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Vertical Integration by Contractual Restraints in Spatial Markets

This paper analyzes the private and social incentives for the use of vertical restraints by a monopolistic manufacturer in transactions with firms in a spatial retail market. Under the conditions of our model, the nonintegrated market equilibrium involves a greater density of outlets and a higher price than an integrated manufacturer would set. At the source of these effects are two potential externalities at the retail level, a vertical externality and a horizontal pecuniary externality. The integrated equilibrium is established and the manufacturer's profits are increased through the use of price ceilings, minimum quantity constraints, or franchise fees. The use of these vertical restraints is Pareto improving for some values of the exogenous parameters in our model and particular conjectures on the part of retail outlets, and socially efficient (in the sense of increasing consumers' surplus plus profits) for all parameter values. Where the source of private incentive for the use of vertical restraints is the spatial nature of retail markets, legal prohibitions against the restraints are inappropriate.

I. Introduction

Manufacturers of products frequently include conditions in contracts with retailers that restrict the final retail price or volume of sales or the retail territory to be serviced by the retail outlet. While such restrictions have largely been ignored in economic theory, they are a source of contention in antitrust legislation.

Why would a manufacturer who has any market power be interested in imposing any restrictions on the retail sector rather than setting the wholesale price and selling to all buyers? If manufacturing and retailing markets satisfy the conventional conditions for perfect competition, these restrictions would not be used. In this case, the competitive price system alone would be sufficient to coordinate the retailers' output and entry decisions with the manufacturer's interests. Therefore, the use of these restrictions signals some further characteristic of markets. In particular, this paper focuses on the spatial feature of retail markets where retail firms incur some fixed setup costs and geographically scattered consumers incur some traveling costs to purchase a product from one of a limited number of retail firms, characteristics of many

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actual retail markets.[1] In this setting, we demonstrate that certain vertical restraints can profitably be imposed on retailers by a monopolist manufacturer to alter the pattern of both retail prices and diversity of retail outlets otherwise prevailing in an unconstrained equilibrium.

At the heart of our model are two externalities at the retail level. Alternative contractual restrictions neutralize perfectly these externalities so that manufacturers using one of these restraints can achieve the same levels of profit as with full vertical integration. Consequently, transactions costs alone dictate whether manufacturers would use a restraint contract or vertical integration to maximize profits in our setting.

In particular in our model, sufficient restraints include price ceilings, minimum quantity restrictions, and franchise fees but not restricted retail territories. As price floors are not used in our model, other explanations must account for the use of resale price maintenance.

Are these vertical restrictions in society's interest? Antitrust treatment of these vertical restrictions is varying and unsettled. In general, section 1 of the Sherman Act makes all explicit vertical restraints of trade a per se illegal offense in the United States (Scherer 1980, p. 497).[2] Restrictive agreements in the United Kingdom are controlled by the Restrictive Trade Practices Act and, in contrast to the U.S. approach, are subject to expand rules of reason (Scherer 1980, p. 505). Some economists question the anticompetitive effect of most vertical restrictions and advise the courts that vertical restrictions should be either legal per se (Posner 1981) or generally assumed to enhance efficiency (Williamson 1975). Calculations in our model indicate that the vertical restrictions studied here, even together with monopolized retail territories (when necessary), can be Pareto improving and, in extended cases, welfare improving.

In a complementary paper, Bittlingmayer (1983) analyzes the use of retail price ceilings by a manufacturer facing spatially differentiated retailers. Employing a slightly different demand structure, we consider

1. Answers other than the one offered are that these restraints may represent a manufacturer's cartel or a dealers' cartel administered by the manufacturer. In this case, the analysis is straightforward. Another argument is that manufacturers wish to restrain retail trade to provide a sufficient incentive for retailers to undertake the provision of product information to consumers that will affect favorably the demand for the product of the manufacturer. For some reason, the provision of this information by an independent retailer may be most efficient for the manufacturer. In the absence of any restraint, discount houses will free-ride on the provision of the information, undercutting the incentives to incur the costs of providing the information. Telser (1960) has advanced this argument to explain resale price maintenance; in a separate paper (Mathewson and Winter 1983), we examine the private and public incentives for resale price restrictions where there are consumer informational costs.

2. For the case of vertical *territorial* restraints, however, U.S. courts have recently become more lenient. See Caves's (1980, p. 2) discussion of the U.S. Supreme Court's decision on Continental T.V. v. GTE Sylvania (1976) (433 U.S. 36, 1976).

restrictions beyond retail prices, addressing both positive and normative implications of these restrictive policies and analyzing the source of the incentives for restrictions in terms of agents' property rights.

In Section II we set out our basic model. The first stage describes the nature of alternative equilibria in retail markets with open entry and no vertical restraints imposed by manufacturers, conditional on conjectures by retailers about the behavior of their rivals. Section III describes the effect on these retail equilibria of various restraint instruments that are at the disposal of the manufacturer. Section IV locates the equilibrium retail price and number of retail outlets for a manufacturer with vertical restrictions relative to the unconstrained price and outlet configuration. This is essential to the determination of profitable restraints in a spatial market and the direction of the imposed constraints (e.g., a price floor or a price ceiling?). In Section V, we analyze the welfare consequences of the vertical restrictions. Finally, in Section VI we offer some summary comments.

II. The Basic Model

A. Assumptions

We consider a retail market for a product under the following assumptions, some of which are standard in the spatial competition literature:[3]

(a1) Consumers are uniformly distributed with density v along a circle or a line of infinite length.

(a2) Consumers have a common travel cost t per unit distance per unit quantity purchased.

(a3) Retail outlets buy at a wholesale price P_w. Each incurs a fixed (but not sunk) cost F and no variable costs other than the wholesale price.

(a4) There is free entry into the retail market so that outlets continue to enter the retail market until profits are driven to zero.

(a5) Existing retail outlets locate symmetrically in the retail market.

(a6) The wholesale market is supplied by a monopolist who incurs a constant cost of production c and maximizes profit per unit distance. The manufacturer incurs no transportation cost in distributing the products to outlets.

(a7) The demand per consumer is $f(P + ts)$ where P is the retail price paid by the consumer (called the "mill" price) and s is the distance traveled to the outlet. Each consumer buys from the outlet whose "delivered" price $(P + ts)$ is the lowest.

