The Logic of Vertical Restraints

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ABSTRACT

The first theme of this paper is that direct (product) competition acts as a tournament between retailers when informational problems (or transaction costs) prevent the manufacturer from using contracts based on their relative performances. Anti-competitive restraints such as exclusive territories and resale price maintenance (which, we show, are not necessarily good substitutes) may or may not be privately desirable. The second theme of the paper is that privately desirable anti-competitive restraints may not be socially desirable. In our model, consumers prefer competition because its good insurance properties for the retailers do not force the manufacturer to raise the wholesale price; and because, for a given wholesale price, they prefer the competitive price adjustment to cost and demand shocks.
I. Introduction.

Upstream and downstream firms often do not trade intermediate goods through a simple linear price mechanism. Their relationship also involves vertical restraints such as resale price maintenance (RPM), exclusive territories (ET), franchises and exclusive dealing, to name a few. Vertical restraints constitute a challenge to both the theorist and the applied economist. They represent one of the most obvious applications of agency theory, with relatively explicit contracting terms. They are of considerable interest to the Antitrust practitioner, as witnessed by the high number of cases related to such restraints. Furthermore, some disagreement remains as to what motivates these restraints, and even more disagreement relates to their welfare consequences (see Scherer [1980], Blair-Kaserman [1983]).

This paper's tenet is that the private and social desirability of such restraints ought to be studied by first analyzing the delegation problem underlying them. This is indeed the route taken by the recent theoretical literature on this topic (Dixit [1983], Gallini-Winter [1983], Mathewson-Winter [1983 a,b,c, 1984]). In this literature the upstream unit (manufacturer) sells a good to downstream ones (retailers). The manufacturer can control/observe some variables such as the quantity bought by each retailer and possibly the retailers' prices, their areas of distribution, etc... However, it either cannot or is not legally allowed to control some other variables such as the number of retailers, their locations or their selling efforts. This lack of control of some variables gives rise to undesirable horizontal and vertical externalities. For instance, the lack of control of
selling expenses may give rise to underprovision of effort and free-riding (Telser [1960]); or imperfect control of retail prices gives rise to the celebrated double marginalization (Spengler [1950]). The main merit of the above-mentioned literature is to show how simple vertical restraints may suppress these externalities. To cite only two well-developed examples, a franchise (or RPM) can solve the double marginalization problem; while ET or RPM (together with a franchise) can eliminate promotional externalities. Mathewson and Winter [1983 a, 1984] offer a fairly comprehensive treatment of this type of control.

This literature derives some interesting and intuitive explanations of vertical restraints. It, however, has the drawback of not exploring the roots of the delegation problem. Indeed, each agent (retailer) makes its decisions having the same full information as the principal (manufacturer) about his certain environment. Thus the manufacturer's only concern is to make sure that the retailers take some given actions. The adaptation to the environment through delegation is ignored because of the absence of uncertainty. In this literature, the manufacturer generally uses all available vertical restraints (for instance, if he can monitor the final price, he imposes resale price maintenance, since, at worst, he can duplicate the competitive price outcome). Indeed, a theme of this literature is the search for a set of "minimally sufficient vertical restraints", i.e., restraints that enable the manufacturer to realize the first-best or integrated profit.

In this paper we consider retailers' informational superiority about the environment as well. Given this informational assumption, we focus on the private and social desirability of anti-competitive restraints such as RPM

\[1\text{For a review of the methodology of this literature, see Rey-Tirole (1985).}\]
and ET. We compare them with the policy that allows competition between the retailers. We find that:

a) vertical restraints may or may not be desirable from the manufacturer's point of view, i.e., may or may not be part of an optimal contract. Thus, the manufacturer may decide not to use informationally feasible restraints. Indeed, a central theme of the paper is that direct (product) competition acts as a tournament between the retailers when informational problems prevent the manufacturer from using contracts based on their relative performances.

b) in contrast to conventional wisdom, RPM and ET are not necessarily substitutes;

c) the comparison between the different control policies depends much on the type of uncertainty; and

d) vertical restraints may both be privately desirable and decrease aggregate surplus, and therefore should not be legal per se.

Section 2 sets up the model. Section 3 computes the manufacturer's profit and social welfare for competition, ET and RPM, under "market uncertainty" about cost and demand and retailers' extreme risk aversion. It compares the results for this case, and discusses the factors influencing the private desirability of restraints. Section 4 makes the polar assumption of retailers' risk neutrality, while Section 5 treats the case of "idiosyncratic uncertainty". Section 6 summarizes the welfare aspects and explains the likely bias of the social planner towards competition. Section 7 generalizes our analysis to arbitrary concave utility functions for the retailers. It studies the "purely competitive" framework -- market uncertainty and undifferentiated retailers -- and shows that the manufacturer always prefers competition to RPM, and that the difference in the manufacturer's profit between
competition and ET grows with the retailer's Arrow-Pratt index of absolute risk-aversion; the manufacturer prefers competition (ET) if the retailers are very risk averse (risk neutral); it also shows that aggregate welfare is always higher under competition than under an anti-competitive restraint (ET or RPM). Lastly, Section 8 draws the main conclusions of our analysis and suggests some extensions.

II. The Model.

Let us describe our basic model. Some variants will be introduced later. A manufacturer produces a single product at constant unit cost $c$. He supplies this product to a large number of "independent markets" (one can think of geographical markets.) A market, the entity we focus on, stands for a set of customers located on a segment of length one. They are uniformly distributed along the segment with unit density. Consumers are indexed by their distance $y$ to the left end of the segment.

We will not be concerned with the number of retailers or their location (these features could be incorporated into the model). We simply assume that there are two retailing sites located at the two extremes of the market. Each site is occupied by a retailer, who is chosen by the manufacturer. There is a competitive supply of (identical) potential retailers.

A consumer located at $y$ pays a transportation cost $ty$ (respectively, $t(1-y)$) per unit of product purchased from the left-end retailer (respectively right-end retailer). For instance, if he picks the left-end retailer and the latter charges a retail price $q$, the real price paid by the consumer is
\{q+ty\}. We assume that all consumers have the same linear demand curve. Let 
\(x=d-(q+ty)\) denote the quantity bought by a consumer located at \(y\), assuming he 
buys from the left-end retailer.

A retailer has distribution cost \(\gamma\) per unit of sale. He chooses the 
retail price of the product. The two retailers are Bertrand competitors (as 
noticed in Section 6, the absence of collusion between the retailers is cru-
cial to some of our results).

We assume for the moment that the manufacturer can impose only two-part 
tariffs on his retailers. So if \(x\) is the quantity sold to a retailer, the 
latter pays \(\{A+px\}\) to the manufacturer where \(p\) is the wholesale price and \(A\) 
is a franchise fee.

Several (non-independent) justifications can be given for such a re-
striction on the reward scheme. First, two-part tariffs are commonly used in 
real world vertical arrangements. Second, state regulation may prohibit that 
the same product be sold to different dealers at different prices (see Smith 
Lastly, the restriction can be given a justification from (more primitive) 
informational assumptions. To this purpose, let us make the following as-
sumptions: a) The manufacturer can observe only the amount of product sup-
plied to a retailer and whether or not the retailer carries his product. He 
can observe neither the actual quantity sold by the retailer and the latter's 
profit, nor for the moment the retail price and the area of distribution,\(^2\) b) 

---

\(^2\)The retail price may not be observable, or at least not verifiable by a 
court when the retailer can give hidden price discounts to his customers. 
Another possibility -- not formalized here -- is that the "generalized 
price" to the customer includes unobservable non-price elements (such as 
service).
The manufacturer is not allowed to refuse to deal (ex-post) with a retailer (see footnote 5).

