goes on to prove that allocative rationing results in a preferred equilibrium to rationing by means of a tax on gas (which is the same to the consumer as a higher market price), but that the latter is preferred to reduced consumption by means of a general tax on all commodities, or an income tax. Reder does not discuss exchangeable coupon rationing.

Samuelson (23) discusses the pure theory of choice under rationing. He explains simple rationing in which the Government specifies the maximum amount of a particular commodity that each individual can consume, such as gasoline. He compares this with “point rationing” in which the individual is limited to a weighted sum of commodities. For example, as Neisser (16) suggests, Government can hardly assign a certain amount of each of the different cuts of meat to a consumer, but can limit the consumption of the group of meat products with the point prices of each cut of meat providing the relative weights. In the current gasoline case, it is implied that regular gas carries the same weight as premium. Samuelson works out the equations for maximizing utility under point rationing without exchange of points. He adds that unless the Government were to explicitly ban such transactions, an exchange market
for points would arise. From a welfare point of view, he says, it can be shown that the free interchange of coupons for money is, in a certain sense, optimal. But in his concluding sentence he warns that it should not be thought that anything he has said is an argument for making coupons interchangeable, since there might in fact be grave difficulties in the way of devising a method of point allocation which would recognize the harm done to individuals. The harm Samuelson was concerned with was that done to the middle class when the rich bought stamps from the poor and bid up the stamp market price. Samuelson is right in saying that the rich and poor might trade to mutual advantage and to the disadvantage of the middle class, but he overlooks certain corollaries: (a) the rich could bid up the price of scarce gas in the same way if there were no rationing and prices were allowed to rise, and this would disadvantage both the middle class and the poor; society may be better off with allocative rationing than with no rationing at all; and (b) the middle class consumers are better off buying or selling coupons at the price the rich bid them up to than in using their allotment and not exchanging coupons; society may be better off with exchangeable coupon rationing than with allocating coupons; society may be better off with exchangeable coupon rationing than with allocative rationing. Boulding (2) says that rationing is probably the most equitable method of direct restriction of purchases during a shortage. He added that if price is allowed to rise freely the rich may bid up the price until the commodity is out of reach of the poor.

It will be shown in connection with figure 3, below, that rationing with exchangeable coupons leads to a higher level of consumer utility than does allocative rationing. Under allocative rationing, at \((M_2, G_1)\) in figure 1, the marginal rate of substitution of gas for money is not equal to the price ratio, suggesting that the consumer might move to a higher indifference level than \(I_2\) by entering a negotiable coupon market. Figure 2 shows the effect of such a market on the budget line.

With a resale market and \(q > 0\), combination \((M_2, G_1)\) is feasible \((R = G_1)\). This point is common to both the original budget line \(B_0\) and the one with exchangeable coupons \(B_2\). The slope of \(B_0\) is \(p\); the slope of \(B_2\) is \(p + q\). If the consumer sells coupons he not only gains \(q\) for cash coupons sold but also foregoes buying gas for \(p\) per coupon; for each coupon sold, \(p + q\) is available to spend on nongas goods \((M)\). The demand for gas now depends on the tangency of \(B_2\) with an indifference curve.

Figure 3 illustrates the solution for a consumer with a preference pattern such that he buys coupons but consumes less gas at \(p + q\) than at \(p\). The implications of other preference patterns are discussed below. With exchangeable coupons, the consumer in figure 3 uses \((M_3, G_2)\) and realizes \(I_3\). He is worse off than before the shortage but better off than under higher market prices or under regulated consumption with nonnegotiable coupons.

Several results follow from this analysis. First, if there is an exchangeable coupon market, then the pump price of gas plus the coupon price is the relevant choice indicator in allocating gas among alternative uses. The opportunity cost applies whether the user is buying or selling coupons. If the coupon resale market is functioning smoothly, the allocation of gas obtained by this choice indicator will not be very different from that obtained by the free market price. Consequently, the allocation of gasoline among alternative ends will be about the same under higher market prices as under exchangeable coupon rationing. The differences will be attributable more to the different income effects than to a difference in the choice indicator. On the other hand, allocation of gasoline among...
alternative ends is likely to be different under exchangeable coupon rationing from what it would be under an allocative rationing system where priorities have to be set by the Government.

