Market Behavior Under Partial Price Controls

The Case of the Retail Gasoline Market

Frank Camm
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The Case of the Retail Gasoline Market

Frank Camm

March 1983

Prepared for the U.S. Department of Energy
This study is one product of research on petroleum product price controls under The Rand Corporation's Energy Policy Program. Although it discusses only retail market effects, it relies heavily in parts on work on wholesale price controls reported in Camm, Phelps, and Stan (1981a, b). The research on price controls has been supported by the U.S. Department of Energy under Contract No. DE-AC01-79PE0078, and by Rand corporate funds.

This report is intended primarily for economists interested in price controls. Although it draws heavily on the case of gasoline price controls during 1979-80, similar logic could easily be applied to a wide variety of other price controls that lead to multiple monetary prices in a single market. Examples include markets for health care, housing, food, and labor, where goods and services traded at administratively set prices play an important part in otherwise competitive markets.
SUMMARY

The use of firm-specific controls on the price of gasoline during 1979 and 1980, at both the wholesale and the retail level, dramatically affected the retail market for gasoline. The most visible effect was a diversity of monetary prices across service stations within particular retail market areas. Price could no longer play its usual role in clearing the retail market for gasoline. Queues and other changes in quality of service at stations arose to maintain the balance of market demand and supply. This report examines the behavior of an otherwise competitive market in the presence of such regulation-induced nonprice phenomena.

In such a market, consumers consider both monetary prices and costs imposed by queues in deciding where to buy gasoline and how much to buy. Using a price-theoretic model of behavior, we can predict how various changes in effective price regulation affect consumers. Four important results are obtained.

First, a regulatory change in one specific part of the retail gasoline market will tend to affect all parts of the market, but to have diminishing effects in more distant parts. For example, changes in the most heavily controlled prices will affect price and consumption in the (distant) uncontrolled segment of the market, but the effects on consumption will be greater at stations with low prices than at stations with higher prices.

Second, increasing price control in any part of the market has a strong tendency to help people with low costs of time and hurt those with high costs of time. Consumers with higher time costs will choose to pay higher monetary prices for gasoline. To the extent that cost of time is correlated with wage rates, changes in partial price control have important and predictable effects on gasoline consumption at different income levels.

Third, increasing price control has ambiguous effects on average queue lengths. Those effects depend on the specific form of increasing control, the distribution of controlled prices in the market, the distribution of time costs among consumers, and other factors.
Fourth, partial control can easily be less efficient than total control. In fact, through their effects on queueing times and production, some forms of partial control are highly likely to be worse, in the economist's eye, than total control at the lowest price in the partially controlled market.

These results are important whether the government consciously maintains a partially controlled market or not. It would be hard to argue that the government actively pursued the form of partial decontrol that occurred in gasoline markets during 1979-80. But proposals for specific forms of partial control, such as the "gourmet gasoline station," emerged during that period. It was argued that, for consumers who preferred paying high prices to waiting in long lines, prices at some stations should be decontrolled; these became known as gourmet stations. The present analysis should clarify where such proposals might lead, and generally help to foresee the effects of government policies that currently maintain partial price controls in markets for health care, food, housing, labor, and other goods and services.
ACKNOWLEDGMENTS

I wish to thank Daniel Kohler, Bridger Mitchell, David Seidman, Rodney Smith, and especially Charles Phelps and Peter Stan, for helpful discussions and comments. I also thank June Kobashigawa, Ethel Lang, and Helen Loesch for their care in preparing the manuscript.
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I. INTRODUCTION

The use of firm-specific controls on the price of gasoline during 1979 and 1980, at both the wholesale and the retail level, dramatically affected the retail market for gasoline. The most visible effect was a diversity of monetary prices across service stations within particular retail market areas. This was accompanied by and closely related to fundamental changes in retailer supply behavior.\footnote{For a detailed analysis of these changes at the firm level, see Camm, Phelps, and Stan (1981a, 1981b).}

Price could no longer play its usual role in clearing the retail market for gasoline. Queues and other changes in quality of service at stations arose to maintain the balance of market demand and supply. This report examines the behavior of an otherwise competitive market in the presence of such regulation-induced nonprice phenomena.

The report emphasizes that firm-specific price controls are quite common and that the degree of price control in a market can generally be characterized both by the severity of restrictions on output prices of any firm and by the extent of price restrictions across the market as a whole. That is, we can think of a continuum between totally controlled and totally uncontrolled markets; such markets are actually polar cases of a more general partially controlled market. In such a market, motorists weigh the price and nonprice components of purchases at alternative stations and make a "modal" choice on the basis of their personal characteristics. This report examines the equilibrium levels of price and nonprice components that emerge from such modal choices by all consumers in a market.

Section II briefly reviews the relevant price controls in effect in 1979 and 1980. Section III presents a simple model of partial price control whose implications are developed in Sec. IV. Section V examines how such price controls affect economic efficiency. Section VI illustrates how the analysis can be brought to bear on a specific, concrete, policy proposal, the idea of "gourmet gasoline
stations." Several appendixes develop the formal mathematical results that underlie arguments developed in the text.
II. RECENT PRICE CONTROL IN GASOLINE MARKETS

Gasoline markets in the United States were partially price controlled during 1979 and 1980. This section briefly reviews the controls in place during 1979-80, the prominent characteristics of gasoline markets then, and how they changed over that period.

THE SPRING 1979 REGULATIONS

In the spring of 1979, Department of Energy (DOE) regulation of retail service stations allowed retailers to charge a maximum legal ceiling price based on a fixed markup above the price they paid for wholesale gasoline. If retailers had historically been charging less than their full legal price, as commonly occurred, they could "bank" the difference between actual and legal maximum price in an "account," from which they could later draw "banked costs" to legally raise their price above what would have otherwise been a binding maximum price. Thus, the price any retailer charged depended on the price he paid for gasoline at wholesale, his allowed margin, the magnitude of his banked costs, and also on market conditions. The prices charged by stations that could not charge the prevailing market price could vary significantly from one station to the next.

During late 1978 and early 1979, for reasons we do not discuss here, many refiners became subject to a similar set of wholesale level price controls, associated with the Council on Wage and Price Stability (COWPS) guidelines. ¹ They were forced by DOE rules to allocate their available supplies of gasoline among retailers who were previous customers, and to charge less than market-clearing, wholesale prices. Retailers responded by raising their retail prices, receiving the

¹For a complete discussion of these controls, see Camm, Phelps, and Stan (1981a). One point of importance to this report is that while refiners could have legally raised their prices, they could not increase their profits by doing so. They apparently decided to hold their prices down. Hence, price controls on refiners provided effective ceilings on wholesale prices which retail controls ultimately transferred to the retail market. Throughout this report, we assume that regulated price levels behave as if they represented actual price ceilings.
difference as profit, and in doing so, drawing down their "banked costs." Once a retailer had depleted his banked costs, his legal price fell, often by 15 to 20 cents per gallon, and he faced a price ceiling substantially below the market clearing price. Queues rapidly formed, the retailer either ran out of gasoline or was forced to limit hours of service, and customers sought other sources for supplies. This put upward pressure on the market price of those with some remaining banked costs, until, finally, nearly all stations in a given retail market exhausted their banked costs, and hence were forced to use queues to ration available supplies. At such a point, an entire market (for example, Los Angeles and San Francisco in May, Washington, D.C., and New York in June) collapsed, causing a gasoline "crisis."

The transitional periods between a freely functioning market and these occasional, and sensationalized, crises were characterized by what we call here partial price control. Some stations faced effective regulatory price ceilings, and hence experienced queues of various lengths, while others did not. While the acute crises remain most vividly in our minds, these periods of partial control were much more characteristic of the time. In fact, they tend to characterize any attempt to use firm-specific price controls, in gasoline markets and elsewhere. Only when all stations run out of banked costs does the polar case of our model—total price control—become pertinent.

**REVISED RETAIL PRICING RULES**

In August 1979, DOE altered the mechanism for retail service station pricing, placing an overall limit of 15.5 cents per gallon markup above wholesale prices paid by each retailer. (This limit rose through time with general inflation.) The use of "banked costs" to adjust prices was eliminated, thus removing the highest prices from the retail market. (At that time, some retailers were charging more than a 25-cents-per-gallon markup above wholesale costs.) At the same time, for reasons we do not analyze here, refiner prices for wholesale gasoline exhibited a

<sup>2</sup>See Camm, Phelps, and Stan (1981a).
considerable variation, with the spread from lowest to highest prices exceeding 15 cents per gallon.\footnote{Lundberg (1979, 1980, various issues) shows both the wholesale price distribution and the distribution of retail margins.} Through the new DOE retail pricing rules, this wholesale price pattern was closely reflected in retail prices, because every station had the same maximum legal markup, and because excess demand generally allowed all retailers but those with the highest legal price ceilings to charge the maximum legal markup. It was characteristic of the period to find some stations (with high prices) open during "normal" business hours with no queues, while other stations (with prices 15 cents or more below the highest prices) remained open only a few hours per day, with substantial queues when they were open. Again, this is the partially controlled market whose behavior this report examines.
III. A SIMPLE MODEL OF A PARTIALLY PRICE-CONTROLLED MARKET

As illustrated in Sec. II, a partially price-controlled market consists of a set of firms, each of which faces a different regulatory price ceiling. Some ceilings are binding while others are not. These ceilings change continually over time as the different circumstances of the firms in the market change, so that the extent of control in the market tends to ebb and flow over time. This section posits a simple model with which we can examine the effects of this ebb and flow on consumer choice of firm, waiting times, and market clearing price.