Under these informational assumptions, if the manufacturer tries to price discriminate according to the quantity bought by retailers (i.e., does not charge a constant marginal price) and if, as we assumed, he serves a high number of independent markets, the retailers may set up a secondary market for the good ("bootleg"), provided that their transportation costs are low enough.\(^3\) In the extreme case in which the secondary market for the product is perfect, the manufacturer cannot make money by not charging a constant marginal price (equal to the secondary market price). He can, however, impose a franchise fee as he is informed that the retailer carries his product. Note in particular that quantity forcing -- an instance of discrimination -- is not effective here.

Let us now come to the uncertainty about the environment. For the moment, we consider only uncertainty about each market, and not about each retailer. This assumption implies the two retailers in a given market are still symmetrical once the uncertainty is resolved. This "market uncertainty" is market-specific in that the random variables in different markets are uncorrelated. In Section 5 we will consider the case of independent or "idiosynchratic uncertainty" affecting each retailer.

We simultaneously consider two types of market specific uncertainty:

1) Demand uncertainty: the demand parameter \(d\) is distributed on

---

\(^3\)It may seem strange that in a model in which transportation costs may play a role within a market, we neglect transportation costs between markets. Three justifications can be given for this. First, our results hold for zero or negligible consumers' transportation costs within a market. Second, retailers' transportation costs per unit of distance and product may be much lower than consumers' ones. Third, the retailers can be differentiated by other attributes than location.
[d, \bar{d}]. d is not known at the time the contracts with the retailers are signed.

2) Retail cost uncertainty: the distribution cost \( \gamma \) is distributed on \([\underline{\gamma}, \bar{\gamma}]\). \( \gamma \) is not known at the time the contracts are signed. We will assume that \( \underline{d} > c + \bar{\gamma} \), and that \( d \) and \( \gamma \) are independent.

The uncertainty \( (d, \gamma) \) is not observed by the manufacturer. It is observed by the two retailers after their contract is signed, but before they take their pricing decisions. We thus emphasize the adjustment of decision making to the environment.

We posit that the manufacturer is risk-neutral, which can be justified by our assumption that he supplies a large number of independent markets. We first assume that a potential retailer is infinitely risk averse; and that he requires that his profit in the worst possible outcome (the only one he cares about ex-ante) be non-negative. In Section 4, we will consider the polar case in which potential retailers are risk-neutral and Section 7 will treat the general case. Lastly, we assume that retailers must supply demand at the quoted price (this assumption simplifies the analysis, but is not restrictive).

In most of the paper we will give the derivations only for the case of zero transportation cost \((t=0)\). We call this the case of "undifferentiated retailers". Most of the intuition can be obtained from this case. Our construction of a more general Hotelling differentiation model serves two purposes, however. First, it helps motivate the notion of exclusive territories introduced later. Second, when alternative policies are tied in the undifferentiated retailers case, non-zero transportation costs break the tie (see Section 3).
Remark: The reader familiar with the tournament literature may presume (perfect) correlation between the two retailers' environments may enable the manufacturer to extract more information and use more efficient contracts. Remember, however, that final sales can not be observed. Furthermore, the existence of a secondary market prevents the quantities purchased by the retailers from conveying any information. Thus any information that the manufacturer obtains about the state of nature must come from the retailer's announcing it. However, these announcements are "costless"; and it is easily seen that the set of equilibria of an announcement game between retailers organized by the manufacturer is independent of the realized state of nature. Hence, under the reasonable assumption that the retailers consistently coordinate on the same announcement equilibrium (i.e., whatever the state of nature), the manufacturer does not gain by designing such an announcement game. So the two-part tariff is indeed optimal. The economic intuition behind this reasoning is that the retailers can always coordinate to announce that they are facing an adverse environment.

4At least in the two polar cases of risk aversion or in the case of constant absolute risk aversion (this statement also holds for deterministic equilibria for any utility function). The possibility of multiple Nash equilibria in a multiagent-context was noted by Mookherjee (1984). Its implications are particularly severe in our model.

5Our assumption that the manufacturer cannot refuse to deal with a retailer rules out the ex-post auctioning off of the market between the two retailers under contract. This assumption is a crude, but simple, way to formalize the idea that the manufacturer needs the two retailers. It can easily be derived endogenously from the existence of private goodwills (or sufficient differentiation) or of increasing marginal distribution costs. (In a more general model, the number of retailers is in particular determined by the efficient scale).
III. Market Uncertainty and Extreme Retailer Risk Aversion.

a) Competition

As we discussed, the manufacturer, if he cannot control retail prices and areas of distribution, offers a two-part tariff to his retailers. A contract is, therefore, the choice of a franchise fee $A$ and a wholesale price $p$.

We restrict ourselves to symmetric contracts, which involves no loss of generality.\(^6\) We compute the equilibrium behaviors, profits and welfare given that the two retailers compete through prices.

Initially, we consider the case of undifferentiated retailers.

From the absence of differentiation the two retailers act as Bertrand competitors and charge the same retail price in equilibrium: $q=p+\gamma$. Furthermore, whatever the state of nature, the retailers make no ex-post profit. The franchise fee must therefore equal zero.

Since each consumer's demand is $\{d-p-\gamma\}$, the manufacturer's expected profit $\Pi^C$ is given by:

$$
\Pi^C = \max_p \left\{ E\{(d-p-\gamma)\left(p-c\right)\} \right\} = \max_p \left\{ d^e-p-\gamma^e\right\}\left(p-c\right),
$$

where $d^e \equiv Ed$ is the expectation of the demand parameter and $\gamma^e \equiv E\gamma$ the expectation of the retail cost. This yields, with obvious notation,

(1) $A^C = 0$

(2) $p^C = \frac{1}{2} \left(d^e+c-\gamma^e\right)$

(3) $q^C = \frac{1}{2} \left(d^e+c-\gamma^e\right) + \gamma$

(4) $\Pi^C = \frac{1}{4} \left(d^e-c-\gamma^e\right)^2$.

---

\(^6\) As explained earlier, $p$ must be the same for the two retailers. Furthermore, $A$ governs only the retailers' acceptance decision, but not their ex-post behavior.
Defining aggregate welfare $W^C$ as the expected sum of consumers' and manufacturer's surpluses (by assumption the retailers have no surplus), we get:

$$W^C = E\left( \frac{1}{2} (d-q)^2 \right) + \Pi^C$$

or

$$W^C = \frac{3}{6} (d^e - c^e)^2 + \frac{1}{2} \sigma_d^2 + \frac{1}{2} \sigma_{\gamma}^2,$$

where $\sigma_d^2 = E(d - d^e)^2$ is the variance of $d$ and $\sigma_{\gamma}^2 = E(\gamma - \gamma^e)^2$ is the variance of $\gamma$.

Note that for both types of uncertainty the retailers' surplus is equal to zero not only ex-ante, but also ex-post. So, given the wholesale price and the retailers' behavior, the franchise fee does an extremely good job at capturing the retailers' surplus. Note also that the consumer price $q^C$ adjusts fully to retail cost variations and does not adjust to demand conditions, so that the final demand $\{x = d-q\}$ fully responds to both types of shocks. These properties will prove to be important in the following comparisons.

b) **Exclusive Territories**

Let us now slightly modify our informational assumptions by assuming that the manufacturer can also observe the areas of distribution of the two retailers. In particular he can assign the left-end half of the market to the left-end retailer, and the right-end one to the right-end retailer.\(^7\)

This practice, the exclusive territory arrangement (ET), is common in franchise contracts. Each retailer buys the product according to the two-part tariff as long as he does not infringe on the other retailer's territory; otherwise he is heavily fined. We maintain our assumption that the manufacturer cannot control the retail price, so that the optimal contract is either

\(^7\)More complex territorial assignments turn out to be unprofitable.
a two-part tariff contract with competition or a two-part tariff contract with ET.

