Vertical control with bilateral contracts

Daniel P. O’Brien*

and

Greg Shaffer*

It is widely believed that a supplier who distributes her product through retailers can achieve the vertically integrated outcome with nonlinear contracts, provided the retail price is the only target of control and there is no uncertainty. We show that this result fails when retailers cannot observe their rivals’ contracts, as incentives to choose each contract to maximize bilateral profits may yield retail prices well below the vertically integrated level. This provides a new explanation for vertical restraints, and it rationalizes an oft-expressed but never formalized view that resale price maintenance prevents countervailing buyer power from lowering retail prices.

1. Introduction

■ It is widely believed that a supplier distributing a product through retailers can maximize joint profits with two-part tariff contracts, provided the retail price is the only target of control and there is no uncertainty.1 Thus, to explain why contractual provisions such as resale price maintenance or territorial protection are sometimes used, the vertical-control literature either assumes that fixed fees are infeasible (Gallini and Winter, 1983; Mathewson and Winter, 1983; and Perry and Groff, 1985), or it extends the basic model to include service promotion and advertising (Mathewson and Winter, 1984), demand and cost uncertainty (Rey and Tirole, 1986), or multiple upstream firms (Rey and Stiglitz, 1988; Shaffer, 1991; and Perry and Besanko, 1991).

In each instance, a crucial assumption is that competing retailers observe their rivals’ supply contracts before participating in the product market game. By contrast, this article examines the vertical-control problem when an upstream firm engages in secret bilateral relations with downstream buyers. We show that nonlinear contracts are generally not sufficient to maximize joint profits. This provides a new motivation for vertical restraints.2

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* University of Michigan.

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1 Linear wholesale prices can be chosen to induce any desired set of retail prices, and fixed fees can be used to transfer surplus.

2 As Katz (1991) and Coughlan and Wernerfelt (1989) have shown, the strategic role of restraints is greatly diminished in games with multiple upstream firms if contracts are not observable prior to the product market game. For example, the upstream firms in Rey and Stiglitz (1988) would not impose exclusive territories, and the downstream firms in Shaffer (1991) would not seek resale price floors. In our model, by contrast, the role of restraints is actually enhanced.
The crux of the problem is this: at any contracts that induce the vertically integrated outcome, the supplier and any retailer can increase their bilateral profits by privately negotiating a reduction in their marginal transfer (and hence retail) price that shifts customers and profits away from rival retailers. This rent-shifting behavior is a form of opportunism in the sense that the additional profits come at the expense of other retailers. Surprisingly, its implications for equilibrium contracts have not been formally examined.

To illustrate the problem we adopt the terminology of Crémer and Riordan (1987) and define a contract equilibrium as a set of supply contracts that is immune to profitable bilateral renegotiation by the upstream firm and individual retailers. We show that in any contract equilibrium, the marginal transfer price between the supplier and each retailer is set at production marginal cost. Given the competition among the downstream firms, retail prices and hence joint profit will generally be well below the vertically integrated level. This provides the impetus for expanding the feasible set of contracts to include vertical restraints.

One way to eliminate the opportunism that we identify is by assigning downstream firms to nonoverlapping geographic sales regions (closed-territory distribution). Alternatively, the vertically integrated outcome can be achieved in a contract equilibrium with maximum resale price maintenance (price ceilings), coupled with wholesale prices chosen to ensure that downstream firms’ margins are just sufficient to cover their marginal costs. This strategy eliminates retailers’ quasi-rent streams, thereby making bilateral profits equivalent at the margin to joint profits.

Although minimum resale price maintenance (price floors) falls short of supporting the first best in a contract equilibrium (because this leaves retailers with rents and thus does not align bilateral and multilateral incentives), a commitment to an industrywide price floor will often increase joint profits. It does so by breaking the link between retail prices and negotiations over transfer payments. We provide anecdotal evidence that price floors have been used for this purpose.