3. See Capozza and Van Order (1978) for a concise analysis of spatial competition in two dimensions under the assumption of free entry.

While some of the results in this paper hold for arbitrary downward-sloping demand functions, others require specific functional forms. Simplicity and clarity result if we adopt a specific demand function at the outset but indicate as we proceed where our results generalize. One functional form that is used in the spatial economic literature (e.g., Eaton and Lipsey 1976, 1978) that yields tractable results for our problem is the exponential form $f(P) = ae^{-bP}$. Without consequence, we may normalize $a = b = 1$ so that our demand function becomes

$$f(P) = e^{-P}. \tag{a8}$$

An appendix (available on request from the authors) shows that results qualitatively identical to those derived below prevail with a linear demand function, a functional form that appears frequently as well in economic models of spatial competition (e.g., Stern 1972; Novshek 1980; Bittlingmayer 1983).

We begin by developing the nature of price and locational equilibria in retail markets with open entry. Any model of equilibrium retail prices and locations is conditional upon the conjectures that retailers hold about the actions of their rivals. We consider two alternative conjectural possibilities:

(a9a) *Nash conjectures (Hotelling-Smithies competition):* Each retail outlet assumes its neighbors' price to be invariant to its price changes.

(a9b) *Löschian conjectures:* Each outlet assumes that its market area is invariant to changes in its price or equivalently, each outlet assumes that neighboring outlets will match its price change.

Spatial competition theory most commonly uses the Löschian conjectures. Both concepts are useful as together they provide a reasonable range for conjectural assumptions, and they yield varying analytical results in our paper. An equilibrium in the retail market consists of a retail price and radius for each outlet where each outlet maximizes its profits given its conjectures and earns zero profits.[4] For purposes of

4. The symmetry assumption (a5) and the two equilibrium concepts, Löschian competition and Nash or Hotelling-Smithies competition, are standard in the spatial competition. However, some elaboration is necessary to justify symmetry as the outcome of rational locational decisions on the part of firms. A Nash equilibrium in prices *and location* decisions does not exist in spatial models (Eaton 1976; Novshek 1980). For example, in the symmetric, zero-profit equilibrium considered in this paper, any outlet with Nash conjectures in both price and location would have the incentive to move to its neighbors' location and undercut the neighbors' price slightly. Since the outlet would not be facing a competitor in his previous location, its profits would be greater than its neighbors' profits before the move—that is, it would gain positive profit by such an action. Eaton (1972, 1976) modifies the Nash conjectural variation by assuming that the reaction of any competitor will be recognized by a firm if the competitor's delivered price is undercut at the competitor's location. Eaton equilibria are symmetric but may involve positive profits on the part of each firm (Eaton 1976). Both equilibrium concepts used in this paper may be defined precisely as equilibria in prices and locations where firms

comparison, we develop first the conditions that describe the Nash and Löschian equilibria and then the integrated equilibrium conditions.

B. *Retail Market Equilibria for a Given Wholesale Price*

Consider first the Nash equilibrium. Let (P_i, R_i) be the price and radius, respectively, of a single firm i and P be the price of i's neighboring rivals. The demand served by a single outlet is

$$q(P_i, R_i) \equiv 2\int_0^{R_i} ve^{-P_i - ts}\, ds = 2ve^{-P_i}(1 - e^{-tR_i})/t. \tag{1}$$

Define x as the distance from the firm i to its neighbors. With Nash conjectures, R_i is endogenous. It is determined by the condition that a consumer located at the boundary of the market area served by i be indifferent between buying from i and P_i and buying from the neighbor at P:

$$P_i + tR_i = P + t(x - R_i) \tag{2}$$

or

$$R_i = (P - P_i)/2t + x/2. \tag{3}$$

The substitution of (3) into (1) shows the variability in q in response to P_i. With abuse of notation, this substitution yields

$$q(P_i; P, x) = 2ve^{-P_i}[1 - e^{(P_i - P - tx)/2}]/t. \tag{4}$$

The Nash retail market equilibrium (R, P) is determined by a profit-maximizing condition on price,[5] a zero-profit condition on retailers, and a symmetry condition on prices $(P_i = P)$ and locations $(R_i = R = x/2)$. The profits of a retail outlet Π^R are defined as

$$\Pi^R(P_i; P, x) \equiv q(P_i; P, x) \cdot (P_i - P_w) - F. \tag{5}$$

If we substitute (4) into (5), the maximization of profits with respect to P_i and symmetry yields

$$2(1 - e^{-tR}) - (2 - e^{-tR})(P - P_w) = 0. \tag{6}$$

Free entry into the retail market implies a zero-profit condition. From (5) and (1), the zero-profit equilibrium condition is

$$2ve^{-P}(1 - e^{-tR})(P - P_w)/t - F = 0. \tag{7}$$

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currently in the market have either Eaton's modified conjectures (for Nash or Hotelling-Smithies competition) or Löschian conjectures and this fact is recognized rationally by potential entrants.

5. The demand curve facing any outlet in equilibrium is discontinuous, since if the outlet lowered its price enough to capture the consumers situated at its neighbors' locations, it would capture *all* the consumers served by the neighbors (Salop 1979). For the first-order condition to be sufficient for the maximization of retail profits, the outlet's inverse demand curve cannot cross its average cost curve at the point of discontinuity, a condition which holds for the cases of exponential and linear consumer demand functions when marginal cost is constant.

Equations (6) and (7) determine the Nash equilibrium (P, R) for a given wholesale price P_w.

Consider next the Löschian equilibrium. Under Löschian conjectures, each retail outlet believes either $dR_i/dP_i = 0$ in calculating dq/dP_i from (1) or, equivalently, $dP/dP_i = 1$ in calculating dq/dP_i from (4). That is, if changes in P_i are matched by changes in P, then the boundary of firm i's market area remains unaltered.[6] In this case, the resulting maximization of profits with respect to P_i on the substitution of (1) into (5) yields

$$P = 1 + P_w. \tag{8}$$

Here, the (symmetric) price for each firm is independent of R. Equations (7) and (8) determine the Löschian equilibrium (P, R) for a given wholesale price P_w.

Both the Nash and Löschian equilibrium for retail firms involve a tangency between the retail firm's perceived demand curve and its average cost curve. The perceived demand curve for the Löschian firm is the prorated industry demand curve, while the perceived demand curve for the Nash firm is more elastic in equilibrium than the prorated industry demand curve. Consequently, in equilibrium, Löschian retailers sell less output at higher average costs than their Nash counterparts under identical cost conditions.