Let us now compute the optimal two-part tariff, profit and welfare under ET. Each retailer is a monopoly in his territory. Given a wholesale price \( p \) and realizations of demand \( d \) and cost \( \gamma \), he maximizes \( \frac{1}{2} (d-q)(q-p-\gamma) \) over his resale price \( q \). So \( q = \frac{1}{2} (d+p+\gamma) \); and the retailer's ex-post profit is \( \frac{1}{8} (d-p-\gamma)^2 \). As he is extremely risk averse, the franchise \( A \) must give him a non-negative profit in the worst state of nature. Thus \( A = \frac{1}{8} (d-p-\gamma)^2 \). The total franchise fee received by the manufacturer in the market is \( 2A = \frac{1}{4} (d-p-\gamma)^2 \).

The manufacturer's optimization problem can be written:

\[
\Pi^{\text{ET}} = \max_{p} \left\{ \frac{1}{4} (d-p-\gamma)^2 + E(d- \frac{1}{2} (d+p+\gamma))(p-c) \right\}
\]

This yields: (6) \( A^{\text{ET}} = \frac{1}{8} (d-p-\gamma)^2 \)

(7) \( p^{\text{ET}} = c+(d^e-d) + (\gamma-e) \)

(8) \( q^{\text{ET}} = \frac{1}{2} (d+c+\gamma + (d^e-d) + (\gamma-e)) \)

(9) \( \Pi^{\text{ET}} = \frac{1}{4} (d-c-\gamma)^2 + \frac{1}{4} [(d^e-d) + (\gamma-e)]^2 \)

and (10) \( W^{\text{ET}} = \frac{3}{8} (d-c-\gamma)^2 + \frac{1}{4} [(d^e-d) + (\gamma-e)]^2 + \frac{1}{8} \sigma_d^2 + \frac{1}{8} \sigma_\gamma^2 \).

Note that under demand uncertainty the wholesale price exceeds marginal cost \((p>c)\). They are equal only in the certainty case \((d^e=d\) and \(\gamma^e=\gamma)\).

Under uncertainty, a wholesale price close to marginal cost is still desirable to avoid double marginalization. However, the uncertainty faced by a retailer under ET decreases with the wholesale price: a higher wholesale price means a lower retailer's profit margin and therefore a lower sensitivity of retailer's profit to demand and cost variations. Thus increasing the
wholesale price above marginal cost has desirable insurance properties, in that it transfers risk-bearing from the retailers to the risk-averse manufacturer.

c) Resale Price Maintenance

Let us now assume that, in addition to the quantity bought by a retailer and the fact that the latter carries the product, the manufacturer also observes the retail price (see footnote 2 for the limitations of such an assumption). A feasible policy then consists in fixing the retailer's retail price, together with a two-part tariff for his purchase of the product. We call this policy resale price maintenance (RPM). In the presence of price observability, there may exist better incentive schemes than competition (two-part tariff) and RPM (two-part tariff plus resale price fixing). The manufacturer could more generally charge a two-part tariff in which the franchise fee would depend on the price chosen by the retailer (and possibly on the price chosen by his competitor), if such a contract can be enforced. Unless the law prohibits discrimination between retailers, focusing on competition and RPM involves some loss of generality. But these two arrangements are interesting in their own right, as they are both simple and frequently used. Let us also mention that, in this particular model, price ceilings and price floors can be shown not to be optimal for the manufacturer (they are dominated either by RPM or by competition).

Let us now solve for the best RPM contract. We assume w.l.o.g. that the same contract is offered to all retailers.

Under RPM, a retailer is rather passive. He charges the prescribed price q and obtains half of the market. His ex-post profit is \( \left\{ \frac{1}{2} (d-q) \right\} (q-p-\gamma) \) in state of demand d and cost \( \gamma \). Thus the franchise must be \( A = \frac{1}{2} \)

^Note that, if the area of distribution is also observable, ET plus RPM is equivalent to RPM. This property may not hold in different models (see Mathewson-Winter [1984]).
\[(d-q)(q-p-\gamma) \text{ (for } q>p+\gamma; \text{ for } q<p+\gamma, A = \frac{1}{2} (d-q)(q-p-\gamma)): \text{ it is easily shown that one can restrict oneself to the situation } q>p+\gamma).\]

RPM adds both an extra control variable plus an extra constraint (that the price be constant across states of nature) to the manufacturer's maximization problem, which becomes:

\[
\Pi^{\text{RPM}} = \max \{(d-q)(q-p-\gamma)+\bar{E}(d-q)(p-c)\}. \quad \{ (p,q) | q>p+\gamma \}
\]

We obtain:

\[
\begin{align*}
(11) \quad & A^{\text{RPM}} = 0 \\
(12) \quad & p^{\text{RPM}} = \frac{1}{2} (d^e+c-\gamma) \\
(13) \quad & q^{\text{RPM}} = \frac{1}{2} (d^e+c+\gamma) \\
(14) \quad & \Pi^{\text{RPM}} = \frac{1}{4} (d^e-c-\gamma)^2 \\
\end{align*}
\]

and

\[
(15) \quad W^{\text{RPM}} = \frac{3}{8} (d^e-c-\gamma)^2 + \frac{1}{2} \sigma_d^2.
\]

d) **Comparisons and economic intuition**

We first compare the results obtained so far for undifferentiated retailers. Straightforward computations lead to Table 1 (hats are used to denote demand uncertainty, and tildes are used to denote cost uncertainty):
<table>
<thead>
<tr>
<th>Demand uncertainty</th>
<th>Retail price</th>
<th>Sensitivity of retail price to uncertainty</th>
<th>Private desirability of restraints</th>
<th>Social desirability of restraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>( q^\text{ET} &gt; q^\text{C} = q^\text{RPM} ) for all ( d )</td>
<td>( \frac{d^\text{ET}}{dd} = .5 )</td>
<td>( \frac{d^\text{C}}{dd} = 0 )</td>
<td>( \frac{d^\text{RPM}}{dd} = 0 )</td>
<td></td>
</tr>
<tr>
<td>Cost uncertainty</td>
<td>( \frac{E(q^\text{RPM})}{\gamma} = 1 )</td>
<td>( \frac{\hat{q}^\text{ET}}{\gamma} = .5 )</td>
<td>( E(q^\text{RPM}) &gt; E(q^\text{C}) )</td>
<td>( \frac{E(q^\text{RPM})}{\gamma} &gt; \frac{E(q^\text{C})}{\gamma} )</td>
</tr>
</tbody>
</table>

Table 1: (undifferentiated retailers, market uncertainty, extreme risk aversion).

We see that, under demand uncertainty, the manufacturer is indifferent between competition and RPM (assuming that he can observe the retailers' prices). To break this tie, let us consider the case of differentiated retailers \( (t > 0) \). The computations are somewhat tedious. We here simply give the main results for slightly differentiated retailers \( (t \text{ small, but positive}) \).

\( (16) \quad \hat{\Pi}^RPM > \hat{\Pi}^C \)

and \( (17) \quad \hat{q}^\text{RPM} \approx \hat{q}^\text{C} \) (to the second order in \( t \)).

Note that \( (16) \) and \( (17) \) imply that the social planner also prefers RPM to competition.
These results, Table 1 and continuity with respect to the differentiation parameter (which can be checked) lead to the following propositions:

**Proposition 1:** If there is no uncertainty \( \sigma_d^2 = \sigma_y^2 = 0 \), competition, ET and RPM are equivalent, both from the manufacturer's and from the social welfare points of view. The retail price and the manufacturer's profit are equal to the vertically integrated monopoly price and profit.

**Proposition 2:** Assume that retailers are slightly differentiated and extremely risk-averse. Under uncertainty, competition, ET and RPM are not equivalent: Under demand uncertainty, the manufacturer prefers RPM to competition, and competition to ET. Under cost uncertainty he prefers competition to ET, and ET to RPM. The social planner does not object to these rankings.

Proposition 1 is familiar from the literature: for our model and under certainty, a two-part tariff, RPM and ET are all sufficient control mechanisms in the sense of Mathewson-Winter [1984], in that they allow the manufacturer to realize the vertically integrated profit.