CHOOSING AMONG FIRMS

When two firms selling in the same market charge different monetary prices for the same good, consumers will buy from the firm with the lower price unless some nonprice factor offsets the attractiveness of this low price. At a retail gasoline station, nonprice factors might include such quality variables as the length of business hours, the willingness to check under the hood or provide maps for free, and so on. In particular, they include the length of time a customer must wait in line for service. This report treats waiting time as the dominant nonprice factor in the retail gasoline market, and implicitly assumes that differences in all other nonprice factors are not important across firms. Under this assumption, a consumer observes a price, \( p_i \), and a waiting time, \( t_i \), for the \( i \)th station and chooses the station with a combination \( (p_i, t_i) \) that imposes the smallest cost per gallon on him.¹

Suppose an individual in a household can monetize his cost of waiting in terms of a simple coefficient, \( c \), which measures his time cost. Then the "full" monetized price he faces per gallon of gasoline

¹Waiting time is most directly related to the purchase of a tankful of gasoline, not a single gallon. We use a car's tank capacity to adjust waiting time to a per-gallon equivalent. See App. A for details.
purchased at the \( i \)th station will be \( \pi_i = p_i + ct_i \). He will choose the station with the lowest full price. For example, Fig. 1 shows \( \pi_i \) for three kinds of stations. "Uncontrolled" stations charge a market clearing price of \( p_0 \) and experience no lines. "Mildly controlled" stations charge \( p_1 \) and experience a waiting time of \( t_1 \). "Heavily controlled" stations exhibit \( p_2 \) and \( t_2 \), where \( p_2 < p_1 \) and \( t_2 > t_1 \). For each station, \( \pi_i \) changes as a household's \( c \) changes. Households with \( c > c_1 \)

![Graph showing full prices at stations with different waiting times](image)

Fig. 1—Full prices at stations with different waiting times

\[ ^2 \pi_i \] can be viewed as a hedonic price of a good whose components, gasoline and waiting time, are sold as a bundle. See Rosen (1974). In general, we cannot expect a hedonic price index to be linear in the components of the good. Appendix A justifies this assumption and explains the meaning of \( c \) in more detail.

\[ ^3 \] We abstract from spatial considerations here. The cost of reaching a station would also be important to a consumer and could have crucial effects on the comparative static results discussed below. For clarity, we set this effect aside to concentrate on the effects that partial price controls would have if all stations were close enough together to ignore the consumer's cost of reaching them.
prefer the station with no waiting time and a high monetary price, $p_0$. Households with somewhat lower $c$, $c_{II} < c < c_I$, prefer a medium-price ($p_1$) station with a low but positive waiting time. Households with the lowest $c$, $c < c_{II}$, prefer a low-price ($p_2$) station with a higher waiting time, $t_2$. The bold locus, $\Pi(c) = \min_i [\pi_i(c)]$, represents the price in the dominant or preferred segment at each level of $c$.

A household's preference for one station over the next depends heavily on the assumption that it cannot lower the cost of waiting associated with its purchase of gasoline. This assumption will not be valid if a deep market for "line-sitters" develops. In the extreme, suppose there is an infinite number of drivers who do not have their own cars, with a cost of waiting lower than $c_{II}$. And suppose it is nearly costless to contract with such drivers. Then almost all car owners will find it advantageous to make such contracts and the cost of waiting will in effect become homogeneous across households. In such circumstances, queues will adjust to assure that $\pi_i = p_i + c_{LS} t_i$ for all $i$, where $c_{LS}$ is the line-sitters' cost of waiting. A single price will effectively prevail in the market and the standard price theory of market behavior will apply.

During 1979 and 1980, such a market for line-sitters may have developed within households or small social circles with teenage drivers. For whatever reason, however, no extensive market developed outside this context. And even if it had, it is unlikely that all line-sitters would have had identical costs of waiting. Enough heterogeneity in the waiting time of drivers in the queues themselves developed to require an analysis that goes beyond the standard theory. For simplicity, we ignore the secondary market that determines who actually waits.

Note also that suppliers of gasoline have similar incentives to arbitrage the difference in their selling prices. Unless strict enforcement of controls is successful, stations in the segments with lower monetary prices have strong incentives to "retrade" gasoline into the higher priced segments. Such retrading would continue so

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4Rodney Smith pointed out this possibility. For an excellent discussion of its implications in a different kind of market, see Smith (1976).
long as the arbitrageur's commission and expected penalties were smaller than price differentials between segments. While there is some evidence that such illegal retrading did occur during 1979 and 1980, it was not sufficient to eliminate the substantial monetary price differentials that persisted over that period. For simplicity, we assume that such retrading is not a significant activity in the partially controlled market.

In the end, an uncontrolled market will not offer alternative monetary price levels. A station free to set its own price will always prefer price to nonprice rationing. That is because, for a given level of business, price rationing increases profits and nonprice rationing does not. Hence, we will observe such a range of choice only where regulation artificially lowers prices for some stations and not for others. In particular, an unconstrained firm will have no waiting time and will charge the market clearing price of $p_0$.\(^5\) A mildly controlled station will charge $p_1 < p_0$ and hence require some lines to ration its supply. A heavily controlled station will charge $p_2 < p_1$ and experience even longer lines.

**EQUILIBRIUM IN A GASOLINE MARKET WITH THREE MONETARY PRICES**

Within a retail gasoline market, stations with the same prices and waiting times can be said to compete in distinct submarkets or segments of the market. Then increasing price control of the type that occurred in 1979 and 1980, outlined in Sec. II, can be said to do one of two things. First, it can move a firm from a segment with a higher monetary price to another with a lower price. Second, it can reduce the regulated price ceiling for all the firms in a segment of the market. Neither of these need result from a regulatory effort targeted at any particular firm or group of firms. As the discussion in Sec. II emphasizes, we can expect many of the changes in a partially controlled market to result from individual firm responses to general regulatory rules and general market

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\(^5\) An unconstrained firm may of course have transitory surges in demand which it chooses to ration through queues instead of price. A profit-maximizing firm, however, will not allow queues to persist. We ignore transitory phenomena to concentrate on the issue of persistent lines.
changes. Hence, while regulatory changes that change the firms in market segments, or legal prices in these segments, can be viewed in a direct discretionary context, we will generally treat regulatory changes only as the outcomes of individual firm experience within general rules and market conditions.

To keep things manageable, we consider a market with one uncontrolled segment and two controlled segments, one more highly priced than the other. These segments contain stations of the type shown in Fig. 1. While the formal mathematics is restricted to this model, the economics of such a model suggest strongly that its implications apply to markets with many more segments—that is, markets with many different, but effective, regulatory price ceilings. To understand how our three market segments behave in equilibrium, we must understand the demand and supply in each segment and the equilibrium conditions that link segments to one another.

A household's demand embodies two choices. The first is an initial choice of which segment to buy in. The second is how much to buy once the first choice is made. (These choices are of course simultaneous, not sequential.) Figure 1 suggests that consumers will choose a consumption segment on the basis of their values of \( c \). Those with \( c > c_I \) buy in the uncontrolled segment, and so on. Once a consumer chooses to consume in the \( i \)th segment, he has a demand \( x(p_i) \). Let \( f(c) \) define the distribution of \( c \) in the consumer population. Then, demand in each of the three market segments can be defined as:

\[
D^0(p_0, c_I) = \int_{c_I}^{\infty} f(c)x(p_0)dc
\] (1)

\[
D^1(p_1, t_1, c_I, c_{II}) = \int_{c_{II}}^{c_I} f(c)x(p_1 + ct_1)dc
\] (2)

\[
D^2(p_2, t_2, c_{II}) = \int_{0}^{c_{II}} f(c)x(p_2 + ct_2)dc
\] (3)
Conditions on the supply side are defined more by regulation than by market forces. In particular, of the monetary prices, only $p_0$ is free to vary. Hence, supply in the controlled segments is price inelastic and determined by regulation. Further, the supply function in the uncontrolled segment will in general not be the industry marginal cost function. In fact, the supply curve can be downward sloping. These conditions suggest a set of supply functions of the form

\begin{align*}
S^0 &= S^0(p_0, \kappa_1) \\
S^1 &= S^1(\kappa_1, \kappa_2) \\
S^2 &= S^2(\kappa_2)
\end{align*}

where $\kappa_1$ and $\kappa_2$ represent regulatory policies which, respectively, shift supply from the 0-th to the 1st segment and shift supply from the 1st to the 2nd segment. For example, suppose the supply allocated to a particular station in the 1st segment were $\Delta S$. And suppose the effective price ceiling for that station were raised from $p_1$ to $p_2$; the station would be moved from the 1st to the 2nd segment. This is equivalent to a change in $\kappa_2$. $S^1$ would fall by $\Delta S$; $S^2$ would rise by the same amount. If, on the other hand, this station were totally decontrolled, it would move from the 1st to the 0-th segment. This would be equivalent to a change in $\kappa_1$. $S^1$ would again fall by $\Delta S$; $S^0$, for fixed $p_0$, would rise by the same amount.