C. First-Best Equilibrium

We now develop the retail market preferred both by a vertically integrated firm and by a nonintegrated upstream manufacturer serving a free-entry (zero-profit) retail market. For the vertically integrated firm, profit per unit distance is

$$\Pi(P, R) = [q(P, R) \cdot (P - c) - F]/2R, \tag{9}$$

where c represents (constant) per unit costs. For the nonintegrated manufacturer, profit per unit distance is a function of P_w, P, and R. With abuse of notation,

$$\Pi(P_w; P, R) = q(P, R)(P_w - c)/2R. \tag{10}$$

If the (P, R) of (10) are established in a free-entry retail market, then the zero retail-profit condition ([5] set equal to zero with $P_i = P$) can be used to eliminate P_w from (10), which leaves profits as exactly the function of P and R described by (9). That is, (9) is not only the profit of a vertically integrated firm for values of (P, R) but also the profits of an upstream manufacturer as a function of the "target" variables in the downstream equilibrium conditional on a free-entry (zero-profit) retail market. For the exponential demand case, substituting (7) (with $P_i = P$

6. Capozza and Van Order (1978, p. 899) point out this equivalence.

and $R_i = R$ as the vertically integrated firm has symmetrical retail behavior under our assumptions) yields

$$\Pi(P, R) = [2ve^{-P}(1 - e^{-tR})(P - c)/t - F/2R]. \qquad (11)$$

Note that (P, R) in (11) reaches a maximum at $P^* = 1 + c$, which is independent of R. (This will be useful later.) Define (P^*, R^*) to be the "first-best" equilibrium for the manufacturer.

The question is whether the manufacturer needs to integrate fully to achieve (P^*, R^*) or finds the available restraint instruments sufficient. Not surprisingly, the set in the (P, R) target space that is feasible for the manufacturer depends on the available instruments. Before we proceed further, some definitions will prove useful. Two instruments are perfect substitutes when the feasible sets attainable through the two different instruments are identical and an instrument is sufficient, or first-best, if (P^*, R^*) is contained in its feasible set. As a first step toward determining the profitability of each of the restraints, we characterize the feasible sets that can be achieved through the available instruments. Once we do this, we will be ready to define the specific sets of instruments for our particular retail price and location problem.

III. Instruments and Feasible Sets

A. *Wholesale Price*

When all vertical restraints are prohibited and the manufacturer has only the wholesale price as an instrument, the set of attainable target values is a (one-dimensional) curve in (P, R) space. We label this the "reaction curve." Under Nash conjectures for the outlets, eliminating P_w from (6) and (7) yields

$$P = \ln [(4v/Ft)(1 - e^{-tR})^2/(2 - e^{-tR})] \text{ (Nash reaction curve)}. \qquad (12)$$

Similarly, when the outlets have Löschian conjectures, eliminating P_w from (8) and (9) yields

$$P = \ln [(2v/Ft)(1 - e^{-tR})] \text{ (Löschian reaction curve)}. \qquad (13)$$

These two reaction curves are depicted in figure 1. Each curve describes the combinations of retail prices and location of retail outlets (numbers of retail outlets) that are possible with different levels of wholesale prices. As P_w increases, the retail prices under either conjectural variation rise and outlets are further apart (fewer in number). In the limit, as P_w approaches a maximum sustainable wholesale price at which a single retail firm would just cover costs, the Löschian and Nash retail market equilibria converge. The Löschian reaction path lies above the Nash reaction path. There are two reasons for this. First, as

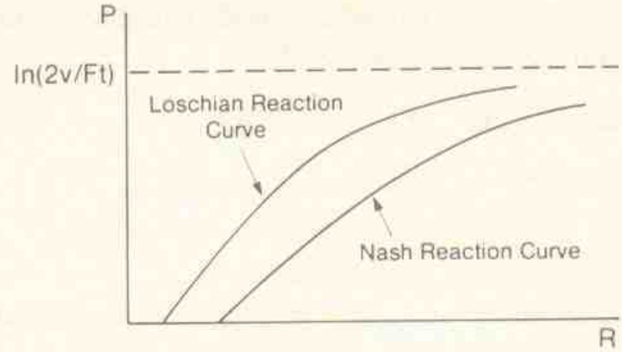


FIG. 1.—Nash and Löschian reaction curves

a comparison of (6) and (8) reveals, for a given P_w and R, the markup by Löschian retail firms exceeds the markup by Nash retail prices. This holds because the price elasticity for retail firms under Nash conjectures exceeds that under Löschian conjectures. In fact, because Löschian firms expect their market area to be invariant to price changes, they have the standard monopoly price markup. Second, the wholesale price P_w facing Löschian firms for a given R (number of outlets) is greater than the P_w facing Nash firms. This holds because at a given R (number of retail outlets), the zero-profit retail equilibrium condition requires a higher P_w where the retail price is greater. Therefore, higher P_w plus lower perceived price elasticities cause higher retail prices in the Löschian market, for given locations of retail outlets.

In either of these retail settings, the objective of the monopolist manufacturer is to choose P_w to maximize $\Pi(P, R)$ of equation (11) subject to the relevant reaction curve. P_w alone is sufficient to achieve the first-best equilibrium only if the respective reaction curves pass exactly through (P^*, R^*), an event with a negligible probability of occurrence. Therefore, we expect manufacturers to have a profit incentive to use vertical restraints as additional instruments. (For one particular consumer demand specification—each consumer buying one unit of the commodity and all consumers sharing the same reservation price, as in Salop [1979]—there is no incentive for integration or vertical restraints: it can be shown that the reaction curves are as depicted in fig. 2, containing (P^*, R^*).)[7] We consider four alternative options that characterize many wholesaler contracts.