The two articles closest to ours are McAfee and Schwartz (1991) and Hart and Tirole (1990). The latter examine incentives for vertical integration in a model with two upstream Bertrand suppliers and two downstream Cournot distributors. They find that unobservable nonlinear contracts are insufficient to maximize joint profits, thus providing incentives for vertical integration. The scope of our article differs from theirs by focusing on the case of a single upstream firm selling to multiple Bertrand competitors and by emphasizing the role of vertical restraints. We also allow for more general upstream costs. McAfee and Schwartz define the concept of pair-wise proof equilibrium, which requires each retailer to conjecture that any unexpected offer from the upstream firm is a bilateral deviation. This turns out to yield the same outcome as the contract equilibrium concept that we employ. However, McAfee and Schwartz differ from us in that they restrict attention to two-part tariffs and do not consider the role of vertical restraints.

2. The model

Consider an upstream firm selling a product to \( N \) differentiated retailers for subsequent distribution to final customers. We model this situation as a two-stage game. In stage one,

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3 See Goldberg (1976), Klein, Crawford, and Alchian (1978), and Klein (1980) for other examples of opportunism in contractual relationships.

4 The extension to Bertrand competition is not straightforward in this class of models. Under Cournot competition, the amount the supplier collects from one retailer through his nonlinear contract does not change when another retailer secretly changes his quantity. Hence, it is clear that there is no way to construct nonlinear contracts that internalize incentives to shift rents across the vertical structure. Under Bertrand competition, however, a secret reduction in one retailer’s price will reduce other retailer’s sales, which will generally reduce their payments to the supplier. One might think that the incentive to shift rents toward a given retailer could be internalized with nonlinear contracts that would penalize the supplier with lower receipts from other retailers. However, we prove in Section 3 that any set of unobservable nonlinear contracts that is bilaterally optimal does not maximize joint profits.
the supplier and each retailer agree on a supply contract. We shall consider take-it-or-leave-it offers as well as bilateral bargaining. In stage two, retailers play a Bertrand pricing game. The outcome of the game will depend crucially on what retailers know about their rivals’ contracts when they choose prices. We say contracts are observable when each retailer knows his rivals’ contracts before the pricing game, and unobservable when they are private information.

We begin by assuming that the supplier makes take-it-or-leave-it offers in stage one. A retailer accepts the supplier’s contract by setting price so as to sell one or more units, and he rejects the contract if he does not sell the good, i.e., by setting his retail price equal to infinity. This assumption is made initially in order to understand the role of observability in the most commonly used framework. We then extend the model to allow for simultaneous bilateral bargaining.

Retailer $i$’s total payment for the supplier’s product is given by $T_i$. In the absence of laws constraining the upstream firm’s contracting behavior, $T_i$ may generally depend on any variables that are observed by both the upstream firm and retailer $i$ and can be verified by a court. We consider the quantity sold by retailer $i$ (a nonlinear contract), the location of firm $i$’s sales, and the price retailer $i$ sets (resale price maintenance). We assume that $T_i$ is differentiable almost everywhere with respect to $i$’s quantity.

Let the retail price of good $i$ be $P_i$, and let $P = (P_1, \ldots, P_N)$. The demand for good $i$ is given by $D_i(P)$. We assume that for any price vector of firm $i$’s rivals, there is some “choke” price for good $i$ above which its demand is zero. For all positive values of $D_i$, the demand for good $i$ is differentiable in $P$, downward sloping in $P_i$, the goods are substitutes, and an equal rise in the price of all goods causes the demand for good $i$ to fall.

Upstream costs are given by $C(\sum_{i=1}^{N} D_i)$. We assume that $C$ is differentiable, increasing, and convex. Let the supplier’s profit be given by $\pi_M = \sum_{i=1}^{N} T_i - C(\sum_{i=1}^{N} D_i)$, and let retailer $i$’s profit be $\pi_i = P_i D_i - T_i$.