Second, rationing under an exchangeable coupon market is likely to lead to higher levels of consumer satisfaction than allocative rationing which, in turn, is preferred to programs which reduce consumption through higher taxes or higher prices.

Third, inasmuch as the allocation of gas among alternative uses is about the same under exchangeable coupons and higher market prices, the difference between those programs is one of income distribution. Coupons give the added value to final users, and higher prices transfer it to the oil industry. A tax equal to the coupon value would result in approximately the same allocation of gasoline while transferring income to the Government. The income effect will have some impact on the allocation of gas among alternative uses. If we are thinking of 94.5 billion gallons of gas per year and a coupon price of $0.30 per gallon, the implied income transfer is $28 billion per year. For an individual, private, licensed driver allocated 10 gallons per week, it amounts to $156 per year.

Fourth, the utility of the program depends on controlled pump prices. If the pump price is allowed to rise toward the free market price, then the value of a coupon in the market is
diminished and the need for a rationing program is reduced.

The curves were drawn in figure 3 to reflect a consumer who will buy coupons and consume gas so that \( G_2 > R \). Other consumer psychologies can be superimposed on the money constraint of figure 2 to suggest selling rather than buying coupons. At the extreme, if a licensed driver received coupons but always rode a bicycle, he could sell all his coupons. The situation can be imagined with reference to figure 2. Before rationing, the bicyclist had \( M_4 \) to spend. After receiving and selling his gas ration \( R \) at price \( q \) per unit, he finds he has \( M_5 \) to spend. Hence the income effect of the program is \( M_5 - M_4 \). All licensed drivers receive this income effect. The bicyclist realizes all the effect in cash.

Some consumers may be better off under exchangeable coupon rationing than in the initial, prerationing equilibrium. The result depends on a utility surface reflecting a high marginal utility of money relative to the marginal utility of gas. Figure 4 depicts a consumer who sells some coupons, buys some gas, and is better off than under the initial conditions. This result is particularly likely to obtain for a consumer whose preference pattern is such that \( R > G_0 \) (not shown in the diagram). Such a consumer would be indifferent between allocative rationing and the prerationing situation. He benefits from a program which keeps pump prices lower. And he benefits from the income effect of exchangeable coupons.

Attention needs to be turned to the effects of gasoline rationing with exchangeable coupons on
alternative income levels. Neisser (16) addresses the question of the conditions under which the lowest income classes would benefit from rationing at the cost of the rest of the population. He suggests the outcome depends in part on the overall income distribution, on the percent that the value of the rationed item is of the individual's total purchases, and on whether the rationed allowance exceeds the quantity the individual consumed before rationing. If the income elasticity of demand for gas is positive, we might expect to find a higher income person using more gas than \( R \) and a lower income person using less, although the number of gallons rationed \( (R) \) is the same for both consumers.

Figure 5 shows the possibility of the lower income person becoming relatively better off from the realization of added cash through the sale of coupons, while the higher income person finds his utility reduced under rationing. This is not to say that the program necessarily helps low-income families at the expense of those with higher incomes, but there does appear to be such a general tendency. The income effect is proportionately larger for the lower income consumer. A family with two licensed drivers and an income of $3,000 per year will find the market value of the coupons received to be around 10 percent of income. For a family earning $30,000 per year, the income effect of the program would be only 1 percent of income. Hence the

Figure 5
income distribution effect of the exchangeable coupon rationing program is progressive.

The lower income person's gain depends on a well-ordered market for coupons. If he sells coupons for $0.05 or $0.10 a gallon to someone who will resell them for $0.40 or $0.50 to a desperate user, then the income transfer is to the broker rather than to the low-income seller or the desperate buyer. Under a well-ordered coupon market, the regulated pump price plus the market price of coupons \((p + q)\) is the relevant choice indicator regardless of consumer psychology or income level.