B. *Vertical Price Restraints*

A vertical price restraint can be implemented optimally as either a price floor or a price ceiling depending on the relative location of (P^*, R^*) and the respective reaction curves. If the upstream manufacturer has

7. For a further discussion of the use of restraints under these demand conditions, see Dixit (1983).

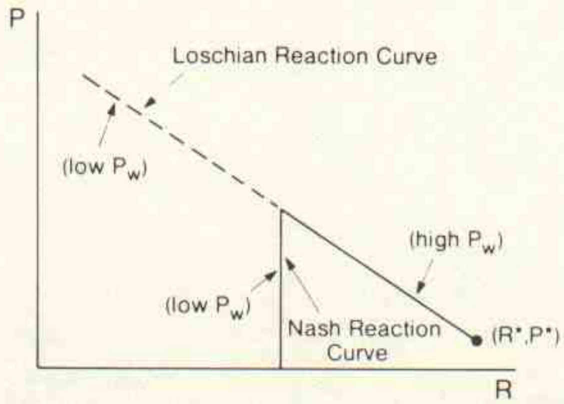


FIG. 2.—Nash and Löschian reaction curves for common reservation price

the power to set the retail price, then the only equilibrium condition for the retail market is zero profits for retail firms (eq. [7]). Once P is set, (7) determines R as an unbounded function of the wholesale price. Therefore, *any* point in the target space can be attained with the instruments P_w and P; the retail price restraint is a first-best instrument. If (P^*, R^*) lies above (below) the reaction curve, a retail price floor (ceiling) is both a profitable and a sufficient instrument for the manufacturer.

Because of the symmetry in our model, and because our only departure from classical competitive assumptions in modeling the retail market is the explicit introduction of space and location, the market equilibrium is described by only two target variables, the retail price and the density of retail outlets. It is not surprising, therefore, that two instruments, the wholesale price and a vertical price restraint, are sufficient to achieve the equilibrium that maximizes the manufacturers' profits. However, this would not be the case if the retail market contained a third dimension such as product quality or local advertising or unknown retail conjectures.[8]

C. *Volume Restrictions*

In general, if demand functions are invertible and retail inventories are ruled out, quantity restrictions imposed by manufacturers on retailers should be equivalent to price restrictions. Our world is complicated slightly by the presence of demand functions for each outlet.

Consider a minimum quantity restriction and a price ceiling imposed on retailers. Equivalence between these two instruments amounts to showing that if (P^0, R^0) is any equilibrium that is achievable with a price ceiling, then $q(P^0, R^0)$ (defined by eq. [1]) is the corresponding minimum quantity restriction on wholesale purchases. If the immediate neighboring outlets set $P = P^0$, then to sell $q(P^0, R^0)$, any particular

8. An extended discussion of the manufacturer-retailer coordination problems with local advertising appears in Mathewson and Winter (1982).

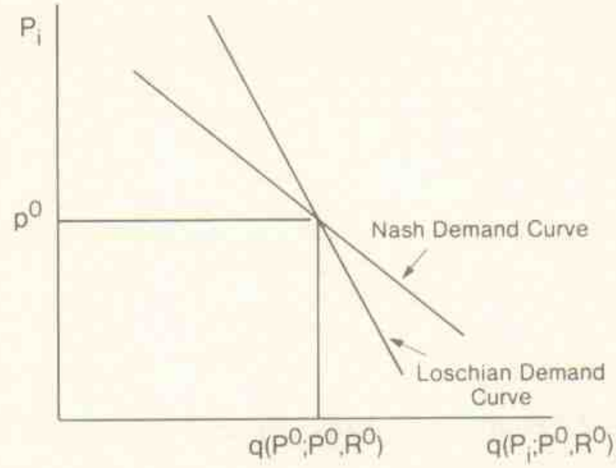


FIG. 3.—Nash and Löschian demand curves

outlet i must set $P_i \leq P^0$, whatever the conjectural assumptions. That is, the Nash and Löschian demand curves intersect at (P^0, R^0) (see fig. 3). Since a price ceiling can achieve (P^0, R^0), $d\Pi^R(P_i; P^0, R^0)/dP_i\ (P_i = P^0)$ is positive and the outlet has no incentive to set a lower price. Therefore, it sets $P_i = P^0$ and sells exactly the minimum allowed quantity.

A similar argument would show the equivalence between a price floor and a minimum quantity restriction. Therefore, in principle, if (P^*, R^*) lies above (below) the reaction curve, a minimum (maximum) quantity restriction would be both a profitable and a sufficient instrument for the manufacturer. However, in practice, quantity and price restrictions are not used uniformly. Rather, price floors (as opposed to maximum quantity restrictions) and minimum quantity restrictions (as opposed to price ceilings) appear to dominate (see Caves 1980, p. 11). The reason for this may lie with a monitoring argument outside our formal model. For a manufacturer, it is easy to enforce minimum quantity purchases on the retailers with each wholesale transaction. However, incentive difficulties arise where the manufacturer has to rely on retailers to report upward deviations from a price ceiling by wayward outlets. The presence of these price deviants only benefits competing retailers so there is a disincentive to report the offending retailers to the manufacturers.

D. *Franchise Fees*

A franchise fee is a fixed fee G payable by each retail outlet to the manufacturer. (In the case of a subsidy, G is negative.) With this instrument, the manufacturer has a two-part wholesale price (P_w, G). Increasing franchise fees for each wholesale price serves to restrict the number of retail outlets, that is, retail outlets are located further apart. In the face of open entry, the zero-profit condition (7) in the presence of a franchise fee becomes

$$2ve^{-P}(1 - e^{-tR})(P - P_w) - F - G = 0. \qquad (14)$$

Under Nash conjectures, the transformation from instruments to target involves setting (P_w, G) to achieve (P^*, R^*) by solving equations (6) and (14) for P_w and G as functions of (P^*, R^*). Under Löschian conjectures, the optimal retail price $P^* = 1 + c$ is attained by setting $P_w = c$, since (8) reveals that Löschian retail firms set $P = 1 + P_w$ independent of R, and then G is set to achieve the optimal market area R^* from (14).[9] Therefore, independent of retail conjectures, *any* point in the target space can be attained with the instruments P_w and G; *franchise fees are a first-best instrument.*

Since $P_w = c$ in the case of Löschian conjectures, all rents are collected at the retail level and are transferred back to the manufacturer through the franchise fee. Since $P_w > c$ in the case of Nash conjectures, the rents are collected by the manufacturer through both the wholesale prices and the franchise fee. In both cases, all the rents accrue to the manufacturer.

E. Closed Territory Distribution

Closed Territory Distribution (CTD) is the assignment by a manufacturer of an exclusive territory to each retailer within which the retailer has monopoly rights to the distribution of the manufacturer's product. It is apparent that CTD rationalizes Löschian conjectures for retailers, namely, that their market area is invariant to changes in their retail prices.