3. Take-it-or-leave-it offers

It is well known that when retailers can observe their rivals’ nonlinear contracts, the joint profit-maximizing outcome can be supported in a subgame-perfect equilibrium. Two-part tariffs suffice; an $N$-dimensional wholesale price vector is sufficient to elicit the desired $N$-dimensional retail price vector, while fixed fees transfer the surplus.\textsuperscript{5} Clearly, this result relies on contract observability, whereby each retailer can calculate his own and his rivals’ equilibrium pricing decisions given any vector of nonlinear contracts.

Once observability is dropped, however, a retailer’s pricing decision can no longer be conditioned on his rivals’ contracts. Yet his profit will depend on his rivals’ prices, and those prices will depend on his rivals’ contracts. To choose price optimally, each retailer must form beliefs about his rivals’ contracts and pricing strategies. Formally, the take-it-or-leave-it game with unobservable contracts has no subgames, so subgame perfection cannot be employed.

Not surprisingly, there are many Nash equilibria. Little additional insight is gained by requiring retailers’ strategies to be sequentially rational given rational beliefs about their rivals’ contracts. This is the case because, for many of the Nash equilibria, there are corresponding perfect Bayesian equilibria in which each retailer’s pessimistic beliefs about his rivals’ contracts justify the threat to cut price or reject any offer not meeting his expectations.

\textsuperscript{5} See Mathewson and Winter (1984) for the two-part tariff case. To make this precise under more general nonlinear contracts, one must rule out contracts that induce subgames in which Bertrand equilibria do not exist.
For example, the set of nonlinear contracts that induce the vertically integrated price vector $\mathbf{P}^I$ can be supported in a perfect Bayesian equilibrium. For any unexpected offer, each retailer would be sufficiently pessimistic in his belief about the magnitude of his rivals’ discounts that he would reject it. By similar reasoning, retail prices greater than and less than $\mathbf{P}^I$ can be supported with appropriately chosen out-of-equilibrium beliefs. Thus, the supplier cannot ensure her first-best outcome.

One might think that firms could coordinate on joint profit–maximizing contracts. But this is not obvious, since any joint effort may invite profitable deviations by coalitions of firms. An intuitive requirement for coordination in a bilateral contracting game is that contracts be stable against such deviations by coalitions of players who contract with each other. We formalize this idea with the contract equilibrium concept of Crémer and Riordan (1987).

**Definition 1.** A contract equilibrium (with unobservable contracts), $\mathbf{T}^*$, and Nash equilibrium prices induced by these contracts, $\mathbf{P}^*$, such that $\forall i, T^*_i$ induces retailer $i$ to maximize the bilateral profits $\pi_M + \pi_i$ of the supplier and retailer $i$, taking $(T^*_i, P^*_i)$ as given.

Thus, a contract equilibrium requires contracts to be bilaterally optimal for the supplier and each retailer, holding rival retailers’ prices and supply contracts fixed. Prices are held fixed because rivals cannot respond to deviations they cannot observe.

Our motivation for the contract equilibrium concept is based on the idea of robustness against renegotiation. At a hypothesized equilibrium contract, it is reasonable to ask whether a firm can increase its profit by proposing an alternative contract that one of its contracting partners could not rationally refuse. If so, then the hypothesized equilibrium does not seem very compelling. If contracts do not form a contract equilibrium, some retailer could make an alternative offer to the supplier that would increase both their profits.\(^6\) The supplier would not revise her beliefs and reject a profitable counteroffer, since she can observe all contracts.

It turns out that the contract equilibrium concept is similar to the “pair-wise proof” restriction of McAfee and Schwartz (1991) and the “market-by-market bargaining” restriction of Hart and Tirole (1990). They posit that retailers hold unilateral deviation beliefs. That is, whenever a retailer receives an unexpected offer, he believes his rivals’ contracts have not been altered from what was prescribed by the equilibrium. It is easy to see that any perfect Bayesian equilibrium with unilateral deviation beliefs must yield a contract equilibrium with the supplier receiving all the rents. For if it did not, the supplier could make a unilateral deviation offer to some retailer that, given the retailer’s unilateral deviation beliefs, would increase both their profits.