It may be expected that the market will develop a bid-ask system of pricing. For example, a driver with a few extra coupons might sell them to a retailer for $0.25 each and a customer might come along a few minutes later and buy them for $0.30.

On the consideration that the consumer can acquire \(A\) coupons in the market at price \(qa\) or sell \(S\) coupons at price \(qs\), it is useful to restate the consumers' problem as follows: Maximize

\[
(1) \quad U = f(M, G)
\]

subject to

\[
(4) \quad M = I - pG - qaA + qS
\]

where

\[
(5) \quad G = R + A - S
\]

\[
(6) \quad AS = 0
\]

\[
(7) \quad A \geq 0
\]

\[
(8) \quad S \geq 0
\]

\[
(9) \quad qa \geq qs
\]

The marginal condition for maximizing utility in this situation is a pair of inequalities:

\[
(10) \quad (p + qa) \frac{\partial U}{\partial M} \geq \frac{\partial U}{\partial G} \geq (p + qS) \frac{\partial U}{\partial M}
\]

Now if the consumer is buying coupons, then \(A > 0, S = 0\), and

\[
(11) \quad (p + qa) \frac{\partial U}{\partial M} = \frac{\partial U}{\partial G}
\]

which says that coupons and gas are acquired up to the point at which the utility of one more gallon of gas equals the utility of the money represented by \((p + qa)\). If the consumer is selling coupons, then \(A = 0, S > 0\), and

\[
(12) \quad (p + qS) \frac{\partial U}{\partial M} = \frac{\partial U}{\partial G}
\]

which says that coupons are sold and gas is acquired up to the point at which the utility of one more gallon equals the utility of the money represented by \((p + pG)\). If the consumer is neither buying nor selling coupons, then the utility of a gallon of gas lies below the utility of \((p + q)\) but above the utility of \((p + qa)\).

If the price for which a consumer can sell coupons is below the price at which he can buy them, a kink appears in the budget constraint \(B\), as in figure 6. The intersection of this kink with the indifference map allows for corner solutions which increase the likelihood that the utility maximizing quantity of gas precisely equals the ration \((R = G, L)\).

The Theory of the Firm

From the point of view of an individual firm, the problem may be regarded as one of seeking to maximize profits \((\pi)\) from the production of a single product \((Y)\) using a variable resource \((X)\) and gasoline \((G)\) with an exchangeable coupon ration \((R)\). That is, maximize

\[
(13) \quad \pi = P_y Y - P_x X - pG + q(R - G)
\]

subject to

\[
(14) \quad Y = f(X, G)
\]

where \(P_y\) and \(P_x\) are the price of the product and variable factor respectively, \(p\) is the price of gas, \(q\) the exchange value of a coupon, and \(R\) the ration of coupons. The marginal condition with respect to optimal use of \(X\) is

\[
(15) \quad P_y \frac{\partial Y}{\partial X} = P_x
\]

and that for gas is

\[
(16) \quad P_y \frac{\partial Y}{\partial G} = p + q
\]

which says the condition for using \(X\) is that the marginal value product equals the factor price,
while the condition for using gas is that the marginal value product of gas equals the pump price of gas plus the market value of the exchangeable coupons. These two conditions imply

\[ \frac{\partial X}{\partial G} = \frac{p + q}{P_x} \]

which says the marginal rate of substitution equals the ratio of the pump price plus coupon price to the price of \( X \). Thus as \( q \) becomes larger, less gas relative to \( X \) will be used in order to make the marginal rate of substitution larger. In terms of factor-factor substitution, higher coupon prices \( (q) \) encourage firms to use relatively less gas and more of other resources subject to the technical possibilities of conserving gasoline.