We can demonstrate that the Löschian reaction curve is a boundary of the set of (P, R) equilibria attainable with CTD. First, establishing closed territories of equilibrium radius has no effect on the Loschian equilibrium. Starting from a point on the Löschian reaction curve and holding P_w constant, the manufacturer cannot decrease market area (R) through CTD because of the zero-profit constaint. However, the manufacturer could use CTD to establish a larger radius for the market area of each retailer. Such an action would leave P unchanged as $P = 1 + P_w$ under the (rationalized) Löschian conjectures. Therefore, any point to the right of the Löschian manifold in (P, R) space (fig. 1) could be attained through the use of CTD together with P_w.

Is there a profit incentive for the manufacturer to impose CTD on retailers whose conjectures are already Löschian? The answer is no. With P_w unchanged, a CTD policy that increases R and leaves P unchanged would only lower the manufacturer's profits—fewer outlets with P unchanged would only decrease the quantity demanded by final consumers. CTD could increase the *combined* profits of the manufacturer and the retailer, but in this case, the profits would have to be shared with the retailers. Any attempt by the manufacturer to collect

9. The optimal P_w is equal to c under franchising fees for any demand curve. When $P_w = c$ is substituted into a Löschian firm's first-order condition on price, the condition reduces to the first-order condition for an integrated firm.

back these rents through franchise fees would leave a redundant instrument, as we have demonstrated in the previous section that franchise fees and wholesale prices are sufficient to achieve the equilibrium that is most profitable for the manufacturer. Indeed, to establish (P^*, R^*) with CTD, the manufacturer would have to accept exactly zero profits as the necessary P_w would equal c, thus transferring *all* rents to the retailers. Therefore, if conjectures by retailers are Löschian, CTD is superfluous.

However, a manufacturer could use CTD to fix retail market areas, and therefore to force Löschian conjectures on retailers currently holding Nash or any other conjectures.[10] The impact of such a change would be to increase retail prices (to the level of a retail monopolist) and, through entry into the retail market, to increase the density of retail outlets. Increased retail prices and increased numbers of retail outlets have warring effects on the demand for the product and hence on the manufacturers' profits. A priori, it is not possible to tell which effect is dominant. (Refer to fig. 1.) If (P^*, R^*) were above the Löschian reaction curve, CTD would be definitely profitable, although not a first-best or sufficient instrument; if (P^*, R^*) were between the two reaction paths, CTD would be potentially profitable but not first-best. We consider the location of (P^*, R^*) relative to the two reaction curves in the next section.

The analysis in this section shows that, whether the retail firms hold Nash or Löschian conjectures, the wholesale price and one of price restraints, volume restraints, or franchise fees are sufficient for the monopolist manufacturer to achieve the first-best (integrated) equilibrium (i.e., price restraints, volume restraints, and franchise fees are substitute instruments). This result generalizes easily to an arbitrary downward-sloping consumer demand curve.

IV. The Location of (P^*, R^*) Relative to the Sets Attainable with Various Restraints

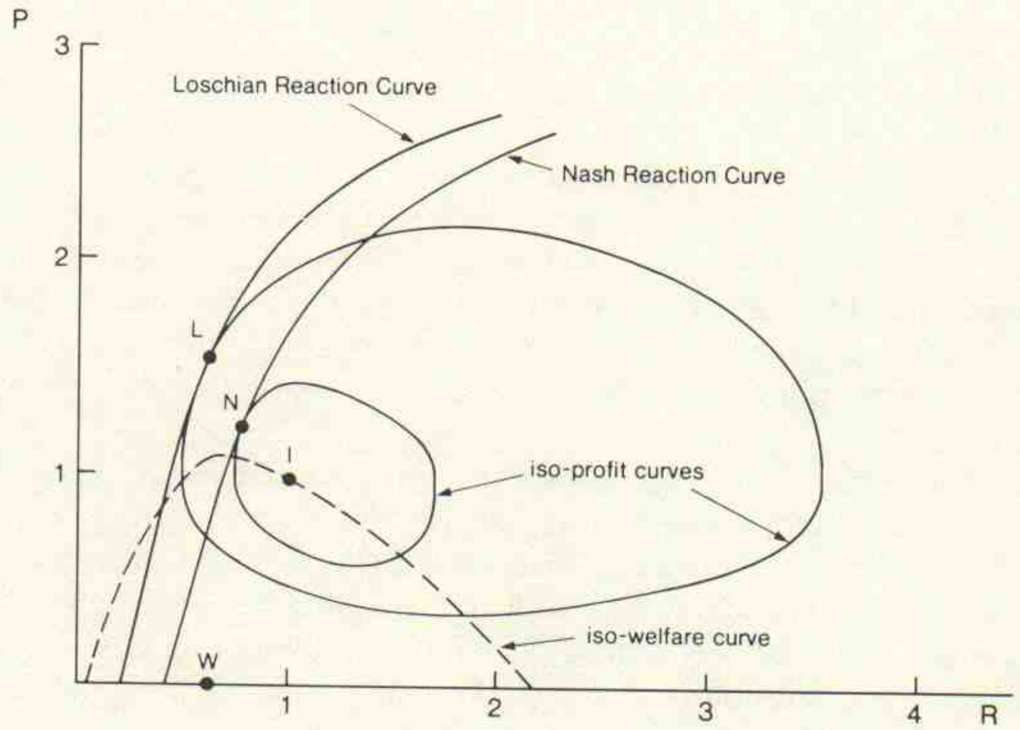
(P^*, R^*) lies *below* the Löschian reactive curve. It is possible to show this is the case of a general, downward-sloping demand curve. To do so, we need to demonstrate that each retail outlet under Löschian conjectures has an incentive to raise its price when competing outlets set a price P^* and its market area is R^*. By definition, P^* maximizes $\Pi(P, R)$ of equation (11) conditional on R^*. Therefore, P^* satisfies

$$q(P, R^*) + (P - c)\partial q(P, R^*)/\partial P = 0. \tag{15}$$

Under Löschian conjectures, each retailer's perceived profits at R^* and any P are $\Pi^R(P, R^*) \equiv q(P, R^* (P - P_w) - F$, so that

$$\partial \Pi^R/\partial P = q(P, R^*) + (P - P_w)\partial q(P, R^*)/\partial P. \tag{16}$$

10. We are indebted to Yehuda Kotowitz for this point.



W ≡ welfare optimum (at P = 0, R = .53)
I ≡ integrated equilibrium
N ≡ nonintegrated equilibrium under Nash conjectures
L ≡ nonintegrated equilibrium under Loschian conjectures.