Demand and supply must clear within each segment. To achieve this, assume that each firm is unable to affect price via its output decision, where the price of interest is either a market price like $p_0$ or the length of its queue. Assuming it sells all its gasoline at the legal price, its profits are unaffected by its queue length.\footnote{For a brief discussion of these issues, see App. D. For details, see Camm, Phelps, and Stan (1981a, b).}

\footnote{The same cannot be said for other nonprice components like length of hours or quality of attendants' services. As noted above, this model implicitly assumes that these components are not important relative to queue length in nonprice rationing.}
assumption is harder to sustain in the uncontrolled segment, particularly if few firms or even one firm operates within this segment. For simplicity, this analysis proceeds as though all uncontrolled firms were also price takers. (Further analysis will be needed to deal with alternative assumptions.) Under the assumption that all stations are price takers, we get the following intrasegmental equilibrium equations:

\[ D^0(p_0, c_I) = S^0(p_0, \bar{c}_1) \]  \hspace{1cm} (7)

\[ D^0(p_1, t_1, c_I, c_{II}) = S^1(\bar{c}_1, \bar{c}_2) \]  \hspace{1cm} (8)

\[ D^2(p_2, t_2, c_{II}) = S^2(\bar{c}_2) \]  \hspace{1cm} (9)

Variables marked with a bar are exogenous to the system. Changes in these represent effective changes in regulation. In general, increases in \( \kappa_1 \) and \( \kappa_2 \) and decreases in \( p_1 \) and \( p_2 \) all represent increasing regulation. All other variables are endogenous and are subject to analysis. Changes in \( p_0, t_1, \) and \( t_2 \) provide measures of changes in segmental prices. Changes in \( c_I \) and \( c_{II} \) change which consumers consume in individual market segments.

These market segments are tied together by those consumers just marginal to adjacent markets. Marginal consumers between the uncontrolled and mildly controlled segments, for example, have a time cost, \( c_I \), for which \( p_0 = p_0 = \pi_0 = p_1 + c_I t_1 \). Those between the two controlled segments have a time cost, \( c_{II} \), for which \( p_1 + c_{II} t_1 = \pi_1 = \pi_2 = p_2 + c_{II} t_2 \). These conditions are summed up in two intersegmental equilibrium equations:

\[ p_0 = p_1 + c_I t_1 \]  \hspace{1cm} (10)

\[ p_1 + c_{II} t_1 = p_2 + c_{II} t_2 \]  \hspace{1cm} (11)

The next section analyzes the effects of regulatory change on the endogenous variables shown in Eqs. (7)–(11).
IV. THE EFFECTS OF CHANGES IN FIRM-SPECIFIC PRICE CEILINGS

As noted in Sec. III, reductions in firm-specific price ceilings can be represented within our model as increases in $\kappa_1$ or $\kappa_2$ or as reductions in $p_1$ or $p_2$. We can examine the effects of such changes by totally differentiating and applying Cramer's rule to derive qualitative comparative static results. Table 1 presents these (see App. B for details). This section traces the economic logic underlying these results.

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CHANGE IN $\kappa_1$

An increase in $\kappa_1$ is a tightening of regulation that shifts supply from the uncontrolled to the mildly controlled segment. This increase in price control has the puzzling effect of reducing queues in the controlled segments. Why does this occur? A supply shift of this kind can be expected to create excess demand in the uncontrolled segment and excess supply in the mildly controlled segment. These excesses will be relieved in two ways. First, adjustment in monetary prices and waiting times can
alter the demand of all consumers in each segment to reduce the excesses. Second, migration can shift demand from one segment to another to relieve the excess. Consider each in turn.

Suppose at first that no migration occurs. Then price will rise in the uncontrolled segment and waiting times will fall in the mildly controlled segment. These changes lead to violations in the intersegmental equilibrium conditions of Eqs. (10) and (11). In particular, they make $c_1$ appear too low and $c_{II}$ too high, suggesting that migration from both "extreme" segments into the mildly controlled segment would be required to regain intersegmental equilibrium.\(^1\)

Alternatively, suppose no price adjustment is allowed and that the excesses are relieved by moving the consumers with the lowest $c$ in the uncontrolled segment into the mildly controlled segment. This must raise $c_1$, again violating the intersegmental condition of Eq. (10). That is, such a migration cannot be sustained unless $p_0$ rises relative to $t_1$.

In the end, some adjustment of both kinds is required to reach a new equilibrium. A rise in $p_0$ does two things. It induces migration out of the uncontrolled segment, and it induces reduced consumption by those who remain in the uncontrolled segment, thereby releasing gasoline for consumption elsewhere. Similarly, a fall in $t_1$ induces migration into the mildly controlled segment and increases consumption by those already in that segment. Both help exhaust the new supplies in the uncontrolled segment. Finally, the fall in $t_1$ induces migration from the heavily controlled segment, releasing gasoline to be consumed by those who remain in that segment. The demand of those who remain will rise enough to consume those supplies only if $t_2$ falls. But $t_2$ cannot fall as much as $t_1$ without choking off

\(^1\)Totally differentiating Eq. (10) yields $t_1 dc_1 = dp_0 - c_1 dt_1$, so that $dp_0 > 0$ and $dt_1 < 0$ together imply $dc_1 > 0$. Similarly, Eq. (11) implies that $(t_2 - t_1) dc_{II} = c_{II} (dt_2 - dt_1)$, suggesting that for $dt_1 < 0$ and $dt_2 = 0$, $dc_{II} > 0$.\)
out-migration. These are the economic events that underlie the mathematics of the comparative static results in Table 1.

![Graph showing effects on full prices of an increase in $\kappa_1$](image)

**Fig. 2—Effects on full prices of an increase in $\kappa_1$**

Figure 2 depicts these results. An increase in $\kappa_1$ shifts the dominant price locus from $\Pi^0$ to $\Pi^1$. By lowering waiting times, the increased control reduces full prices for everyone in the two controlled segments. By raising $c_I$ from $c_I^0$ to $c_I^1$, it also brings consumers from the uncontrolled into a controlled segment of the market and lowers their full prices. In fact, the increase in control benefits everyone with $c < c^*$ in Fig. 2; only those with high waiting costs suffer.

In general, an increase in $\kappa_1$ shifts supply between two market segments which have rather tenuous connections on the demand side of the market. The only connection between the uncontrolled and mildly controlled market segments exists in the households just at the margin between the segments. Price adjustments occur very much as they would in two totally unrelated markets because most households do not consider market segments other than the one in which
they are consuming viable alternatives, particularly for small shifts in supply. Price and waiting time adjustments differ significantly from those that would occur in unrelated markets only to the extent that migration achieves a significant portion of the demand adjustment required to meet the shift in supply. Or what is the same thing, unless small changes in \( c_1 \) imply large migrations, prices and waiting times in the separate segments will adjust to supply shifts very much as though no connections existed between segments on the demand side.

Very similar arguments apply to the relationship between the two controlled market segments. To the extent that small changes in \( c_{II} \) imply large migrations, changes in \( t_1 \) must be closely reflected in changes in \( t_2 \). But if large changes in \( c_{II} \) imply little migration, the controlled segments will behave very much like unrelated markets. The heavily controlled market segment will feel little effect from the regulatory change in \( \kappa_1 \); nearly all the benefits of reductions in waiting times will accrue to households with high enough \( c \) to make them choose the mildly controlled market.

More generally, if we were to expand the number of controlled segments to allow many controlled price levels--a change that would be consistent with recent experience, this effect of segmentation should still hold. A shift in supply from the uncontrolled to the most mildly controlled market segment would have less and less effect on market segments with lower and lower regulatory price ceilings. In fact, because the effect of changes near the "top" of the market on segments below is a serial process, migrations between any two market segments can be sluggish enough to wash out all effects below those two segments. The probability that such a sluggish margin is encountered somewhere in the chain increases as we move to more and more heavily controlled segments.

In sum, a supply shift from the uncontrolled to the controlled segment leads to market behavior that looks very much like substitution behavior between segments and standard response to excess demand within segments. The relative importance of these responses depends significantly on the shape of the distribution of \( c \) in the consuming population. Whatever the relative importance of these effects,
this tightening of price controls actually reduces waiting times and increases the price paid in the uncontrolled segment. Hence, the effects of such control go well beyond the controlled segment.

**CHANGE IN $\kappa_2$**

An increase in $\kappa_2$ shifts supply from the mildly controlled to the heavily controlled market segment, tightening regulation. Like an increase in $\kappa_1$, this increase in price control again shortens some queues, but it increases others. Its net effect on queues depends on the relative size of the mildly and heavily controlled segments. Like an increase in $\kappa_1$, this change creates excess demand in one segment—this time the mildly controlled segment—and excess supply in another, the heavily controlled segment. This observation allows us to explain the results reported in Table 1 for $\kappa_2$ in much the same way that we explained those for $\kappa_1$.

As before, these excesses can be relieved either by changes in waiting times (and prices) or by migration. Changes in waiting times and prices without migration lead to initial values of $c_I$ that are too high and $c_{II}$ that are too low. These call for migration out of the mildly controlled segment into the other two. Migration without price changes leads to a value of $c_{II}$ that is too high to be sustained without changes in waiting times. Hence, as the results in Table 1 suggest, changes of both types are required to reach a new equilibrium.

In particular, a rise in $t_1$ does three things. It induces migration of consumption out of the mildly controlled segment toward the heavily controlled segment along the same route that the supply shift took; that is, it induces demand to follow supply. Second, it induces migration from the mildly controlled to the uncontrolled segment, again displacing demand from the segment with a shortage. Third, it induces conservation on the part of those who remain in the mildly controlled segment. All of these continue until excess demand in the mildly controlled segment is relieved. Migration into the uncontrolled segment causes excess demand there, thereby raising $p_0$. This has two effects. First, it causes consumers initially in the uncontrolled segment to conserve, thereby releasing gasoline for newcomers.
Second, it ultimately discourages further migration. For any migration to occur at all, of course, $p_0$ cannot rise as much as $t_1$. Finally, migration into the heavily controlled segment continues until any further migration would push $c_{II}$ higher than the level justified by the final waiting times in the two controlled segments and the inter-segmental equilibrium condition of Eq. (11) between them. In the final equilibrium, the waiting time in this segment fails to induce higher consumption by those initially in the market segment and migration of new consumers into the segment. Together, these actions exhaust the new supply made available in this segment.