In addition, this line of thinking leads one to suspect that, as \( q \) rises, the final product mix of the economy under rationing is likely to reflect an increased proportion of commodities which require relatively less gas in their production and distribution.

The level of gas consumption by the firm is analyzed by reference to the demand in the factor market as measured by the marginal value product. In figure 7, \( G_0 \) is the amount of gas the firm uses at price \( p \). Suppose the ration \( R \) is less than \( G_0 \). The firm can exchange coupons plus money for gas up to point \( R \). If, at this juncture, the marginal value product of gas exceeds the opportunity cost \( p + q \), as assumed in figure 7, the firm will buy coupons on the market and

Figure 6
maximize profits with \( G \) units of gas. Figure 7 shows the incentive for a firm to buy coupons on the market when \( MVP_g > (p + q) \) at \( G = R \).

On the other hand, if \( MVP_g < (p + q) \) at \( G = R \), the firm will have an incentive to sell coupons as shown in figure 8. From figures 7 and 8 it becomes apparent that \( p + q \) is the choice indicator of how much gas to use, and the size of \( R \) has no direct relation to the optimal level of \( G \). However, the firm prefers a large \( R \) to a small one because of the income transfer effect. The monetary value of the transfer is \( qR \), indicated by the shaded area in figures 7 and 8.

In the event that a bid-ask pricing system obtains for coupons, the marginal condition for optimal use of gas by the firm is

\[
(p + q_d) \geq MVP_g \geq (p + q_s)
\]

The case for which \( MVP \) lies between these bounds, and both inequalities hold, is shown in figure 9. The firm will maximize profits by using exactly the ration of gas, \( R \), in this instance. Should the demand for gas by the firm shift to the right, the firm will buy gas for \( p + q_d \); should it shift to the left, the choice indicator becomes \( p + q_s \).

The Coupon Market: Aggregate Supply and Demand

Individual actions of firms and households in response to a distribution of exchangeable gas rationing coupons will lead to a market for coupons as described above. This section addresses the question of the probable monetary value of a coupon. If we start from an initial price and quantity, and assume a gas shortage, an estimate of the price impact depends upon an estimate of the price elasticity of demand for...
There are a number of difficulties involved in answering this empirical question. Some estimates of short- and long-run elasticities are available, but none drawn from a set of statistically satisfying situations paralleling the recent experience. The number of observations of price hikes in the range of 10 to 50 percent per year is not sufficient for a statistical estimate. And there is little statistical evidence as to the importance of probable shifters in the price-quantity relationship such as population, income per capita, tastes, and prices of related goods. But in a practical situation one works with what one has. Various statistical analyses point to a short-run price elasticity between -0.10 and -0.25, confirming the notion that the market for gasoline is inelastic. An elasticity of -0.20 would suggest that the 38 percent price rise from the spring of 1973 to the spring of 1974 was sufficient to curtail use by around 7 percent. Inasmuch as use was estimated around 12 percent below unconstrained demand at preshortage prices, and the remaining 5 percent could easily be explained by voluntary conservation practices and by continuing evidence of upward pressure on prices, it does not appear unreasonable to use -0.2 for illustrating the price effects of a gasoline shortage with implications for the exchange market price of coupons.

A price elasticity of -0.2 implies, under appropriate assumptions, a price flexibility of -5. Thus a shortage of 10 percent in gas supplies may induce a 50 percent increase in prices, resulting in a gain in total revenue to the industry of 35 percent. The relationship between price, quantity, and total revenue when the price flexibility equals -5 is shown in Table 1. The way this market behavior may translate into a price of coupons can be traced in Table 2.

Suppose the economy is in equilibrium with 105 billion gallons of gas selling for $0.60 per gallon, and a total revenue of $63 billion to the industry, when a 10 percent shortage in supplies arises. Then only 94.5 billion gallons of gas are available. One way to induce consumers to demand no more than the reduced supply of gas is to raise the price. With a price flexibility of -5 and a shortage of 10 percent, the resulting increase in price would be 50 percent. The price of gas would increase to $0.90 from $0.60. The total revenue to the oil industry would increase by 35 percent to $85 billion, a gain of $22 billion (Table 2).