FIG. 4.—Equilibria and welfare optimums for $c = 0$, $t = 1$, $v = 5$, and $F = 1$

Since $P_w > c$ due to the monopoly power of the manufacturer, (15) and (16) together imply that $\partial\, \Pi^R(P^*, R^*)/\partial P > 0$.

Therefore, assuming the satisfaction of second-order conditions, retail price *ceilings* (as opposed to floors), or *minimum* (as opposed to maximum) quantity restraints, or franchise *fees* (as opposed to subsidies) are both profitable and sufficient to achieve the manufacturer's profit-maximizing equilibrium (P^*, R^*). When conjectures are Löschian, CTDs are not profitable.

For exponential (or linear) final demands, (P^*, R^*) lies below the Nash reaction curve as well. Define $(\hat{P}, \hat{R})$ to be the nonintegrated Nash equilibrium, that is, the equilibrium that maximizes the profits of the manufacturers conditional on the reaction curve which we denote now as $R = \phi(P)$. (Figure 4 shows reaction and iso-profit curves for particular parameter values.) The Nash reaction curve has a positive slope and the iso-profit curves of the manufacturer are vertical at (P^*, R) for arbitrary R (i.e., from [11], $\partial\Pi/\partial P$ evaluated at P^* is independent of R). Therefore, (P^*, R^*) lies below the Nash reaction curve if and only if $\hat{P} > P^*$. To show $\hat{P} > P^*$, we evaluate the derivative of the manufacturer's profits with respect to P at $[P^*, \phi(P^*)]$. If $\partial\Pi[P^*, \phi(P^*)]/\partial P > (<)\ 0$, then $\hat{P} > (<)\ P^*$ as the relevant second-order conditions are satisfied.

For the exponential demand function, we may solve (12) for $R = \phi(P)$ and substitute this into (11) to obtain

$$\Pi[P, \phi(P)] = [Ft(P - c - 1)]/[-2 \cdot \ln\ (1 - e^{P} \cdot Ft/2v)]. \quad (17)$$

Equation (17) has a positive price derivative at $P^* = 1 + c$. Therefore, conditional on our demand specification, results identical to the Löschian case prevail even when retailers have Nash conjectures.

We cannot determine analytically whether the radius for retail outlets that maximizes the integrated profits (R^*) is greater or less than the nonintegrated radius where conjectures are either Nash or Löschian, even with our functional forms.[11] However, stimulation results (reported below) indicate that the market area always increases with integration.

At the source of these effects are two potential retailer externalities. First, the retailer does not appropriate any increment in profit flowing to the upstream manufacturer through the $(P_w - c)$ wedge when the retail price is adjusted. When both the manufacturer and the retailer (by virtue of the retailer's fixed costs) have price-setting powers, the double marginalization of Spengler (1950) is present. This vertical externality works to leave retail prices (P_i's) too high.

For the nonintegrated Nash retailers, a horizontal *pecuniary* externality exacerbates the pricing decision. With Nash conjectures, any increase in retail prices confers unexpected positive benefits on neighboring retail firms because of the positive cross elasticity of demand. These unappropriated benefits to the individual Nash retailer act to suppress retail prices at each retail location.[12]

The Löschian retailer, in contrast, believes that his neighbors change their prices to match any changes in his own prices. The change in neighbors' prices imposes an externality on the retailer identical to the externality imposed *by* him. Therefore, pecuniary conjectural externalities among retailers are offsetting. This leaves only the vertical externality at work for the Löschian retailer.

In sum, Löschian retailers overprice due to the vertical externality. Nash retailers are subject to warring effects—the same vertical externality as Löschian firms which increases retail prices and an offsetting horizontal externality which shades retail prices (i.e., Nash reactions curves lie below Löschian reaction curves in fig. 1). However, our analysis indicates that the vertical externality dominates the pecuniary horizontal externalities for Nash retailers, as even they continue to set retail prices that are too high.

Appropriate vertical restrictions employed in this paper internalize

11. Refer to fig. 4. A sufficient condition for R^* to exceed the nonintegrated R would be for $\partial^2\Pi(P, R)/\partial P\partial R < 0$. However, for our exponential demand curve $\partial^2\Pi/\partial P\partial R > 0$, so the impact of integration on R must be determined numerically.

12. Any noncooperative game has such pecuniary externalities. The real effect of these externalities is the failure to achieve joint profit maximization (the cooperative solution).

these externalities, that is, establish correct property rights for agents. Price ceilings (quantity floors) set total rent-maximizing final retail prices (quantities) whatever the retailer's conjectures while wholesale prices together with open entry into the retail sector generate optimal retailer density and transmission of total rents to the retailer. Alternatively, manufacturers may use franchise fees. For Löschian retailers, traditional marginal-cost transfer prices avoid double marginalizations and therefore yield maximum rents that, in turn, are transferred to the manufacturer through appropriate franchise fees. The corresponding scheme for Nash retailers is slightly different. Sufficient double marginalization is tolerated to correct for the horizontal conjectural externality (i.e., $P_w > c$) and generate maximum rents while franchise fees play the usual transfer role.

Although two instruments are sufficient in our world to achieve the profit-maximizing solution for the manufacturer, this is not the case if manufacturers are uncertain of the conjectures held by retailers. The impact of a franchise fee as the sole restraint, for example, would have an uncertain impact on the retail market equilibrium. However, CTD would *impose* Löschian conjectures on retailers, and the use of CTD together with wholesale price and one other vertical instrument (say, franchise fees) is therefore sufficient to achieve the first-best solution. As an empirical fact, a franchise usually receives territorial protection (Caves and Murphy 1976, p. 572).

Subject to the demand and conjectural variations explored here, the spatial nature of retail markets alone *never* gives rise to resale price floors, a vertical restraint sometimes analyzed with spatial overtones (Gould and Preston 1965).[13] Rather, in the context of our assumptions, the rationale for resale price maintenance must be sought elsewhere, perhaps along the line of Telser's (1960) information hypothesis.