Proposition 2 summarizes the basic results for market demand and cost uncertainty. Let us now give the economic intuition behind the manufacturer's choices between competition and vertical restraints (welfare aspects will be studied in section 6.)

The manufacturer has two objectives:

1) ensure an optimal exploitation of monopoly power by the vertical structure.

2) provide adequate insurance to his retailers.

These two objectives, which aim at not choking final demand and at extracting
a high franchise fee from the retailers, conflict, as we shall see shortly.

The optimal exploitation of monopoly power has been the focus of the literature on vertical restraints. The manufacturer would like the retail price to be as close as possible to the monopoly price (the price that would be charged by the vertically integrated industry), and this for all states of nature. With linear demand this monopoly price is

\[ q^m = \frac{d+c+\gamma}{2} \]

It is responsive, although not fully, to demand and retail cost shocks. The degree of responsiveness will be the focus of our discussion, as the manufacturer can always control the average retail price though the wholesale price or RPM. Consider first exclusive territories. Under this restraint each retailer has an unconstrained monopoly on his territory, and therefore chooses the correct response to a demand or retail cost shock. The one difference with the vertically integrated industry is that his fictitious production cost is the wholesale price \( p \) instead of the marginal cost \( c \). Under linear demand, he charges

\[ q = \frac{d+p+\gamma}{2} \]

So we conclude that exclusive territories ensure a perfect use of decentralized information. To obtain a perfect coincidence of the retailer's and the vertical structure's objectives, the manufacturer must avoid a pricing distortion at the wholesale level: \( p=c \). This is indeed what he does under certainty (see equation (7)); under uncertainty however this policy conflicts with insurance as we will see. Second, if the manufacturer imposes RPM, the retail price exhibits no responsiveness to demand and retail cost shocks. (Price ceilings and floors do allow some use of decentralized information, but are non-optimal in this model.) Lastly let us consider competition. When the retailers are undifferentiated, the retail price is entirely "cost determined": \( q=p+\gamma \). Like for RPM, this price is insensitive to demand shocks. Contrary to RPM, it reacts to retail cost shocks; it even overreacts relatively to the vertically integrated structure.
When retailers are differentiated, the retail price reacts more to demand shocks and less to cost shocks, as the competition weakens and the structure becomes closer to the ET arrangement. From this study, we conclude that ET uses decentralized information in a more efficient way than RPM and competition; it is superior in terms of exploitation of monopoly power, as the retail price can be fine-tuned to the retailers' environment.

Let us now consider the insurance objective. Let us first consider competition. If the retailers are undifferentiated, Bertrand competition ensures that their profit is not sensitive to uncertainty. So competition provides perfect insurance to the retailers. The profit of differentiated retailers does fluctuate under uncertainty, but the insurance properties of competition remain fairly good. RPM has terrible insurance properties under cost uncertainty: The retailers then bear the whole risk as they must fully adjust their profit margin to cost shocks. Under demand uncertainty, however, RPM gives perfect insurance. The profit margin is independent of the state of nature, and the wholesale price can be chosen so that this profit margin be zero, in which case the retailers' profit is independent of demand (see equations (12) and (13)). This perfect insurance is the reason why the manufacturer prefers RPM to competition under demand uncertainty and differentiated retailers. Lastly, consider exclusive territories. The retailers their price to the shocks, but cannot avoid substantial fluctuations in their profits. To share the retailers' risk somewhat, the manufacturer is forced to raise the wholesale price above the marginal cost, thus introducing a double marginalization.

To summarize: ET makes a better use of decentralized information than competition or RPM. Competition has very good insurance properties under both types of uncertainty. RPM gives perfect insurance under demand uncer-
tainty, but lets the retailers bear the whole risk under cost uncertainty. ET has mediocre insurance properties.

Let us demonstrate that ET is not optimal under market uncertainty and infinite risk aversion, by noticing that under an appropriate competitive scheme the manufacturer can always make more than the ET profit by a) requiring no franchise, b) charging a wholesale price equal to the ET retail price in the worst state of nature ($d$ and $\overline{\gamma}$) minus the highest possible distribution cost. The retailers clearly accept such a contract. If $q^m(p+\gamma,d)$ denotes the monopoly price in state of demand $d$ with total input price $(p+\gamma)$, the manufacturer's profit under ET is:

$$[d-q^m(p+\gamma,d)] [q^m(p+\gamma,d)-p(\overline{\gamma}+\gamma)] + E[d-q^m(p+\gamma,d)] [p^m-\gamma] + [d-q^m(p+\gamma,d)] [p^m-\gamma],$$

and under the proposed competitive arrangement:

$$E[d-(q^m(p+\gamma,d)-\overline{\gamma}+\gamma)] [q^m(p+\gamma,d)-\overline{\gamma}-\gamma] - c].$$

Using successively the facts that for all $d$, $d-q^m(p+\gamma,d) < d-q^m(p+\gamma,d)$ (final demand is higher in higher states of demand) and that for all $\gamma$ and $d$, $q^m(p+\gamma,d) > q^m(p+\gamma,d)$ (the retail price increases with the retail cost under monopoly), we see that the manufacturer prefers the proposed competitive arrangement to ET. The basic idea of this proof is that by imposing competition, the manufacturer can do as well in the worst state of nature (as in the certainty case); and he keeps the retail price down, and thus demand up, in better states of nature. This reasoning holds for undifferentiated retailers. Under differentiation a similar argument can be made that ET is dominated by RPM.

Lastly, under demand uncertainty and differentiated retailers, the manufacturer does a little bit better by using RPM rather than competition. In the competition case differentiation introduces a double marginalization which RPM helps suppress.
The main conclusions of this section are that competition has good insurance properties and does relatively well (it is only dominated by RPM in the case of demand uncertainty and differentiated retailers). RPM and ET are far from being substitutes. RPM is preferred in case of demand uncertainty, while ET scores better for cost uncertainty.

IV. Market Uncertainty and Retailer Risk Neutrality.

We now show that the degree of risk aversion is crucial to the previous rankings. We still assume that the manufacturer is risk-neutral. But we now consider the polar case in which the retailers are also risk neutral. For simplicity we study undifferentiated retailers.

Under competition, the retailers make a zero variable profit whatever the state of nature. So risk aversion plays no role and \((A_C, p_C, q_C, \pi_C, W^C)\) are still given by equations (1) through (5).

Under ET, in state of nature \((d, \gamma)\), a retailer charges \(q = \frac{1}{2}(d+p+\gamma)\) and makes profit \(\frac{1}{8}(d-p-\gamma)^2\). The essential difference with the extreme risk aversion case is that now the manufacturer can recover this profit in expectation, and not only in the worst state of nature. So

\[
(18) \quad A^{ET} = \frac{1}{8}E(d-p-\gamma)^2.
\]

Maximizing the manufacturer's profit over the wholesale price gives:

\[
(19) \quad p^{ET} = c
\]

\[
(20) \quad q^{ET} = \frac{1}{2}(d+c+\gamma)
\]

\[
(21) \quad \Pi^{ET} = \frac{1}{4}(d^C-c-\gamma^e)^2 + \frac{1}{4} \sigma_d^2 + \frac{1}{4} \sigma_\gamma^2
\]

and

\[
(22) \quad W^{ET} = \frac{3}{8}(d^C-c-\gamma^e)^2 + \frac{3}{8} \sigma_d^2 + \frac{3}{8} \sigma_\gamma^2.
\]

Notice that the manufacturer avoids the double distortion by charging a wholesale price equal to his marginal cost.
Lastly, under RPM, one can easily show that:

\[ q_{\text{RPM}} = \frac{1}{2} (d^c + \gamma^e + c) \]  

\[ \Pi_{\text{RPM}} = \frac{1}{4} (d^e - \gamma^e - c)^2 \]  

and

\[ w_{\text{RPM}} = \frac{3}{8} (d^e - \gamma^e - c)^2 + \frac{c_d^2}{2} \]  

(A and p are indeterminate).