Rationing with exchangeable coupons and with the pump price of gas frozen at $0.60 would create a coupon exchange market. The exchange price of a coupon would be bid up by users who value gas at more than the pump price. This market would reallocate the fixed

Table 1. Changes in price per gallon and total value of gasoline when price flexibility is -5 and supply declines by specified percentages

<table>
<thead>
<tr>
<th>Change in quantity</th>
<th>Change in price</th>
<th>Change in ( pQ )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>-1</td>
<td>5</td>
<td>3.95</td>
</tr>
<tr>
<td>-5</td>
<td>25</td>
<td>18.75</td>
</tr>
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<td>-10</td>
<td>50</td>
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<tr>
<td>-15</td>
<td>75</td>
<td>48.75</td>
</tr>
<tr>
<td>-20</td>
<td>100</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Table 2. Market value of gas and of coupons under alternative assumptions when supply declines by specified percentages

<table>
<thead>
<tr>
<th>Change in quantity</th>
<th>Quantity per year</th>
<th>Free market price of gas, ( p_f )</th>
<th>Value of gas, ( p_f q )</th>
<th>Price of a coupon, ( q ), at ( p = 0.60 )</th>
<th>Value of coupons, ( qQ )</th>
<th>Value of gas at ( p = 0.60 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td>Billion gallons</td>
<td>Dollars</td>
<td>Billion dollars</td>
<td>Dollars</td>
<td>Billion dollars</td>
<td>Billion dollars</td>
</tr>
<tr>
<td>0</td>
<td>105.00</td>
<td>0.60</td>
<td>63.0000</td>
<td>0.00</td>
<td>0.0000</td>
<td>63.0000</td>
</tr>
<tr>
<td>-1</td>
<td>103.95</td>
<td>0.63</td>
<td>65.4885</td>
<td>0.03</td>
<td>3.1185</td>
<td>62.3700</td>
</tr>
<tr>
<td>-5</td>
<td>99.75</td>
<td>0.75</td>
<td>74.8125</td>
<td>0.15</td>
<td>14.9625</td>
<td>59.8500</td>
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<td>-10</td>
<td>94.50</td>
<td>0.90</td>
<td>86.6500</td>
<td>0.30</td>
<td>25.8500</td>
<td>56.7000</td>
</tr>
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<td>-15</td>
<td>89.25</td>
<td>1.05</td>
<td>93.7125</td>
<td>0.45</td>
<td>40.1625</td>
<td>53.5500</td>
</tr>
<tr>
<td>-20</td>
<td>84.00</td>
<td>1.20</td>
<td>100.8000</td>
<td>0.60</td>
<td>50.4000</td>
<td>50.4000</td>
</tr>
</tbody>
</table>

Source: Table 1.
quantity of gas among users so that the value of gas at the margin to the user is equal to the opportunity cost of the pump price plus the coupon price. Coupons at $0.30 to ration 94.5 billion gallons of gas would generate a $28 billion coupon market (table 2). This is a measure of the income transfer to firms and households from the oil industry. With a market price of $0.90 for gas, the oil industry would gross $85 billion. But with $0.60 gas and $0.30 coupons, firms and households receive $28 billion, and the oil industry grosses only $57 billion. Hence the $28 billion gain to individuals is accompanied by a $6 billion loss to the oil industry (table 2).

The oil industry could avert this loss by seeking an increase in the pump price to $0.67. This would hold the industry gross (including taxes) at $63 billion. Then coupons would reach equilibrium at $0.23 per gallon and the gross value of the coupon market would be $22 billion per year (table 3).