![Diagram](image)

**Fig. 3—Effects on full prices of an increase in $\kappa_2$**

Figure 3 depicts these results. As in Fig. 2, the increased control associated with a rise in $\kappa_2$ shifts the dominant price locus from $\Pi^0$ to $\Pi^1$. Like a rise in $\kappa_1$, a rise in $\kappa_2$ raises full prices for those with high costs of waiting and lowers it for those with low waiting costs. The waiting cost that distinguishes winners from losers, $c^*$, is lower here because $\kappa_2$ acts "lower" in the market.
than $k_1$. In general, we should expect fewer people to favor a rise in $k_2$ than one in $k_1$.

The segmentation of markets observed with respect to $k_1$ applies here as well. In the absence of much migration—where large changes in $c_I$ or $c_{II}$ are associated with small intersegmental movements—these segments operate more or less independently. Waiting lines rise in the mildly controlled market segment and fall in the heavily controlled market segment in response to the shift in supply from one to the other, much as they would if the segments were totally unrelated. Uncontrolled price would hardly be affected. Large migrations—migrations very sensitive to changes in $c_I$ and $c_{II}$—would have just the opposite effects.

In a model with more than three segments, we would expect effects much like those associated with changes in $k_1$. Because migration is the only channel of effect between segments not directly affected by the supply shift, the scope of influence of a supply shift depends on the extent of migration between each pair of adjacent segments. As we move away from the segment directly affected, the expected effect of any supply shift falls as the serial effect of cumulative migrations dampens the effect of the initial changes in waiting time induced by the shift. In particular, only one intersegmental connection at which migration is meager washes out any effects beyond this connection.

In sum, a supply shift between controlled segments leads to market behavior that again looks like substitution behavior between segments and the standard response to excess demand within segments. The tightening of price control associated with such a shift can increase or decrease waiting times on net. It can also raise uncontrolled prices. The effects of such a change fall as we move through more controlled segments, defined by distinct prices, to reach the segment defined by any particular price, including the uncontrolled price.
CHANGE IN $p_1$

An increase in $p_1$ raises the price ceiling in the mildly controlled market, loosening price regulation. As Table 1 indicates, this lowers $t_1$ and, because of the accompanying rise in $c_1$ and $c_{II}$, tends to shift consumers to more tightly controlled market segments. This shift reduces demand in the uncontrolled segment, lowering $p_0$, and increases that in the heavily controlled segment, raising $t_2$.

More specifically, raising $p_1$ raises the cost of consuming gasoline in the mildly controlled segment and induces two forms of demand response. Consumers at the margin migrate into adjacent segments and inframarginal consumers conserve. Together, these actions reduce demand in the mildly regulated segment and thereby reduce the pressure on queues; $t_1$ begins to fall. As $t_1$ falls, the price bundle which characterizes that mildly controlled segment, $(p_1, t_1)$, begins to look more like that in the uncontrolled segment, $(p_0, 0)$, and less like that in the heavily controlled segment, $(p_2, t_2)$. Hence migration out is heaviest into the heavily controlled segment, which begins to look relatively more attractive to marginal consumers than the "new" mildly controlled segment with a higher monetary price. This migration continues until rises in $t_2$, induced by the inflow, just offset the rise in $p_1$ and the fall in $t_1$, and the intersegmental equilibrium condition of Eq. (11) is satisfied again. Meanwhile, as $t_1$ falls, migration out into the uncontrolled segment reverses. As $t_1$ falls, mild control looks relatively more attractive to marginal consumers in the uncontrolled segment and in-migration begins. This continues, reducing uncontrolled demand and hence $p_0$, until intersegmental equilibrium is established again.

The graphical presentation in Fig. 4 parallels that in Figs. 2 and 3. In this case, a rise in $p_1$ reduces control and this is reflected in the shift from $n^0$ to $n^1$. Falling control benefits those
with higher waiting costs (higher than \( c^* \)) and injures consumers with low waiting costs.

A rise in \( p_1 \), then, always tends to decontrol the market by making the mildly controlled segment look more like the uncontrolled segment and less like the heavily controlled segment. This simple observation immediately suggests the migrations that ultimately give us the results in Table 1. Oddly, note that such decontrol can easily increase the total length of lines. Note also that if we expand the number of segments involved, considerations like those in the discussion of \( \kappa_1 \) and \( \kappa_2 \) apply here directly. The initial expansion of demand in the second segment will induce migration into third, fourth, and other segments, but such effects are rapidly damped as we move to more and more heavily controlled segments.
CHANGE IN $p_2$

An increase in $p_2$ raises the price ceiling in the heavily controlled market, loosening price regulation. Like an increase in $p_1$, it induces a fall in waiting time, this time $t_2$, great enough to make the relevant controlled segment look less controlled. This induces marginal consumers in the mildly controlled market to migrate to the heavily controlled segment, raising $c_{II}$. That migration reduces demand in this segment, lowering $t_1$. And this in turn, through the now familiar chain effect, induces migration from the uncontrolled segment, raising $c_1$ and lowering $p_0$. Changes in $p_2$ work in almost exactly the same way that changes in $p_1$ do. The only significant difference is that decontrol through a rise in $p_2$ unambiguously reduces waiting time by assuring that no migration moves toward a controlled segment in which waiting time must adjust solely to reflect rising demand.

![Diagram](image)

**Fig. 5—Effects on full prices of an increase in $p_2$**

Figure 5 depicts the effects of the rise in $p_2$. As in Fig. 4, decontrol benefits those with high waiting costs and injures those with low waiting costs. In general, however, more people benefit from a
rise in \( p_2 \) than from one in \( p_1 \). The "deeper" in the market a price rise is allowed, the more people "above" the price rise benefit from its effects on waiting time. As the number of segments rise, of course, we must keep damping effects in mind.

SOME GENERAL OBSERVATIONS

Increases in control—through increases in \( \kappa_1 \) and \( \kappa_2 \) or decreases in \( p_1 \) and \( p_2 \)—tend to benefit one group at the expense of another. Consumers with high waiting costs not only prefer price-based allocation but benefit from policies that provide such allocation; those with low waiting costs benefit from policies that increase price control and hence the importance of nonprice rationing arrangements. Different policies place the dividing line between winners and losers at different places, but the general importance of waiting cost to policy incidence remains.

This result is tempered by segmentation in the market. In fact, individual segments of the market are only crudely interrelated. As a result, changes in the control of one part of the market need not have significant effects in other parts of the market. We expect effects to fall off in segments farther from the segment directly affected, where distance is measured by number of controlled price levels between two segments. In particular, increased price control should tend to benefit consumers with waiting costs just "below" the segment affected and to injure those just "above." Consumers at the extremes of the market, however, need not be affected at all. In general, the potential exists for closely targeted changes in partial price control policy. Such targeting has not occurred in the past. Policymakers may wish to consider how partial price control affects economic efficiency before they attempt it. The next section looks at economic efficiency.
V. PARTIAL PRICE CONTROL AND ECONOMIC EFFICIENCY

Economists typically favor free markets over price-controlled markets on the basis of economic efficiency; effective price controls invariably impose social losses. That should not lead us to believe that partial decontrol of a partially controlled market promotes efficiency or even that the economic efficiency of a partially controlled market lies between that of a free market and that of a totally price controlled market.

This section seeks some basic characteristics of a social loss function that might be written

$$L = L(\kappa_1, \kappa_2, p_1, p_2)$$  \hspace{1cm} (12)

We want to determine whether we can unambiguously sign any of the partial derivatives of this function. L, in turn, has three components:

- The cost of an inappropriate aggregate level of gasoline production and consumption;
- Given this level, the opportunity cost of forgone arbitrage between households paying different full prices for gasoline; and
- The cost of time lost in queueing.

Each of these is a function of our four policy variables.

Before we can examine these components and aggregate them to find L, we must determine whether they are well defined; that is, whether their values depend on the order in which we change \(\kappa_1\) and \(p_1\). All three components potentially reflect losses in consumer surplus and problems in defining consumer surplus exactly in the face of multiple price changes are well known.\(^1\) We avoid these problems because policy changes affect only one price relevant to consumer surplus—the full price of gasoline. This is true despite the fact that gasoline can be purchased in different kinds of stations. The kind of station does not change the basic character of the commodity, gasoline, and hence does not enter the household’s utility function. The kind of station simply

\(^1\)See, for example, Silberberg (1972).
alters the terms under which a household purchases gasoline. Hence, the problem of changing a number of prices in various orders does not arise. So long as the full price of gasoline in any market segment is a well-defined function of $c$ and our policy parameters, then $L$ and its components will be well defined. So long as Eqs. (7)-(11) yield a unique equilibrium, this will be true. That is, if only one set of values for $p_0$, $t_1$, $c_I$, and $c_{II}$ is compatible with a set of values for the policy parameters, then all the information required to place a household in a market segment and compute its full price for any set of policies is available. For the purposes of our analysis, we assume that a unique equilibrium does exist for the model in Sec. III, and hence, $L$ and its components are well defined. Because the components are well defined, we can simply sum across individuals to calculate each component and then sum the components to calculate $L$. To do this, consider first how the first two aspects of efficiency are reflected in any individual's consumption decisions, and then consider all three aspects from the viewpoint of the market as a whole.