**Proposition 3**: Assume that the retailers are risk neutral and non-differentiated. Under either demand or cost uncertainty, a) the manufacturer prefers ET to competition and RPM, b) however, the social planner objects to this ranking as he prefers competition to ET (and in general to RPM as well).

Let us now interpret and draw the implications of Proposition 3a). (leaving 3b for Section 6). We noticed in section 3 that ET makes better use of decentralized information while competition is more efficient at providing insurance. We showed that, under extreme risk aversion, the second effect dominates the first so that the manufacturer prefers competition. Under risk-neutrality, however, the second effect disappears, and therefore, ET is preferred. Actually ET even enables the manufacturer to realize the integrated profit by making each retailer a residual claimant for the profits of the vertical structure.

The other interesting fact is that the social planner does favor competition. This will be explained in section 6.

**Remark**: As in section 3 we may wonder whether we can break the ties by introducing a differentiation between the retailers. It turns out that, under demand uncertainty and retailers' risk neutrality, competition and RPM are always equivalent from both the private and the social points of view:
Fixing a wholesale price is equivalent to fixing the retail price, under competition and demand uncertainty. So the vertical structure can realize the same aggregate profit with the two arrangements. Since the manufacturer can always capture the retailers' expected profit under risk neutrality, he also realizes the same profit with the two arrangements.

By contrast, the equivalence between competition and RPM under cost uncertainty and retailers' risk neutrality is an artifact of the linearity of demand (for instance, for a convex demand curve $\Pi_C > \Pi_{RPM}$).

V. Idiosyncratic Uncertainty.

Until now we have considered only "market uncertainty". We can also study the polar case in which the two retailers face (independent) idiosyncratic uncertainty. Here we naturally focus on cost uncertainty, as a demand shock will most certainly affect interdependent retailers simultaneously.

We assume that retailers are not differentiated and that each retailer knows his competitor's cost as well as his own cost when he chooses a retail price. For simplicity, we also assume that each firm's distribution cost is

\[ F(\gamma) = \frac{\gamma - \gamma_x}{\gamma - \gamma_y} \]

where $\alpha > 0$ ($\alpha = 1$ gives the uniform distribution) on $[\gamma, \gamma]$; and that $(\gamma - \gamma_y)$ is "not too high", so that, under competition a retailer with cost $\gamma_1$ charges $(p + \gamma_2)$ when his competition has cost $\gamma_2 > \gamma_1$.

---

9He may have inside information, for instance. However, we maintain the assumption that the manufacturer can not make the contracts contingent on costs (i.e., costs are not verifiable by a court). Had we assumed that the retailers do not observe their competitor's cost, we would have used the Bayesian Nash equilibrium concept.
It can be shown that: (see Appendix)
- with infinitely risk-averse (respectively risk-neutral) retailers, both the manufacturer and the social planner prefer competition to ET (respectively ET to competition).
- RPM is always dominated from both points of view (as in the market uncertainty case).

The analysis also suggests that conflicts between social and private desirabilities will occur for intermediate degrees of risk-aversion.

In our model, RPM and ET insulate retailers from intrabrand competition. Thus, the degree of correlation between the retailers' shocks is irrelevant and previous formulas for the ET and RPM cases are still valid. The main difference between idiosynchratic and market uncertainties is that under idiosynchratic uncertainty and competition, cost differentiation leads to some double marginalization and retailers profit variability. Although competition still keeps a lid on retail prices (at least under our assumption that cost differentials are not too big), it no longer functions as a perfect tournament.

VI. When do Private and Social Objectives Conflict?

Let us first summarize our results about the private and social desirabilities of vertical restraints for undifferentiated retailers:¹⁰

¹⁰For tie-breaking, see sections 3 and 4.
The main policy issue in our model comes from the fact that consumers are left out of the contract between the manufacturer and the retailers. While the contract is efficient from the point of view of the parties that sign it, the externality on the consumers may call for public intervention.\textsuperscript{11}

The analysis shows that private and social objectives may well conflict. For instance, when the retailers are risk-neutral, the manufacturer may im-

\textsuperscript{11}Mathewson-Winter (1983a,b,c) show in a wide variety of circumstances that, when there is no uncertainty, vertical restraints increase aggregate welfare. Gallini-Winter (1983) exhibit a case in which aggregate welfare can be higher without any restraint (in particular the manufacturer is prevented from changing a franchise fee) than with all restraints. However, this result does not hold if franchise fees are allowed, as is usually the case under current U.S. law. Indeed, a franchise fee in their model is a sufficient instrument, so that the manufacturer does not lose anything by not using ET or RPM even if he can do so.
pose a vertical restraint (ET) and the social planner (or antitrust authority) may want to restore competition between the retailers.

There seems to be a general bias in our model for the consumers to prefer competition to ET and RPM. This may seem trivial. As competition reduces the retailers' profit margins, one might think that it therefore lowers consumer prices. However, this reasoning is false since it ignores the difference in wholesale price between regimes. Indeed, in the absence of uncertainty the increase in wholesale price exactly offsets the decrease in the profit margin (Proposition 1) so that the consumers are unaffected by vertical restraints. The reasons why the consumers in general prefer competition are in our model connected to uncertainty.

The consumers' preference for competition has two origins. Remember that the consumers' surplus \( S = E\left[ \frac{(d-q)^2}{2} \right] = \frac{(\bar{d}-q)^2+\text{var}(d-q)}{2} \) decreases with the average price and increases with the variance of consumption (since it is convex). For undifferentiated products and market uncertainty, competition scores better on the two accounts:

1) The expected price is lower under competition.

2) The competitive price is more sensitive to cost disturbances and less sensitive (or at least not more sensitive) to demand disturbances than the ET and RPM prices.\(^{12}\) So in both cases, the variance of consumption is higher under competition.

Let us provide some intuition about why this is so.

1') Let us see why the expected price is lower under competition. Again, it is useful to start from the no uncertainty case, in which the consumer price is the same for the three regimes. Let us introduce market

\(^{12}\)Because retailers are not differentiated, the consumer price reacts less to demand disturbances under RPM.
uncertainty and retailers' risk aversion. The manufacturer then may want to change the wholesale price to reduce the retailers' risk (remember that the ex-post retailing behavior is independent of the ex-ante uncertainty and risk aversion, so that we can identify changes in the wholesale price with changes in the consumers' price). Under competition the retailers' profit is independent of the wholesale price and therefore a wholesale price adjustment does not help reducing risk. To the contrary, under ET or RPM, the manufacturer can in general decrease the retailers' risk by increasing the wholesale price (and decreasing correspondingly the franchise fee): A lower profit margin means a lower variance of profits, as can easily be checked. So uncertainty calls for an increase in the wholesale price only when the contract specifies an anticompetitive restraint. Again, lower expected consumer prices under competition can be attributed to the good insurance property of the competitive system. Under retailers' risk-neutrality, however, competition, ET and RPM lead to the same expected price, as could be expected from the previous reasoning.

2') Let us now see why consumption has a higher variance under competition. Consider first the case of demand uncertainty. The competitive price is entirely determined by cost conditions (from our constant returns to scale technology); therefore, it does not adjust to demand shocks. Neither does it under RPM. But under ET, the consumers' price partially adjusts to demand conditions. So consumption varies most under competition and RPM. Second, consider the case of cost disturbances. The competitive price adjusts one hundred percent with the retail cost, while it adjusts partially under ET and not at all under RPM. Again, the variance of consumption is highest under competition.
These two effects -- lower expected prices and higher variance of consumption -- create a bias in the policy intervention towards favoring competition. Indeed, the social planner may want to prohibit a privately desirable restraint.