V. Welfare Analysis

To this point, we have demonstrated that there is a private incentive for the imposition by the monopolist manufacturer of some vertical restraints on the retail sector with open entry. Are these restraints in society's interests? Should these restraints be prohibited? We define welfare improvement as either a Pareto improvement (in the absence of side payments among economic agents) or an increase in the sum of

13. In particular, Gould and Preston (1965), in studying price floors, posit a rationale for manufacturer intervention in the retail sector that is related to our spatial story, but they restrict their attention to a positive analysis of RPM. In their model, as in ours, more retail outlets act to increase demand. Gould and Preston predict that increased retail margins increase the number of retail outlets but decrease their size and that final retail prices rise or fall depending on the slope of marginal cost curves and final demand elasticities.

consumers' and producers' surpluses. While the Pareto definition is stronger, it provides only a partial ordering of alternatives.

Our analysis indicates that wholesale prices together with either retail price ceilings or minimum quantity restrictions or franchise fees are sufficient to achieve vertically integrated monopoly profits. Therefore, the relevant welfare comparisons are the respective nonintegrated and integrated solutions. While we are forced to turn ultimately to specific functional forms and pseudoempirics, some initial insight and progress is possible at a theoretical level.

From the point of view of social efficiency, the nonintegrated retailer sets too high a price. Aside from the usual monopoly deadweight loss, as we have argued, nonintegrated retailers fail to internalize either the vertical externality or horizontal conjectural (pecuniary) externality where it is relevant. Integration internalizes these externalities causing a retail price fall, as shown by our analysis. As traditional monopoly losses remain, our welfare analysis involves second-best comparisons.

In general, as we have argued, the change in the density of retail outlets, or equivalently in retail market areas R, with integration is ambiguous. Consequently, the welfare effect of integration through changes in R is ambiguous as well. Even so, one possible effect is clear. Because the monopolist does not appropriate fully the gain in consumer surplus with increases in the density of outlets but does incur the full social costs, the integrated monopolist's diversity of retail outlets falls short of the socially efficient level. If retail outlets become less dense with integration, welfare could fall as the delivered price. In this case, $(P + ts)$ could rise.

Therefore, a necessary and sufficient condition for either integration or vertical constraints capable of achieving the integrated solution to be Pareto improving is that the highest delivered price paid by any consumer in the integrated equilibrium be less than the lowest delivered price (i.e., the "mill" price) in the nonintegrated equilibrium.

That this condition is sufficient is obvious: Under this condition, the welfare of every consumer increases; as well, the manufacturer's profit increases while entry guarantees that the retailers' profits remain unchanged at zero. That this condition is necessary is less obvious. Consider consumers located on a circle. An equilibrium (P^*, R^*) is preserved when specific firm locations are rotated around the circle. Therefore, for any equilibrium, it is always possible to locate stores so that the consumer enjoying the lowest delivered price in the nonintegrated equilibrium (a consumer located directly at a retail outlet) is the consumer paying the highest delivered price in the integrated equilibrium (the same consumer now located at the margin of a market area). Hence, the condition is necessary.

There is no general guarantee that respective prices and market areas in our model meet the conditions for Pareto efficiency. Even if integrated equilibria are not Pareto improving, however, they may be efficient on the basis of the sum of consumers' surplus and profits. We can calculate the consumer surplus per unit area corresponding to our exponential demand function and add to it the manufacturer's profits given by equation (11) (retailers always receive zero profits) to obtain welfare per unit area as

$$W \equiv [2ve^{-P}(1 - e^{-tR})(P + 1 - c)/t - F]/2R. \qquad (18)$$

There is no guarantee that, under general demand conditions, respective prices and market areas change with integration to improve this welfare measure. Further, even with our specific functional forms, we cannot solve explicitly for profit-maximizing price and market equilibria under either Nash or Löschian conjectures so that analytical comparisons of welfare under alternative price and retail arrangements are impossible.

Instead, the issues of Pareto improvement and efficiency are pursued through numerical simulation. The critical parameters of the model are (F, v, c, t). F can be normalized to one without consequence; the results are reported for $c = 0$ and were verified for positive values of c. Values of t and v are chosen to range from the margin where retail markets are just viable (i.e., where consumers are spread sufficiently thinly and have sufficient travel costs that given the fixed costs imposed on retailers, retail markets are just viable) to a close approximation of nonspatial competitive conditions.

Table 1 reports our numerical results. Denote $\tilde{P}$ as the Löschian-constrained retail price and continue to denote $\hat{P}$ as the Nash-constrained retail price. For all the parameter values selected and displayed in table 1, $\hat{P} < P^* + tR^*$ so that integration is never Pareto optimal under Nash conjectures. For Löschian conjectures at the retail level, however, integration may be Pareto improving. Figure 5 depicts the set of parameters (v, t) (for $c = 0, F = 1$) for which $\tilde{P} > P^* + tR^*$ (i.e., for which integration or vertical constraints are Pareto improving). Under Löschian conjectures, integration or vertical constraints are Pareto improving for combinations of low travel costs (t) and high densities of consumers (v), conditions close to nonspatial markets. In this case, as travel costs are small, consumers are universally better off with integration because of lower retail prices.

Welfare as measured by the sum of consumers' and producers' surpluses always increases with integration as indicated in table 1. As well, for all parameter values, integration increases the market area for each retailer (reduces the number of retail outlets). As retail market conditions move toward conventional competitive conditions (i.e., $t \rightarrow 0$, $v \rightarrow \infty$), table 1 reveals that retail prices and profits for the Nash nonintegrated equilibrium converge to the unconstrained prices and maximum profit. In Nash retail markets, the incentive for vertical inte-

TABLE 1 Equilibrium Values of $(P, R. \Pi, W)$ for Selected Values of (t, v) for $c = 0$ and $F = 1$