INDIVIDUAL CONSUMPTION DECISIONS

Figure 6 shows the demand function, $x(\pi)$, for an individual who chooses to consume in a controlled segment, say the first one. At a full price, $\pi_1$, he chooses to consume $x^0$ units. To "pay" for this, he spends $p_1 x^0$ dollars and waits $t_1 x^0$ hours in line. The shaded areas show two sources of social loss associated with the individual's consumption decision.

Area $W$, equal to $ct_1 x^0$, is the cost of waiting in line and presumably represents the value of the individual's time in his next most productive activity. When an individual invests part of his scarce time in the purchase of gasoline, that time yields no other product than the transfer of the gasoline to him. When the same individual invests the same amount of time to produce some saleable good or service, sells this product, and then uses the proceeds of the sale to buy gasoline, that expenditure of time increases the stock of goods and services available for consumption. Hence, even when an individual is indifferent about
Fig. 6—Welfare costs associated with the individual household

how he uses his time, society as a whole is not. It suffers from the loss of product that results from an individual’s decision to queue up. By encouraging the use of queueing to acquire gasoline, a partially controlled market imposes costs that would not be present if only cash sales prevailed.

Area A is slightly more subtle. To understand it, we must understand $p^*$, the price that would prevail in an uncontrolled market. For simplicity, we can think of it as the social marginal cost of gasoline.\(^2\) The vertical distance between $p^*$ and the $x(n)$ function represents the difference between this social marginal cost and the household’s willingness to pay for an additional gallon. Area A represents the extent to which social cost exceeds the household’s willingness to pay when it chooses to consume at $x^0$.

In essence, Area A is the cost of diverse prices in the market that can be attributed to this particular household. If all households

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\(^2\)In fact, we know that $p^*$ will lie below $p_0$ in a partially controlled market. And because the 0-th segment is the only market segment in which supply is not fixed, we might treat the marginal cost of gasoline in this market as the relevant social marginal cost. As we shall see, $p_0$ need not reflect any social marginal cost. For a justification for using $p^*$, see Camm (1976) or Ippolito and Masson (1978).
faced p*, as they would in a totally uncontrolled market, this source of cost would vanish. But in a partially controlled market, some consumers—for example, those in the uncontrolled market segment—face prices higher than p* and others—like those in the second controlled segment—face prices even lower than π1. Consumers in different segments display differences in willingness to pay. Those with high marginal willingness to pay (πhigh) would gladly buy from consumers with low marginal willingness to pay (πlow). Such a trade would yield a net gain per gallon of πhigh − πlow that the two consumers could split between themselves. Summing areas like Area A across all consumers yields a measure of the potential "gains from trade" from such arbitrage among households if such arbitrage were possible. The presence of this social loss is simply a reflection of the fact that these gains from trade remain unrealized.

To understand the full losses from partial price control, we must sum areas like W and A across households and add losses associated with over- or under-production in the uncontrolled market segment. We turn to these issues now.

LOSSES IN THE MARKET AS A WHOLE

Changes in the level of partial price control change individual decisions, which in turn change the level of social loss associated with regulation. This subsection suggests how changes in price controls will affect each source of social loss.

Queueing Costs

The first source, queueing costs, can be examined by aggregating the costs to households, cτx(π), across our two controlled market segments:

\[ W \equiv \int_{c_{\text{II}}}^{c_{\text{I}}} \left( c_{\text{I}} x(p_1 + c_1) f(c) dc + \int_{0}^{c_{\text{II}}} c_{\text{II}} x(p_2 + c_2) f(c) dc \right). \]
Table 2 indicates how \( W \) changes in response to the four types of decontrol that correspond to the changes analyzed in Section IV. Because partial decontrol affects the cost of waiting in several ways simultaneously, it is not possible to determine a general net effect of decontrol on this cost. Hence Table 2 breaks out the effects of different relationships between partial decontrol and the cost of waiting.\(^3\)

Assumptions about the relative magnitudes of these effects allow us to predict how the cost of waiting would respond to partial decontrol.

Very briefly, increases in \( p_1 \) and \( p_2 \) affect waiting simply by reducing demand for gasoline and hence total waiting time. Increases in \( c_{\text{I}} \) and \( c_{\text{II}} \) change the amount of time spent waiting for a given amount of gasoline by shifting the venue of its purchase. Increases in \( t_{\text{I}} \) and \( t_{\text{II}} \) have the dual effect of increasing the waiting time associated with a given amount of gasoline and reducing the demand for gasoline. That is why the effect of increases in \( t_{\text{I}} \) and \( t_{\text{II}} \) depends on how elastic demand is for gasoline with respect to waiting time.

It is difficult to generalize about the effect of partial decontrol on the cost of waiting time. Different forms of decontrol have different effects and these depend on the relative size of market segments, relative waiting times in controlled segments, the distribution of time cost in the population, and so on. The important point to take from these results, however, is that partial decontrol can increase the cost of waiting and hence potentially increase the social cost associated with gasoline consumption. That is, because of the cost of waiting, partial decontrol need not improve the performance of a partially controlled market. To say more would require specific empirical data on the market in question.

\(^3\)Appendix C derives the expressions in Table 2 from Eq. (13) and justifies their signs. \( \eta_t \) is defined as \( \frac{\partial x}{\partial t} \) and, for the purposes of this particular analysis, assumed to be equal for all gasoline consumers.
Table 2

COMPONENTS OF THE EFFECTS OF PARTIAL DECONTROL ON THE COST OF WAITING

<table>
<thead>
<tr>
<th>Form of Decontrol</th>
<th>( \frac{\partial W}{\partial p_1} dp_1 )</th>
<th>( \frac{\partial W}{\partial p_2} dp_2 )</th>
<th>( (\frac{\partial W}{\partial t_1}) dt_1 )</th>
<th>( (\frac{\partial W}{\partial t_2}) dt_2 )</th>
<th>( \frac{\partial W}{\partial c_I} dc_I )</th>
<th>( \frac{\partial W}{\partial c_{II}} dc_{II} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \kappa_1 ) falls</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>( \kappa_2 ) falls</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>( p_1 ) rises</td>
<td>-</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>( p_2 ) rises</td>
<td>0</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

\(^a\)The total effect of regulatory change on the cost of waiting is simply the sum of these components:

\[ dW = \frac{\partial W}{\partial p_1} dp_1 + \frac{\partial W}{\partial p_2} dp_2 + \frac{\partial W}{\partial t_1} dt_1 + \frac{\partial W}{\partial t_2} dt_2 + \frac{\partial W}{\partial c_I} dc_I + \frac{\partial W}{\partial c_{II}} dc_{II} \]
Costs of Persistent Price Differentials

As noted above, persistent price differentials point to forgone arbitrage opportunities that can be seen as social losses. Area A in Fig. 6 can be represented for each individual as

\[ A = \int_{0}^{x} (\pi - p^*) dx \]

where \( x^* \) is the individual's consumption level at \( p^* \)—that is, where the marginal value of further arbitrage is zero. Aggregating across individuals yields

\[ A = \int_{0}^{x^*} f(c) \int_{0}^{x} (\pi - p^*) dx dc + \int_{0}^{x^*} f(c) \int_{0}^{x} (\pi - p^*) dx dc \\
+ (p_0 - p^*) \int_{0}^{\infty} f(c)(x^* - x^0) dc \]

(15)

Each term is positive because downward-sloping individual demand functions assure that \( x^* < x^0 \) as \( \pi < p^* \). For similar reasons, any change which reduces \( |\pi - p^*| \) also reduces \( |x^* - x^0| \) and hence the size of the \( i^{th} \) term. Fig. 2 - 5 strongly suggest that incremental measures to reduce control in the market do in fact reduce \( |\pi - p^*| \) and hence A. In each case a measure that reduces control flattens \( \Pi \), the dominant price locus, thereby reducing the range of full prices represented in the market. Carried to the extreme of full decontrol, such measures will yield a horizontal \( \Pi \) at \( p^* \). \( c^* \) is not a fixed value; it may shift as policies change. Further, \( \Pi(c^*) \neq p^* \). Hence, we cannot assume that incremental decontrol reduces \( |\pi - p^*| \) for all c. But a strong tendency exists toward incrementally reduced arbitrage costs as incremental decontrol proceeds.

\[ ^{4} \]Note, of course, that none of the measures considered in Figs. 2-5 can, by themselves, achieve total decontrol. Any combination of them, however, will tend to move \( \Pi \) toward \( p^* \) for all c.
Costs of Inappropriate Supply

Price controls lead to fixed supply in every segment except the uncontrolled segment. For expository purposes, it is assumed here that the supply function for the uncontrolled market segment is simply the horizontal sum of the marginal cost functions of stations operating in this segment. This is shown as MC in Fig. 7. Under these circumstances, partial controls lead to overproduction of gasoline by raising the decontrolled price from $p^*$ to $p^0$. The social loss associated with this overproduction is the shaded area $R$, or

$$R = \int_{X^0}^{X^*} (p^* - MC) dX$$  \hspace{1cm} (16)

Fig. 7—Welfare loss from oversupply in the uncontrolled segment

Measures that reduce control in this market can affect the uncontrolled segment in two ways. First, Table 1 shows that they always reduce $p_0$ and hence reduce $p_0 - p^*$, since $p_0$ moves continuously toward $p^*$ with decontrol. A cut in $p_0$ must move output toward $X^*$; a fall in $p_0$ unambiguously reduces social costs.\footnote{For a more accurate—and convoluted—argument, see App. D.}

\footnote{As App. D explains, however, when MC is not the supply function, this result need not hold.}
SUMMARY

The total social cost associated with partial price control in a market is the sum $L = W = A = R$ from Eqs. (13), (15), and (16). We know that in the absence of regulation, this cost falls to zero. But we have no reason to believe that social cost is monotonically related to the level of control, however that level might be defined. Only for component $A$, the arbitrage cost, do we see a relatively clear monotonically decreasing relationship between control and cost. Such a relationship may exist for component $R$, the cost of inappropriate supply, but it need not. And it clearly does not exist for component $W$, the waiting cost. Here incremental decontrol can easily increase the value of time resources absorbed in lines. Queueing costs are likely to account for a substantial portion of total social cost. Over some ranges of control, they are likely to so dominate other costs that incremental decontrol increases, not decreases, social costs. More explicit statements would require a careful empirical examination of $W$, $A$, and $R$.