The case of idiosyncratic uncertainty is a bit less clear-cut. The idiosynchrony reintroduces monopoly profits and risk under competition. So the general analysis becomes more complex. One can nevertheless find reasonable conditions on the distribution of uncertainty, for extreme risk aversion, such that, for example the consumers prefer competition because the competitive price both is lower on average and fluctuates more than the price under a vertical restraint.

A word of caution should be added here. Our conclusions hold only if there is effective competition between the retailers in the absence of restraints. If the retailers can collude, the competitive solution resembles much the ET one; and preventing the manufacturer from imposing anti-competitive restraints (assuming he still wants to do so) loses much of its interest.

VII. General Retailer Risk Aversion and Demand Function.

We now generalize a number of our results to more general objective functions for the retailers, and some of these results to arbitrary demand functions as well. Each retailer has a Von Neuman-Morgenstern, differentiable, increasing and concave utility function U. His reservation utility is U(0). The "general" demand function is denoted by D(q,d). It is strictly decreasing and differentiable with respect to the retail pricing. Throughout this section, we consider only undifferentiated retailers and market uncertainty (as we noticed earlier, our points about the effects of competition
are made most strongly in this pure Bertrand case).

Let us first study the private desirability of vertical restraints. Sections 3 and 4 showed that, for linear demand, the manufacturer prefers competition to ET under extreme risk-aversion and ET to competition under risk neutrality. Proposition 4 below shows that, for a general demand function, when the retailers' Arrow-Pratt index of absolute risk aversion increases, the manufacturer favors competition over ET more and more:

Proposition 4: Let $U_0$ and $U_1$ denote two utility functions for the retailers and let $\{\Pi^C_0, \Pi^{C}_{ET}, \Pi^C_1, \Pi^{ET}_1\}$ denote the resulting profits for the manufacturer under competition and ET, for a general demand function. Then, under demand and/or cost uncertainty, if $(- \frac{U''_1}{U'_1}) > (- \frac{U''_0}{U'_0})$,

a) $\Pi^C_1 = \Pi^C_0$

b) $\Pi^{ET}_1 < \Pi^{ET}_0$.

Proof: a) A simple, but important step in the proof of Proposition 4 (like in subsequent proofs) consists in noticing that, under competition, the retailers are perfectly insured, so that the retailer's degree of risk aversion is irrelevant. This holds for any demand function (in particular, for linear demand, formulas (1) through (4) hold regardless of $U$).

b) Let us now show that $\Pi^{ET}_1 < \Pi^{ET}_0$. This later property actually is a simple consequence of the Arrow-Pratt theorem as we demonstrate shortly.

Consider exclusive territories and let $p_1$ and $A_1$ denote the optimal wholesale price and franchise fee when the retailer's utility function is $U_1$. Let $V_r(p,d,\gamma)$ and $V_m(p,d,\gamma)$ denote a retailer's and the manufacturer's
variable profits \((V_m)\) is a profit per retailer. For linear demand: \(V_r(p,d,\gamma) = \frac{1}{5} (d-\gamma-p)^2\) and \(V_m(p,d,\gamma) = \frac{1}{4} (d-\gamma-p)(p-c)\). The manufacturer's profit per retailer for an ET contract \([p,A]\) is \([A + EV_m(p,d,\gamma)]\), where expectations are taken with respect to the demand and cost parameters. Also, in order for a retailer to accept the contract:

\[
EU(-A + V_r(p,d,\gamma)) > U(0).
\]

For utility function \(U_1\), the optimal contract \([p_1,A_1]\) satisfies (26) with equality. Thus, zero is the certainty equivalent of the gamble \([-A_1 + V_r(p_1,d,\gamma)]\). Suppose now that the retailers' utility function is \(U_0\). Then, from the Arrow-Pratt theorem, the certainty equivalent of the gamble \([-A_1 + V_r(p_1,d,\gamma)]\) strictly exceeds zero. Thus, the contract \([p_1, A_1]\) is accepted for utility \(U_0\); and leaves a rent to the retailer. Hence, for \(\epsilon\) small, the contract \([p_1, A_1 + \epsilon]\) is also accepted. This proves that \(\Pi^ET_0 > \Pi^ET_1\), since the retailers' ex-post decisions depend only on the wholesale price and not on the degree of risk aversion.

Q.E.D.

We next show that for any degree of risk aversion, the manufacturer prefers competition to RPM (as long as retailers are not differentiated). The proof of this proposition requires the demand function to be (weakly) convex (as is the case for instance for linear and exponential demands).

**Proposition 5:**

a) For demand uncertainty, \(\Pi^C = \Pi^{RPM}\).

b) For cost uncertainty, if \(U\) is strictly concave, and \(D\) is convex in \(q\), \(\Pi^C > \Pi^{RPM}\).

Proof: a) Under demand uncertainty and competition, fixing the wholesale price \(p\) amounts to fixing the retail price \(q = p + \gamma\). Furthermore, the best
wholesale price given a fixed RPM price \( q \) is \( p = q - \gamma \), because it gives perfect insurance to the retailers, like in the competitive case. So, the two arrangements are equivalent.

b) Consider cost uncertainty. Let \( \{ q_{\text{RPM}}, p_{\text{RPM}} \} \) denote the optimal contract under RPM for an arbitrary strictly concave function \( U \). Suppose that the manufacturer offers a competitive arrangement, with \( \{ p_{\text{C}} = q_{\text{RPM}} - \gamma, A_{\text{C}} = 0 \} \). The retailers, who make a zero profit in all states of nature, accept the competitive contract.

Under RPM, the retailer has variable profit

\[
\frac{1}{2} D(q_{\text{RPM}})(q_{\text{RPM}} - p_{\text{RPM}} - \gamma),
\]

which must satisfy

\[
\frac{EU}{\gamma} (- A_{\text{RPM}} + \frac{1}{2} D(q_{\text{RPM}})(q_{\text{RPM}} - p_{\text{RPM}} - \gamma)) = U(0).
\]

which, together with the strict concavity of \( U \), implies:

\[
A_{\text{RPM}} < \frac{1}{2} D(q_{\text{RPM}})(q_{\text{RPM}} - p_{\text{RPM}} - \gamma),
\]

which, in turn, implies that the manufacturer's profit satisfies:

\[
2A_{\text{RPM}} + D(q_{\text{RPM}})(p_{\text{RPM}} - c) < D(q_{\text{RPM}})(q_{\text{RPM}} - \gamma - c).
\]

Under the proposed competitive scheme, the manufacturer's expected profit is

\[
E(D(q_{\text{RPM}} - \gamma + \gamma)(q_{\text{RPM}} - \gamma - c)).
\]

But if the demand function is convex,

\[
\frac{E D(q_{\text{RPM}} + \gamma - \gamma)}{\gamma} > D(q_{\text{RPM}}).
\]

Thus, the manufacturer does better under the competitive scheme.

Q.E.D.

Proposition 5 shows that, for general uncertainty and risk aversion, and convex demand, the manufacturer chooses between competition and ET (assuming all contracts are available). Proposition 4 and sections 3 and 4 show that for general uncertainty and risk aversion, and linear demand the manufacturer prefers ET if retailers are not very risk-averse and competition if they are
very risk averse.

Finally, let us consider the issue of social desirability. We have already noted a number of cases in which private and social objectives conflict. Let us now show that, for general risk aversion and linear demand, consumers prefer competition to the choice of a competition-reducing restraint:

**Proposition 6:** Assume demand is linear: \( D(q,d) = d - q \); then for any degree of retailer risk aversion, expected consumer surplus is higher under competition than under ET or RPM.

**Proof:** As discussed in Section 6, the expected consumer surplus decreases with the expected consumer price, and increases with the variance of consumption. We show that competition scores better on both counts. We already noticed in Section 6 that the competitive retail price fully responds to the retail cost and does not respond to the demand parameter. Thus, consumption reacts at least as much to cost and demand shocks under competition as under ET or RPM.