Table 3. Total value of coupons, price per coupon, and price per gallon of gas required to hold industry revenue constant at $63 billion, when gasoline supply declines by specified percentages

<table>
<thead>
<tr>
<th>Change in quantity</th>
<th>Value of coupons (Billion dollars)</th>
<th>Price of a coupon (Dollars)</th>
<th>Price of gas (Dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>0</td>
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<td>0.6000</td>
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<td>0.0239</td>
<td>0.6000</td>
</tr>
<tr>
<td>-5</td>
<td>11.8125</td>
<td>0.1152</td>
<td>0.6000</td>
</tr>
<tr>
<td>-10</td>
<td>28.0500</td>
<td>0.2332</td>
<td>0.6000</td>
</tr>
<tr>
<td>-15</td>
<td>37.8000</td>
<td>0.3441</td>
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</tr>
</tbody>
</table>

Source: Table 2.

Conclusions

Gasoline rationing using exchangeable coupons and ration banking has several properties quite different from other forms of rationing or allocation. Highlights of some of the properties discussed in this paper, plus a few added considerations, follow:

1. When supplies are below unconstrained demand at present prices, possible solutions are to (a) increase supplies, (b) encourage voluntary reduction in demand, (c) impose a tax or surcharge, (d) raise prices, or (e) ration. This paper focuses on implications of the last two.

2. Each of the above alternatives can bring demand into balance with supply. But the alternatives differ with respect to their impacts on the allocation of scarce gasoline among alternative ends, and also on the distribution of income. The chief difference between raising prices, raising gas taxes, and exchangeable coupon rationing is the effect on income distribution. Raising prices transfers income to the oil industry; raising taxes transfers income to the Government; and coupon rationing transfers income to households and firms. Allocative rationing with priorities set by the Government may result in a different distribution of gasoline among uses than the other alternatives.

3. The magnitude of the income transfer associated with a 10 percent shortage is estimated in the neighborhood of $28 billion per year.

4. Prices at the pump must be frozen below the market level if coupon rationing is to be useful. If prices rise, the value of coupons falls accordingly and may become less on the resale market than the cost of operating the program.

5. The relevant choice indicator that firms and households will use in deciding how much gas to allocate among alternative uses under exchangeable coupon rationing is the sum of the pump plus the coupon price. Hence, if the pump price is $0.60 per gallon and a coupon is $0.30 per gallon, the choice indicator is $0.90.

6. It follows that the size of the ration to a firm or household does not affect the quantity of gas used, but only affects the income distribution. Hence, if one group is rationed at 100 percent of need and another group at 80 percent, the effect is simply to give a subsidy to the former group. Both groups will allocate gas on the basis of whether an additional gallon is worth $0.90 to them.

7. Gas rationing as a means of allocating a scarce resource and avoiding hardship is worthwhile. But, through the income redistribution effects, gas rationing with exchangeable coupons also becomes a welfare program. It may prove less efficient at meeting the latter objective than other welfare institutions. Insofar as the former goal of allocating a scarce resource without hardship is uppermost, coupon rationing may be worth the expense and effort. But if the latter goal of welfare is seen to be paramount, other,
more efficient institutions should be considered.

8. Exchangeable coupon gas rationing creates a new market institution likely to do a business worth $28 billion per year. The institution would be uncertain and imperfect. Some might take advantage of others in this situation. It is a responsibility of the Government when it creates such an institution to watch it, help it, and be sure it works fairly. For example, the Government may help make an efficient market by buying and selling coupons in very small lots. And the Government may collect coupon price information daily and disseminate it as a market news service.

9. The coupon resale market introduces a degree of flexibility in gasoline allocation among alternative ends that allocative forms of rationing don't have. But it doesn't solve all the administration problems. The coupon creates a price-protected market possibly $0.30 per gallon above the pump price. Efforts to circumvent this protection would give rise to black market and other illegal operations. Experience with illegal actions such as price gouging during the gasoline shortage in early 1974 suggests that gasoline rationing regulations with exchangeable coupons must provide adequate audit and enforcement procedures.

References

(21) Rothbarth, E. "The Measurement of Changes in Real Income Under Conditions of Rationing." Rev. Econ. Studies,