To the extent that regulators can target price controls in such a market, of course, distributional issues are likely to play a major role in their thinking. Here, the effects of incremental decontrol are much clearer: Decontrol tends to favor individuals with high waiting costs and to injure those with low waiting costs. While the social losses of different levels of control may interest regulators, then, both the lesser ambiguity of distributional effects and the inherent importance of distributional effects in a public forum are likely to give them significant weight in any conscious policy-attempts to tailor partial price controls in a market.
VI. GOURMET GASOLINE STATIONS: SOMETHING FOR EVERYONE?

A policy proposal presented at the height of the gasoline lines in 1979 provides us with an excellent example of how this analysis might prove helpful in future policy decisions (Cummins, 1979). It called for "selective gas service," the decontrol of selected stations so that motorists who preferred high prices to waiting in line would have the option of paying high prices. And for those motorists who wished to stand in line for gasoline at controlled prices, control would continue at other stations. Some questions arose about how to determine which stations would be allowed to sell at uncontrolled prices, but that problem could readily be overcome. On the whole, the proposal seemed to provide a simple and attractive compromise that offered something for everyone.

Our analysis allows us to examine whether the proposal was in fact as attractive as it looked at the time. The proposal is effectively equivalent to a decrease in $\kappa_1$ in our analysis. Table 1 tells us that such a policy has two clear effects. First, after establishing an uncontrolled market segment, the policy reduces the uncontrolled price with each additional station allowed to sell in that segment. Hence, motorists who use the uncontrolled segment to appear to benefit from selective decontrol (since they voluntarily forgo a wait in the lines) and, once

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1 Stations allowed to sell at uncontrolled prices would make large profits. The government could easily capture those profits by auctioning the privilege to sell at uncontrolled prices at appropriate intervals. If it were politically infeasible to extract these rents from retailers, the government could distribute the privilege to sell at decontrolled prices by lottery, rotate the privilege across stations in some systematic way, or could tax uncontrolled stations and redistribute tax receipts within the industry. For a discussion of the alternatives used in the past, see Rolph (1982).
they start buying uncontrolled gasoline, clearly benefit more as more stations are decontrolled. Second, with each station added to the uncontrolled segment, the lines at the stations that continue to be controlled increase in length. In effect, less gasoline is available at controlled prices and those who continue to demand it must pay a higher full price for it. In fact, some customers "voluntarily" consuming uncontrolled gasoline have been "forced" to do so by growing lines and are in fact worse off than they were before decontrol. On the whole, the change clearly helps those with high waiting costs (and high wages?) and clearly hurts those with low waiting costs (low wages?). At the very least, then, our analysis tells us that selective decontrol does not offer something for everyone. In the end, the name by which the policy became best known, the "gourmet gasoline station" proposal, is probably more descriptive than the rather neutral title, "selective gas service," with which it started.

From the detached view of the economist, the policy also presents problems. As Table 2 indicates, the lengthening lines can very easily increase the total value of resources lost in queuing enough to outweigh any benefits of falling price diversity and more appropriate supply behavior. Detailed empirical analysis would be required to be sure, but this form of partial decontrol can easily impose even higher social costs than total price control in a retail market. The extent of this problem is likely to differ significantly from one market to another and, in particular, from one area to another within any metropolitan area. From the economist's detached social point of view, of course, total decontrol is the preferred course. Where this is not possible, the economist will seek very different levels of control in different areas and may well find out that none are appropriate in some.

We will see retail price controls on gasoline (and other products) again. Gourmet gasoline stations may have a role to play under such controls, but they clearly do not offer something for everyone and might not do so even if perfect compensation were possible. There may be ways to make them more attractive. For example, Table 1 indicates that if a fall in $\kappa_1$ is accompanied by a rise in $p_2$, effects on lines may be
ameliorated and the social costs of waiting reduced. Those with low waiting costs, however, still suffer. The key point, in the end, is that a model of the type offered here should prove useful in examining alternative ways of managing price controls and understanding their behavior when they come again.
VII. CONCLUSIONS

Partial price control in the retail gasoline market during 1979 and 1980 is just one example of a more general phenomenon. In general, partial price control can be viewed from both a positive and a normative point of view. In closing, we consider each briefly.

Partial price control is a much more common occurrence in the economy than one might first imagine. Hence, a simple, positive understanding of how such controls behave is important. As Breyer (1978) and Rolph (1982) emphasize, formal price controls tend to emerge from a legal and historical process that remains relatively stable over time. Whenever that process applies controls on a firm-by-firm basis, partial price control in a retail market is a logical outcome. From that point of view, we should expect formal price controls to lead to partial price controls in retail markets in the future. More generally, whenever government offers goods and services in competition with their private provision, at an administered price different from the market price, a market fully analogous to that under partial price control emerges. Health services, housing, food services, and many labor markets offer examples.\[1\] Hence, a better understanding of how such markets behave adds to our knowledge about a significant portion of the economy. That understanding provides a basis for the second point of view.

Partial price control, narrowly or broadly construed, occurs only where government takes actions to induce it. Whether the government does this purposefully or not, normative analysis of partial price control gives the government the ability to understand better the effects of its actions and to act on that understanding. In particular, it points out the broad redistributive effects of partial control, the broad range of effects that specific instruments of partial control can induce, and the

\[1\]Barzel (1974), Cheung (1974), and Harberger (1972) all offer useful analyses of such markets when differentials between public and private prices cannot be arbitraged away.
ambiguity about economic efficiency associated with partial control. Decisionmakers should be able to use such information in targeting specific policies, such as gourmet gasoline stations, or in more generally designing the price controls that lead to price diversity in the first place. Ultimately, decisionmakers can ask if partial price control in fact achieves what they intend and can thereby assure that their use of partial controls is purposive.
Appendix A

THE FULL PRICE OF GASOLINE

Define a household's well-being or utility as \( U = U(a,y) \), where \( a \) is the rate of consumption per period of automotive services and \( y \) is that of all other goods, the numeraire. And suppose automotive services can be produced with gasoline, whose rate of use is measured by \( x \), and other inputs, whose rate is \( b \): \( a = a(x,b) \). Finally, the household has a Beckerian budget, \( I + wT \), where \( I \) is nonwage income, \( w \) is the (single) wage rate (used as a proxy for value of time), and \( T \) is the total time available per period. A rational household, then, will choose \( a \), \( x \), \( y \), and \( b \) to maximize a Lagrangian:

\[
L = U(a,y) - \lambda [a(x,b) - a] - \mu [p_b b + y + p_x x + x \frac{wT}{K} - I - wT] \quad (A-1)
\]

where \( p_b \) is the price of other inputs to auto services, \( p \) is the price of gasoline, \( K \) is the effective size of the automobile's gas tank,\(^1\) and \( t \) is the time the household expects to spend in line each time it refills its tank.\(^2\)

First-order conditions for maximizing Eq. (A-1) imply

\[
\frac{3u/3a}{3u/3y} \left( \frac{3a}{3x} \right) = p + \frac{w \cdot t}{K} = p + ct \equiv \pi \quad (A-2)
\]

where \( c \equiv w/K \), and

\[
\frac{3a}{3x} = \frac{p + w \cdot t/K}{p_b} = \frac{\pi}{p_b} \quad (A-3)
\]

\(^1\)K is the amount of gas the car will require each time it must be refilled. While this is clearly an endogenous variable, even for a car with a fixed size of gas tank--it will increase as the cost of going to a station increases--we treat it as exogenous here.