Therefore, we need only show that the average consumer price is lower under competition. To this purpose, let us start with the case of risk-neutral retailers. For a linear demand, (3), (20), and (23) show that the expected consumer price is the same under the three arrangements. Now introduce retailers' risk aversion. As we mentioned, the consumer price is unaffected under competition.

Consider next ET. To show that the expected consumer price is higher under risk aversion, it suffices to show that the wholesale price is higher than under risk neutrality: \( p^E_T > c \). Suppose that \( p^E_T < c \). Let us show
that an exclusive territory contract with a wholesale price equal to \( c \) would make the manufacturer better off. To this purpose, let \( A(p) \) be the maximum franchise fee that the manufacturer can impose together with wholesale price \( p \):

\[
(30) \quad \mathbb{E}_U \left( -A(p) + V_r(p, g) \right) = U(0),
\]

where \( g \in (-\gamma) \) and \( V_r(p, g) = \frac{1}{5} (g - p)^2 \) is each retailer's variable profit.

Differentiating (30) gives:

\[
(31) \quad [-A'(p)] = \frac{\mathbb{E}(U'(\frac{\partial V_r}{\partial p}))}{EU'}.
\]

(where \( A' < 0 \) and \( \frac{\partial V_r}{\partial p} < 0 \)). Using the fact that the covariance with respect to \( g \) of \( U' \) and \( -\frac{\partial V_r}{\partial p} \) is negative, (31) implies:

\[
(32) \quad [-A'(p)] < \mathbb{E}[-\frac{\partial V_r}{\partial p}] .
\]

Thus, for \( p^{ET} < c \),

\[
(33) \quad A(p^{ET}) - A(c) < \int_{p^{ET}}^{c} (\mathbb{E}(-\frac{\partial V_r}{\partial p}))dp .
\]

We also know that

\[
(34) \quad \mathbb{E}(V_m(c, g) + V_r(c, g)) > \mathbb{E}(V_m(p, g) + V_r(p, g)) ,
\]

for any \( p \) differing from \( c \) ((34) is simply implied by the fact that residual claimancy for the retailer maximizes aggregate profit in all states of nature). (33) and (34) then imply that

\[
(35) \quad [A(c) + \mathbb{E}(V_m(c, g))] - [A(p^{ET}) + \mathbb{E}(V_m(p^{ET}, g))] > \int_{p^{ET}}^{c} (\mathbb{E}(-\frac{\partial V_r}{\partial p}))dp - \mathbb{E}(V_r(p^{ET}, g)) - \mathbb{E}(V_r(c, g)) .
\]

\[
= \int_{p^{ET}}^{c} (\mathbb{E}(-\frac{\partial V_r}{\partial p}))dp - \mathbb{E}(\int_{p^{ET}}^{c} (-\frac{\partial V_r}{\partial p})dp)
\]

\[
= 0 .
\]
Thus, we conclude that a wholesale price lower than \( c \) under ET is not optimal.

Lastly, let us consider RPM. Under demand uncertainty we know that RPM is equivalent to competition. Thus, let us consider cost uncertainty. Again, if the retailer is risk neutral, the consumer price, \( q^* \) say, is such that aggregate expected profit is maximized. \( q^* \) is also the expected price under competition. Let us show that, under risk-aversion, \( q^{RPM} > q^* \). To this purpose, let us consider a family of RPM contracts such that \((q-p)\) is constant. This will enable us to use a reasoning similar to the one for ET. Let us for this family of contracts introduce the following notation:

\( V_r(q, \gamma) \) and \( V_m(q) \) denote each retailer's profit and the manufacturer's profit per retailer, when \( p \) is adjusted so as to keep \((q-p)\) constant (for instance, in the linear demand case, \( V_r(q, \gamma) = \frac{1}{2} (d-q)(k-\gamma) \) and \( V_m(q) = \frac{1}{2} (d-q)(q-k-c) \) where \( k = q-p \) is a constant).

Let \( A(q) \) be defined by:

\[
(36) \quad EU(-A(q) + V_r(q, \gamma)) = U(0),
\]

where expectations are taken with respect to \( \gamma \). Differentiating (36) and using the negative covariance between \( U' \) and \( \left(-\frac{\delta V_r}{\delta q}\right) \) gives:

\[
(37) \quad [-A'(q)] = \frac{E(U'(-\frac{\delta V_r}{\delta q}))}{EU'} \leq E\left(-\frac{\delta V_r}{\delta q}\right).
\]

which implies

\[
(38) \quad A(q^{RPM}) - A(q^*) \leq \int_{q^{RPM}}^{q^*} E\left(-\frac{\delta V_r}{\delta q}\right) dq
\]

if \( q^{RPM} < q^* \).

Next, we observe that \( q^* \) maximizes \( E[V_r(q, \gamma) + V_m(q)] \).

So for all \( q \),

\[
(39) \quad E[V_r(q, \gamma) + V_m(q)] < E[V_r(q^*, \gamma) + V_m(q^*)].
\]

Using (38) and (39), we obtain, for \( q^{RPM} < q^* \),
(40) \[ [A(q^{\text{RPM}}) + V_m(q^{\text{RPM}})] - [A(q^*) + V_m(q^*)] \]

\[ < \int_{q^{\text{RPM}}}^{q^*} E(-\frac{\partial V_r}{\partial q})dq - E(\int_{q^{\text{RPM}}}^{q^*} (-\frac{\partial V_r}{\partial q})dq) = 0. \]

(40) shows that a RPM contract with \( q^{\text{RPM}} < q^* \) cannot be optimal for the manufacturer. The latter could raise his profit by offering an alternative RPM contract with resale price \( q^* \). We thus conclude that the expected consumer price under RPM exceeds \( q^* \), i.e., exceeds the expected consumer price under competition.

Q.E.D.

We now conclude by showing that, under linear demand, competition is always socially optimal:

**Proposition 7:** Under linear demand, for any degree of retailer risk aversion aggregate welfare under competition exceeds those under ET and RPM.

**Proof:** As before, retailers are put at their reservation utilities, so that their welfare needs not be taken into account for welfare comparisons. Thus, we want to show, that, under linear demand,

\[ \Pi^C + S^C > \max \{ \Pi^{ET} + S^{ET}, \Pi^{\text{RPM}} + S^{\text{RPM}} \}. \]

That welfare is higher under competition than under RPM is a direct consequence of propositions 5 and 6, which show that both the manufacturer and the consumers prefer competition to RPM.

Let us now show that welfare is higher under competition than under ET. First notice that

\[ S^C - S^{ET} = [\frac{1}{\bar{g}} (g^e - c)^2 + \frac{1}{2} \sigma_g^2] - [\frac{1}{\bar{g}} (g^e - p^{ET})^2 + \frac{1}{3} \sigma_g^2], \]
where \( g = d - \gamma \). From the proof of Proposition 6, \( p^{ET} > c \). (42) then implies that

\[
(43) \quad S^C - S^{ET} > \frac{3}{8} \sigma^2 g.
\]

To complete the proof, notice that, from proposition 4, \((\Pi^{ET} - \Pi^C)\) is highest when the retailers are risk neutral; and that for risk-neutral retailers, from (21) and (4), we have: \( \Pi^{ET} - \Pi^C = \frac{1}{4} \sigma^2 g \).

Q.E.D.

Proposition 7 implies that for market uncertainty, undifferentiated retailers and linear demand, anticompetitive restraints should always be prohibited.

VIII. Conclusion.

The following conclusions emerge from our analysis:

1) Under incomplete information about the retailers' environment, the manufacturer may not want to impose vertical restraints, even if he possesses the information required to do so. The efficiency in using decentralized information and the insurance properties of vertical restraints have to be compared with those of the competitive policy. On the whole, the competitive policy scores well for market uncertainty and extreme risk aversion, because its "tournament" aspect insures the retailers. It does not do as well when the retailers are not very risk averse.