	.01			.10			1.0			10		
v and t	I	N	L	I	N	L	I	N	L	I	N	L
1:												
P	1.00	1.06	1.92	1.00	1.20	1.63						
R	17.47	9.28	3.47	6.42	4.02	2.95		NV			NV	
Π	.31	.30	.13	.19	.17	.11						
W	.65	.63	.28	.47	.42	.28						
5:												
P	1.00	1.03	1.81	1.00	1.09	1.56	1.00	1.25	1.17			
R	7.56	3.89	.61	2.53	1.39	.49	1.02	.72	.39		NV	
Π	1.71	1.67	.66	1.43	1.35	.57	.66	.58	.22			
W	3.48	3.43	1.48	3.05	2.92	1.60	1.82	1.60	1.50			
10:												
P	1.00	1.02	1.81	1.00	1.06	1.57	1.00	1.19	1.27			
R	5.31	2.70	.31	1.75	.93	.24	.64	.40	.20		NV	
Π	3.49	3.44	1.32	3.09	2.97	1.17	1.94	1.74	.68			
W	7.07	7.01	2.96	6.46	6.27	3.22	4.65	4.23	3.24			
100:												
P	1.00	1.01	1.34	1.00	1.02	1.81	1.00	1.07	1.57	1.00	1.20	1.27
R	1.66	.83	.02	.53	.27	.03	.17	.09	.02	.06	.04	.02
Π	36.18	36.03	8.88	34.89	34.44	13.23	30.89	29.68	11.75	19.36	17.36	6.82
W	72.67	72.30	32.10	70.72	70.03	29.61	64.65	62.69	32.23	46.51	42.31	32.42

NOTE.—I – value of variable in integrated or appropriately constrained equilibrium; $N \equiv$ value of variable when retailer conjectures are Nash; $L \equiv$ value of variable when retailer conjectures are Löschian; $NV \equiv$ retail market is not viable.

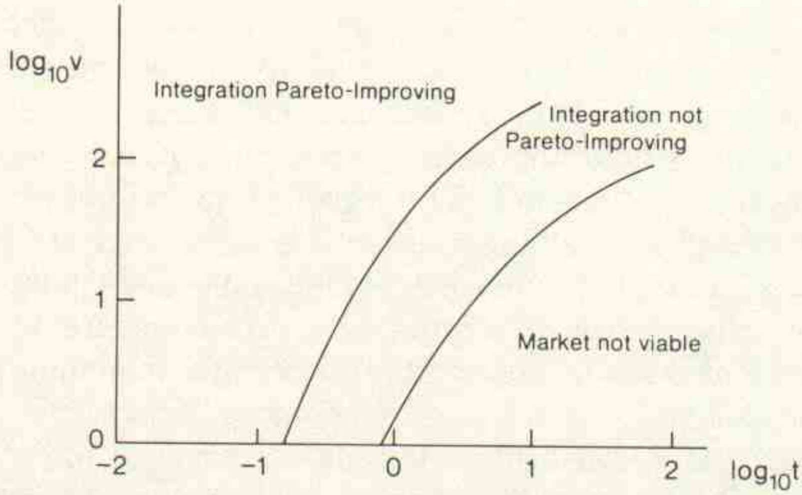


FIG. 5.—Parameter values for which the integrated equilibrium is Pareto superior to the nonintegrated Löschian equilibrium.

gration or the insufficiency of conventional uniform-price contracts disappear when retail markets are conventionally competitive. This is not the case for Löschian retailers because of the monopolistic nature of their price.

Figure 4 depicts the nonintegrated equilibria, the integrated equilibrium, iso-profit curves, and an iso-welfare curve for a particular set of parameter values ($c = 0$, $t = 1$, $v = 5$). Note that the nonintegrated equilibria, points L and N, lie above the iso-welfare curve through the integrated equilibrium I. The negative impact of integration on the density of retail firms (or, in a general interpretation, on product diversity in the market) is welfare decreasing; the nonintegrated radius, (Nash) $\hat{R} = .72$ or (Löschian) $\tilde{R} = .50$, is nearer the welfare-maximizing radius of .53 than is the integrated equilibrium radius, $R^* = 1.02$. However, the detrimental impact on welfare of the decrease in firm density is more than offset by the positive impact on welfare of the decrease in equilibrium price toward marginal cost. Thus, welfare increases with integration.

VI. Conclusions

In this paper we present an economic analysis of the private and social incentives for the use of vertical restraints by monopolistic manufacturers in their transactions with retailers in a spatial retail market characterized by open entry and therefore zero retail profits. In particular, we show that a monopolist manufacturer's profits are increased through the use of vertical restraints in contracts with retail markets. At the source of the profitability of vertical restrictions are two potential externalities at the retail level.

Retailers do not appropriate rents flowing to the manufacturer through the wedge between wholesale prices and marginal costs. This vertical externality present for all retailers yields retail prices that are too high. Nash retailers hold price elasticity conjectures that are too low. This pecuniary horizontal externality acts to depress retail prices. Löschian retailers hold appropriate price elasticity conjectures. Our analysis shows that the manufacturers integrated with the retail firms sets a *lower* retail price and establishes a *lower* density of outlets than the nonintegrated equilibrium whatever the conjectures of the retailers.

Therefore, the instruments profitable to a nonintegrated manufacturer in the spatial model are retail price ceilings, minimum wholesale quantity transactions, or franchise fees, in addition to the wholesale price. Closed territorial distribution may be used to force Löschian conjectures or retailers with other, possibly unknown, conjectures; any additional feasible instruments can then be applied by the manufacturer to these retail outlets as well.

Analytical welfare statements that integrated or constrained equilibria are either Pareto improving or surplus improving are not possible even with our functional forms. Pseudoempirics indicate, however, that, conditional on a range of parameter values, integration is Pareto improving in the case of Löschian retail firms although never for Nash retail firms. Further, the surplus measure of welfare always increases with integration. Where the source of private incentive for the use of vertical restraints is the spatial nature of retail markets, legal prohibitions against the restraints are inappropriate.[14]

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14. Our positive and normative results are conditioned on the assumption of single-product retailers. The most direct extension permits retailers to sell the products of two competing manufacturers (where the retailers are still in a symmetric zero-profit equilibrium). Suppose that manufacturers are Nash in prices. There is now an additional difference in incentives between manufacturers and retailers. Retailers selling both products will internalize the cross-elasticity effect between the competing products in setting retail prices and therefore set each retail price too high from the perspective of each manufacturer. This reinforces the Nash manufacturer's incentive to set retail price ceilings. Thus, in this setting, price ceilings reinforce price competition across substitute products. In multiproduct settings, however, other vertical restraints such as exclusive dealing by retailers may be profitable for manufacturers.

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