\(^2\)If other costs, \( z \) per unit of time, are imposed on those waiting in lines, then \((w + z)t/K\) replaces \( w \cdot t/K \) in Eq. (A-1) and subsequently. Joint production of, for example, newspaper reading and waiting may make \( z \) negative.
Equation (A-2) states that the product of the marginal money value of automotive services times the marginal product of gasoline in the production of automotive services should equal the effective price of gasoline, $\pi$. Note that while the costs of waiting in line are joint costs for all gasoline used, this formulation assigns them equally to all units of gasoline used; $\pi$ is an average price. Equation (A-3) states that increases in $p$ or $t$ should induce substitution in the production of automotive services to increase the relative marginal product of gasoline. The derived demand for gasoline, then, displays the normal scale and substitution effects we expect for any good. But the relevant price to use in examining these effects is $\pi$, which includes both pump price ($p$) and time price ($ct$) components.
Appendix B

COMPARATIVE STATICS OF REGULATORY CHANGES

Comparative statics results for various regulatory changes can be calculated by totally differentiating Eqs. (7)-(11) and solving for the resulting endogenous variables, $dp_0$, $dt_1$, $dt_2$, $dc_1$, and $dc_{II}$, as functions of exogenous variables, $d\kappa_1$, $d\kappa_2$, $dp_1$, and $dp_2$. Start by fully differentiating Eqs. (7)-(11). The resulting system can be represented in matrix form as

$$
\begin{bmatrix}
D^0_0 & 0 & 0 & D^1_1 & 0 \\
0 & D^1_1 & 0 & D^1_1 & D^1_{II} \\
0 & 0 & D^2_2 & 0 & D^2_2 \\
-1 & c_1 & 0 & t_1 & 0 \\
0 & c_{II} & -c_{II} & 0 & t_1 t_2
\end{bmatrix}
\begin{bmatrix}
dp_0 \\
dt_1 \\
dt_2 \\
dc_1 \\
dc_{II}
\end{bmatrix}
= 
\begin{bmatrix}
S^0_1 d\kappa_1 \\
S^1_1 d\kappa_1 + S^1_2 d\kappa_2 - D^1_p dp_1 \\
S^2_2 d\kappa_2 - D^2_p dp_2 \\
dc_1 \\
dc_{II} - dp_1 \\
dc_{II} - dp_1
\end{bmatrix}
$$

where generally $D^i_j = \partial D_i / \partial z_j$ and $S^i_j = \partial S_i / \partial z_j$ and specifically:

$$
D^0_0 \equiv \frac{\partial D^0_0}{\partial p_0} = \int_{c_1}^{D^0_0} x'(p_0) f(c) dc < 0 
$$

$$
D^1_1 \equiv \frac{\partial D^1_1}{\partial c_1} = -x(p_0) f(c_1) = -x(p_1 + c_1 t_1) f(c_1) = -D^1_1 < 0 
$$

$$
D^1_1 \equiv \frac{\partial D^1_1}{\partial t_1} = \int_{c_II}^{c_II} x(p_1 + c_1 t_1) f(c) dc < 0 
$$

$$
D^1_{II} \equiv \frac{\partial D^1_{II}}{\partial c_{II}} = x(p_1 + c_{II} t_1) f(c_{II}) > 0 
$$

$$
D^1_{II} \equiv \frac{\partial D^1_{II}}{\partial c_{II}} = -x(p_1 + c_{II} t_1) f(c_{II}) = -x(p_2 + c_{II} t_2) f(c) = -D^2_{II} < 0 
$$
\[ D_1^0 = \frac{\partial D_1}{\partial p_1} = \int_{c_{II}}^{c_{I}} x'(p_1 + ct_1) f(c) dc < 0 \]  
(B-2f)

\[ D_2^0 = \frac{\partial D_2}{\partial t_2} = \int_{0}^{c_{II}} c x'(p_2 + ct_2) f(c) dc < 0 \]  
(B-2g)

\[ D_{II}^0 = \frac{\partial D_{II}}{\partial c_{II}} = x(p_2 + c_{II} t_2) f(c) > 0 \]  
(B-2h)

\[ D_2^0 = \frac{\partial D_2}{\partial p_2} = \int_{0}^{c_{II}} x'(p_2 + ct_2) f(c) dc < 0 \]  
(B-2i)

\[ E_0^0 = \frac{\partial E_0}{\partial p_0} - \frac{\partial E_0}{\partial p_0} < 0 \]  
(B-2j)

Next, use Cramer's Rule to invert (B-1). The sign of the determinant of system (B-1), \( \Delta \), will affect the sign of each expression that emerges from the inversion. We can use the expressions in (B-2) to sign \( \Delta \):

\[ \Delta = E_0^0 D_{II}^0 (c_{II} t_1 t_2 - c_{II} t_1 D_{II}^0) + E_0^0 [-c_{II} D_{II}^0 D_{II}^0 + D_{II}^0 D_{II}^0 (t_1 - t_2)] 
- E_0^0 D_{II}^0 (c_{II} x'(p_1 + ct_1) f(c) dc < 0 \]  
(B-3)

It will also prove useful to sign the following expressions:

\[ D_1^0 - c_{II} D_1^0 = \int_{c_{II}}^{c_{I}} (c - c_{II}) x'(p_1 + ct_1) f(c) dc < 0 \]  
(B-4a)

\[ D_2^0 - c_{II} D_2^0 = \int_{0}^{c_{II}} (c - c_{II}) x'(p_2 + ct_2) f(c) dc > 0 \]  
(B-4b)

Then it is simply a matter of applying Cramer's Rule successively to sign the expression relevant to Table 1:
\[
\text{sgn } \frac{dp_0}{dk_1} = \text{sgn } \left\{ -c_I^0 D_1^{0} D_2^{1} (t_1 - t_2) - c_{II}^1 t_1 D_1^{1} + E_0^0 c_I^0 \right\} + \left( c_{II}^1 c_1^0 D_2^0 (t_1 - t_2) \right) > 0
\]

\[
\text{sgn } \frac{dp_0}{dk_2} = \text{sgn } \left\{ -c_{II}^1 D_1^{0} D_2^2 (t_1 - t_2) \right\} > 0
\]

\[
\text{sgn } \frac{dp_0}{dp_1} = \text{sgn } \left\{ D_1^{0} D_2^2 \left( D_1^1 - D_1^0 c_1^0 \right) (t_1 - t_2) + \left( c_I^1 - c_{II}^1 \right) D_1^{1} \right\}
\]

\[
- D_1^{1} c_{II}^1 D_2^2 \left( D_1^1 - D_1^0 c_1^0 \right) < 0
\]

\[
\text{sgn } \frac{dp_0}{dp_2} = \text{sgn } \left\{ c_{II}^1 D_1^{0} c_1^0 D_2^2 \right\} < 0
\]

\[
\text{sgn } \frac{dt_1}{dk_1} = \text{sgn } \left\{ E_0^0 t_1 (D_1^0 D_2^1 t_1 - c_{II}^1 D_1^{1}) \right\} > 0
\]

\[
\text{sgn } \frac{dt_1}{dk_2} = \text{sgn } \left\{ -c_I^0 D_1^{0} D_2^{1} (t_1 - t_2) \right\} > 0
\]

\[
\text{sgn } \frac{dt_1}{dp_1} = \text{sgn } \left\{ E_0^0 D_1^{0} D_2^1 c_{II}^1 - D_1^0 D_2^2 (t_1 - t_2) \right\}
\]

\[
+ \left( E_0^0 t_1 + D_1^0 \right) \left( D_1^0 D_2^1 (t_1 - t_2) + D_2^1 D_{II}^1 D_1^1 \right) < 0
\]

\[
\text{sgn } \frac{dt_1}{dp_2} = \text{sgn } \left\{ E_0^0 t_1 + D_1^0 D_{II}^1 (D_2^2 c_{II}^1 - D_2^0) \right\} < 0
\]

\[
\text{sgn } \frac{dt_2}{dk_1} = \text{sgn } \left\{ -E_0^0 D_1^{0} D_2^1 \right\} < 0
\]

\[
\text{sgn } \frac{dt_2}{dk_2} = \text{sgn } \left\{ E_0^0 (t_1 - t_2) (D_1^0 t_1 + D_1^0 c_1^0) + D_1^0 D_1^1 (t_1 - t_2) \right\} < 0
\]

\[
\text{sgn } \frac{dt_2}{dp_1} = \text{sgn } \left\{ -D_{II}^1 E_0^0 \left( -D_1^0 t_1 c_{II}^1 + D_1^0 (c_1^0 - c_{II}^1) + t_1 D_1^{1} \right) \right\}
\]

\[
+ D_{II}^1 D_1^0 c_{II}^1 D_1^{1} - D_1^{1} > 0
\]

(B-5a)  (B-5b)  (B-5c)  (B-5d)  (B-6a)  (B-6b)  (B-6c)  (B-6d)  (B-7a)  (B-7b)  (B-7c)
\[
\text{sgn} \left( \frac{dt_2}{dp_2} \right) = \text{sgn} \left\{ E_0^0 c_{II}^0 \left[ -D_p^0 (t_1 - t_2) + \frac{1}{\rho_2} \right] + E_0^0 c_{II}^1 \left[ -D_p^1 (t_1 - t_2) + D_1^1 \right] + (E_0^0 c_{II}^0 + D_1^0) \left[ -D_p^0 (t_1 - t_2) + D_1^1 \right] \right\} < 0
\]

(B-7d)

\[
\text{sgn} \left( \frac{dc_I}{dk_1} \right) = \text{sgn} \left\{ E_0^0 c_{II}^1 \left[ c_{II}^1 D_{II}^1 + D_2^1 (t_1 - t_2) \right] + D_{II}^1 (t_1 - t_2) + c_{II}^1 D_{II}^1 (D_1^1 + D_2^1) \right\} > 0
\]

(B-8a)

\[
\text{sgn} \left( \frac{dc_I}{dk_2} \right) = \text{sgn} \left\{ c_{II}^0 \left[ (E_0^0 c_{II}^0 + D_1^0) (D_1^1 + D_2^1) + E_0^0 c_{II}^0 \right] \right\} < 0
\]

(B-8b)

\[
\text{sgn} \left( \frac{dc_I}{dp_1} \right) = \text{sgn} \left\{ (E_0^0 c_{II}^1 (D_1^1 - c_{II}^1 D_p^1) + E_0^0 c_{II}^0 (t_1 - t_2) (c_{II}^1 D_p^1 - D_1^1) \right\} > 0
\]

(B-8c)

\[
\text{sgn} \left( \frac{dc_I}{dp_2} \right) = \text{sgn} \left\{ E_0^0 c_{II}^1 (D_2^2 - c_{II}^1 D_p^2) \right\} > 0
\]