When the consumer prices are not observable, or at least not verifiable by a court (see footnote 2), the manufacturer's choice between ET and competition depends on the retailers' risk aversion. Note that the choice of a consumer price by a retailer is but a form of moral hazard. Alternatively,
one could assume that the manufacturer is able to monitor the consumer prices, but not some selling effort levels exerted by the retailers. The manufacturer then faces the same tradeoff between an efficient, because unconstrained by product competition, use of decentralized information (ET), and an efficient provision of insurance, i.e., a better capture of the retailers' informational rent (product competition). In this sense, our paper studies product competition as an incentive device. It differs from the contributions by Hart [1983] and Scharfstein [1985] in that competition occurs between agents working for the same principal, and thus is a choice variable for the latter.

2) A major contribution of the earlier literature on vertical restraints is to have shown that RPM and ET can be substitutes (Bork [1965-66]). We here shade this view somewhat by finding that the two policies behave fairly differently under uncertainty. The two standpoints actually are not inconsistent as they address different problems. The earlier literature emphasized that RPM and ET both insulate retailers from intrabrand competition. Thus, they both can be used to solve the free riding problems in local sale efforts and postsale services. This paper ignores the free rider issue, and focuses on the delegation problem under incomplete information. ET clearly uses decentralized information more efficiently than RPM. But RPM has better insurance properties in the case of demand uncertainty. The search for the best control policy for the manufacturer (when restraints are feasible and effective) must rest on a fine analysis of the type of uncertainty (cost/demand, market/idiosynchratic) and of the retailers' degree of risk-aversion.

3) Another major contribution of the earlier literature on vertical restraints is to have shown that per se illegality of such restraints has no
economic foundations (e.g., Spengler [1950], Telser [1960], Posner [1976-77], Williamson [1975], Mathewson-Winter [1983a], Blair-Kaserman [1983]). The legal status of vertical restraints is fairly involved. Roughly, in the United States, competition (franchise fees) is presumptively legal; ET, after being illegal per se, is now subject to the rule of reason; and RPM suffers from per se illegality except in states which have passed a fair trade law. Recently, Posner [1981] has suggested that vertical restraints ought to be legal per se (unless they result from a dealers' cartel, which is not the case in this paper). Our paper certainly does not support this claim. The planner may well favor competition over the manufacturer's choice of a vertical restraint. Section 6 and Propositions 6 and 7 emphasize the social planner's bias in favor of competition. So at the current stage of research, the rule of reason seems safer. As Posner [1977] notes however, the rule of reason places a heavy burden of analysis on the Antitrust judge. Analysis such as the one presented in this paper may in the long run provide some guidelines for the application of this rule.

Much work remains to be done. First, this paper focuses on the interaction between the use of decentralized information, double marginalization and insurance. We did not consider other important vertical issues such as the provision of selling effort (see the first item in this conclusion though). Second, another yet missing piece of the theory ought to explain why the Antitrust authorities commonly use only elementary controls over vertical structures such as the prohibition of vertical restraints. The Antitrust authorities' limited information about the environment will be a key to answer this query. Third, we have assumed that there is a competitive supply of retailers. This may be reasonable as long as retailers invest little in their relationship with the manufacturer and if they do not possess
attributes, such as location and facilities, that make them special to the manufacturer. Otherwise retailers have some bargaining power (Williamson [1975]). The outcome may move towards a dealers' cartel. The study of retailers' bargaining power can provide a link between the theories of vertical and horizontal restraints. Lastly, we would want to consider the link between competition at the upstream level and vertical restraints. All these questions must await further treatment.
Appendix

Idiosyncratic Uncertainty

In this Appendix, we give the results only for a uniform cost distribution on \([\underline{\gamma}, \overline{\gamma}]\). The same results can be shown to hold for general exponential distributions.

Let us first assume that the retailers are infinitely risk-averse.

It can easily be shown that, as in the "market uncertainty" case, RPM is inferior to competition and ET from both the manufacturer's and the social planner's points of view. So we compare competition and ET.

i) Competition: The franchise fee must equal zero as each retailer makes zero profit for some states of demand.

Note that, if the cumulative distribution function (c.d.f.) of each retailer's cost \(\gamma_1\) is \(F(\cdot)\), the c.d.f. of \(\gamma = \sup\{\gamma_1, \gamma_2\}\) is given by: \(\Phi(\cdot) = F^2(\cdot)\). Straightforward computations then lead to:

\[
\begin{align*}
\lambda^C &= 0 \\
\bar{P}^C &= \frac{1}{2} (d + \gamma_0^C) \quad \text{(where } \gamma_0^C = \mathbb{E}\gamma_0 = \frac{2}{3} \overline{\gamma} + \frac{1}{3} \gamma > \gamma^e, \text{ for the uniform distribution)} \\
\bar{Q}^C &= \frac{1}{2} (d + \gamma_0^C) + \frac{\gamma}{\gamma} \\
\bar{M}^C &= \frac{1}{4} (d - \gamma_0^C)^2 \\
\bar{W}^C &= \frac{3}{8} (d - \gamma_0^C)^2 + \frac{1}{2} \sigma_\gamma^2 \quad \text{(where } \sigma_\gamma^2 = \mathbb{E}(\gamma^2 - \gamma^e) = \frac{\Delta^2}{18} < \sigma_\gamma^2 = \frac{\Delta^2}{12}, \text{ for the uniform distribution)} \quad \text{and } \Delta = \overline{\gamma} - \gamma \).
\end{align*}
\]

ii) Exclusive Territories

Under ET, the outcome is the same as in the case of market uncertainty for each realization of the cost parameter: the degree of correlation is
irrelevant as long as territories are exclusive. So \{\tilde{\eta}^{ET}, \tilde{p}^{ET}, \tilde{q}^{ET}, \tilde{\varpi}^{ET}, \tilde{\omega}^{ET}\} are given by equations (6) through (10).

It is possible to show that, under our assumption that \( \bar{\gamma} \) is not too high relative to \( \gamma \), (9), (10), (44) and (45) imply that \( \tilde{\eta}^{C} > \tilde{\eta}^{ET} \) and \( \tilde{\omega}^{C} > \tilde{\omega}^{ET} \). The consumers prefer competition as from (8) and (43),

1. \( \text{Eq}^{ET} - \text{Eq}^{C} = \frac{1}{2} (\bar{\gamma} - \gamma) > 0 \)

2. \( \frac{\sigma_{\gamma}^2}{4} > \frac{1}{4} \sigma_{\gamma}^2 \) (the consumer price under competition (which fluctuates like \( \sigma_{\gamma}^2 \)) has a higher variance than the consumer price under ET (which fluctuates like \( \frac{\gamma}{2} \)). See section 6 for a broader discussion of consumers' welfare.\(^{13}\)

If retailers are risk-neutral, these results are no longer valid. Actually in this case, both the manufacturer and the social planner prefer ET to competition and competition to RPM. To check this point, it suffices to note that in the case of ET, the nature (idiosynchratic or not) of uncertainty is not relevant when deriving the optimal tariff policy. Since ET allows the manufacturer to realize the vertically integrated profit under risk neutrality, \( \tilde{\eta}^{ET} > \tilde{\eta}^{C} \). So the manufacturer imposes a vertical restraint. It is also possible to show that, for an exponential distribution, \( \tilde{\omega}^{ET} > \tilde{\omega}^{C} \). (The expected consumer price is lower under ET, but the variance of the consumer price is higher under competition).

Thus, for idiosynchratic uncertainty, no conflict between private and social objectives arises if we restrict ourselves to exponential uncertainty and one of the two polar cases of risk aversion. But the analysis clearly suggests that conflicts will arise if we look at more general specifications.

\(^{13}\)While i) holds for any distribution, ii) may not hold for distributions that are not well-behaved (for instance, ii) is not satisfied by a two-part distribution with most of the weight on the high value).
References


Scharfstein, D., [1985], "Product Market Competition and Managerial Slack", Mimeo, MIT.