(B-8d)

\[
\text{sgn} \left( \frac{dc_{II}}{dk_1} \right) = \text{sgn} \left\{ -E_0^0 c_{II}^2 D_2^1 c_{II}^1 \right\} < 0
\]

(B-8a)

\[
\text{sgn} \left( \frac{dc_{II}}{dk_2} \right) = \text{sgn} \left\{ E_0^0 c_{II}^1 \left[ t_1 (D_1^1 + D_2^1) + c_{II}^0 \right] + c_{II}^0 D_2^1 (D_1^1 + D_2^1) \right\} > 0
\]

(B-8b)

\[
\text{sgn} \left( \frac{dc_{II}}{dp_1} \right) = \text{sgn} \left\{ E_0^0 D_2^2 c_{II}^0 \left( c_{II}^1 - c_{II}^1 D_p^1 \right) + (E_0^0 D_2^1 + c_{II}^0) \right\} > 0
\]

(B-8c)

\[
\text{sgn} \left( \frac{dc_{II}}{dp_2} \right) = \text{sgn} \left\{ (E_0^0 c_{II}^1 + E_0^0 c_{II}^0 + D_1^0) \left( D_2^2 - c_{II}^0 D_p^2 \right) \right\} > 0
\]

(B-8d)
Appendix C

REGULATORY EFFECTS OF QUEUEING COSTS

The regulatory effects reported in Table 2 come from (a) signing the relevant partial derivatives of Eq. (12) and (b) combining information on the signs of these derivatives with information from Table 1. This appendix presents the partial derivatives of Eq. (12):

\[
\frac{\partial W}{\partial p_1} = \int_{c_{II}}^{c_{I}} f(c)dc < 0 \quad \text{(C-1)}
\]

\[
\frac{\partial W}{\partial p_2} = \int_{0}^{c_{II}} c_{II} x' f(c)dc < 0 \quad \text{(C-2)}
\]

\[
\frac{\partial W}{\partial t_1} = \int_{c_{II}}^{c_{I}} (c + t_1 c x') f(c)dc = \int_{c_{II}}^{c_{I}} c x(1 + \eta_{t_1}(c))f(c)dc \geq 0 \quad \text{(C-3)}
\]

\[
\frac{\partial W}{\partial t_2} = \int_{0}^{c_{II}} c x(1 + \eta_{t_2}(c))f(c)dc \geq 0 \quad \text{(C-4)}
\]

\[
\frac{\partial W}{\partial c_{I}} = c_{I} t_1 x (p_1 + c_{I} t_1) f(c_{I}) > 0 \quad \text{(C-5)}
\]

\[
\frac{\partial W}{\partial c_{II}} = c_{II} (t_2 - t_1) x (p_1 + c_{II} t_1) f(c_{II}) > 0 \quad \text{(C-6)}
\]

The elements of Table 2 are simply the signs of \( \frac{\partial W}{\partial p_1} \), \( \frac{\partial W}{\partial p_2} \), and so on for \( \frac{\partial W}{\partial z} \), an arbitrary change in regulation that loosens price controls.
Appendix D

THE SUPPLY FUNCTION IN THE UNCONTROLLED MARKET SEGMENT

Firms that are not totally price-bound by firm-specific price controls need not escape their influence. Camm, Phelps, and Stan (1981a) shows that "uncontrolled" firms under the price controls of 1979 and 1980 often had supply responses quite different from those in a totally uncontrolled market. This result has important implications for the analysis of the cost of inappropriate supply in Sec. V. This appendix reviews the supply behavior of firms not totally bound by firm-specific price controls, and develops the implications of this behavior for the welfare analysis in the text.

SUPPLY BEHAVIOR UNDER PRICE CONTROLS

To understand the supply of gasoline during 1979-80, we must look at price controls at the refiner level. These dictated how much gasoline would be available for retail sale by each refiner and its affiliates. Price controls imposed by the Council on Wage and Price Stability (COWPS) limited refiner prices by limiting refiner profits in the following way: 1

$$\pi_c = \alpha + \beta y - w_n$$  \hspace{1cm} (D-1)

where $\pi_c$ = controlled profits,
$y$ = output level,
$n$ = level of inputs whose cost cannot be passed through to consumers ("nonallowed inputs"),
$w_n$ = price of nonallowed inputs, and
$\alpha, \beta$ = firm-specific positive constants set by regulation.

Refiners maximized their free market or normal profits, subject to the constraints in (D-1)

$$\pi_m = py - wa - w_n$$  \hspace{1cm} (D-2)

1What follows is a simplified model of the controls imposed during 1979-80. For a more complete model and more detailed technical discussion, see Camm, Phelps, and Stan (1981a).
where $\pi_m = \text{market profits}$,
$p = \text{price of output}$,
$a = \text{level of inputs whose cost can be passed through to consumers ("allowed inputs")}$, and
$w_a = \text{price of allowed inputs}$.

The nature of refining technology allows us to express inputs as functions of output:

$$a = g(y) \quad (D-3)$$
$$n = h(y)$$

Substituting (D-3) into (D-1) and (D-2), we can set up the following Lagrangian as the refiner's maximand:

$$\max_y \pi_m - \lambda (\pi_m - \pi_c)$$

or

$$\max_y (1-\lambda)(py-w_a g(y) - w_n h(y)) + \lambda (\alpha + \beta y - w_n h(y)). \quad (D-4)$$

Assuming the constraint binds, first-order conditions are

$$(1-\lambda)(p-w_a g' - w_n h') + \lambda (\beta - w_n h') = 0 \quad (D-5)$$

$$py - w_a g(y) - \alpha - \beta y = 0$$

and $\lambda > 0$. Totally differentiating (D-5) with respect to $y$, $\lambda$, and $p$ yields:

$$\begin{bmatrix}
\beta - p + w_a g' \\
0
\end{bmatrix}
\begin{bmatrix}
\frac{d\lambda}{dp} \\
\frac{dy}{dp}
\end{bmatrix}
= \begin{bmatrix}
-(1-\lambda) \\
y
\end{bmatrix} \quad (D-6)$$
For $\lambda = 1$, $dy/dp = 0$. When the refiner was totally price-bound, its supply curve was vertical. For $0 < \lambda < 1,$

$$\frac{dy}{dp} = \frac{y}{\beta - p + \bar{w} g^{-}} < 0 \text{ as } \beta < p - \bar{w} g^{-}$$

(D-7)

That is, the shape of the refiner's supply curve could be negative or positive, depending on the value of $\beta$ chosen by regulators. Values consistent with negatively and positively sloped supply curves could be observed during 1979 and 1980, although negatively sloped curves were more likely. These in turn, in conjunction with margin controls at the retail level, could lead the retail supply curves for individual refiners and their affiliates with negative and positive slopes.

Figure D.1 shows several representative supply curves for stations in the uncontrolled market segment in the text.

Fig. D.1—Representative supply curves for stations in the uncontrolled market segment

MC shows the marginal cost for an individual firm. Depending on how price-control regulations are written, if they are effective, the firm will have a reservation price function like $S^0_a$ or $S^0_b$, each of
which assigns one output level to each price. If all firms are price takers, we can sum individual firm supply functions horizontally to obtain an industry supply function which (a) may itself be negatively or positively responsive to price, and (b) will differ from the marginal cost function for the industry, perhaps substantially. Figure D.2, with uncontrolled industry output on the abscissa and uncontrolled monetary price on the ordinate, shows possible industry marginal cost (MC) and supply ($S^0$) functions.

![Diagram](image)

**Fig. D.2—Welfare costs associated with inappropriate supply in the uncontrolled segment**

**IMPLICATIONS FOR WELFARE ANALYSIS**

With such functions, the social loss associated with an inappropriate supply level is the shaded area between MC and $p^*$ and $X^*$ and $X^0$ or

$$R = \int_{X^0}^{X^*} (p^* - MC) dX$$

(D-8)
Note in particular that while \( S^0 \) from Eq. (4) in Sec. III determines the location of \( X^0 \), it tells us nothing about costs. Cost information is all contained in a function, MC, that underlies \( S^0 \).

Measures that reduce control in this market can affect the uncontrolled segment in two ways. First, Table 1 shows that they always reduce \( p_0 \) and hence reduce \( p_0 - p^* \), since \( p_0 \) moves continuously toward \( p^* \) with decontrol. How this affects social loss depends on the shape of \( S^0 \). If \( S^0 \) is monotonic between \( p^0 \) and \( p^* \), a cut in \( p_0 \) must move output toward \( X^* \); under these circumstances, a fall in \( p^0 \) unambiguously reduces social costs. If, on the other hand, \( S^0 \) takes a form like that in Fig. 8, a fall in \( p_0 \) can easily lead output away from \( X^* \). This will increase the value of \( R \), at least over certain price ranges; incremental decontrol can increase or decrease \( R \).

Second, \( S^0 \) will tend to move toward MC for individual firms that are "uncontrolled" but still affected by controls. Hence \( S^0 \) will also tend to move toward MC for the industry as a whole. If firms with supply curves like \( S^0_a \) in Fig. 7 dominate in the industry, \( S^0 \) will lie to the right of MC at the industry level and decontrol will tend to reduce \( X^0 \), thereby reducing social loss. When \( S^0 \) lies to the left of MC at the industry level, however, decontrol will tend to raise \( X^0 \) and hence social loss. In the end, whether incremental decontrol increases or decreases social losses associated with the inappropriate choice of supply level under partial price control is an empirical question.
BIBLIOGRAPHY