We now show that the joint profit–maximizing outcome cannot be achieved in a contract equilibrium. The following lemma greatly simplifies the analysis.

**Lemma 1.** If $(\mathbf{T}^*, \mathbf{P}^*)$ forms a contract equilibrium, then for all $j = 1, \ldots, N$, $T^*_j$ is continuous and differentiable at the quantity induced by $\mathbf{T}^*$.

**Proof.** See the Appendix.

Suppose retailers have been offered the contracts $\hat{\mathbf{T}}$ that will induce the equilibrium retail price vector $\hat{\mathbf{P}}$. Taking $(\hat{T}_i, \hat{P}_i)$ as given, the combined profit of the supplier and retailer $i$ can be written as

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\(^6\) In an earlier version (O’Brien and Shaffer, 1990) we examined the following renegotiation game. Given an original set of contracts, retailers simultaneously make counterproposals. The supplier then chooses between the original set of contracts and the counterproposals. If the original contracts are reoffered and accepted in a Nash equilibrium to the renegotiation game, they are defined as renegotiation-proof. One can show that the set of renegotiation-proof contracts is the same as the set of contract equilibria.
\[
\pi_M + \pi_i = \pi_M + \sum_{k=1}^{N} \pi_k - \sum_{k \neq i} \pi_k \\
= \{ P_i D_i + \sum_{k \neq i} \hat{P}_k D_k - C \left( \sum_{k=1}^{N} D_k \right) \} - \sum_{k \neq i} (\hat{P}_k D_k - \hat{T}_k).
\]

The supplier and retailer \(i\)'s bilateral objective is to maximize joint profit minus the profits of firm \(i\)'s rivals. That is, given the contracts of retailer \(i\)'s rivals, the supplier and retailer \(i\) will ignore the quasi-rent streams \(\sum_{k \neq i} (\hat{P}_k D_k - \hat{T}_k)\) of the other downstream firms.

The first-order condition for maximizing (1) with respect to \(P_i\) can be written as

\[
\left\{ D_i + (P_i - C') \frac{\partial D_i}{\partial P_i} + \sum_{k \neq i} (\hat{P}_k - C') \frac{\partial D_k}{\partial P_i} \right\} - \sum_{k \neq i} (\hat{P}_k - \hat{T}_k) \frac{\partial D_k}{\partial P_i} = 0.
\]

To see that the vertically integrated prices do not arise in a contract equilibrium, notice that the bracketed term in (2) equals zero at the vertically integrated price vector \(P^1\). Assuming the objective is quasi-concave, we know that since \(\sum_{k \neq i} (P'_k - \hat{T}'_k)(\partial D_k/\partial P_i) > 0\), the supplier and retailer \(i\) will negotiate a contract that induces a retail price cut if they believe retailer \(i\)'s rivals will set \(P^1_{-i}\). The small reduction in \(P'_i\) has only a second-order effect on the total profit of the vertical structure, since \(P^1\) maximizes that profit, but it raises the combined profit of the supplier and retailer \(i\) as consumers substitute retailer \(i\)'s product for those of his rivals. The additional surplus can be divided with a fixed fee.

**Proposition 1.** The vertically integrated outcome cannot be supported in any contract equilibrium.

Intuitively, once a retailer has committed to selling under his supply contract, the supplier has an incentive to divert customers toward another retailer's product in order to earn additional profit from those customers. Since the supplier's margins, \(T' - C'\), are less than the vertically integrated retail margins, \(P^1 - C'\), the loss to the supplier from lower sales through the injured retailers is less than it would be under vertical integration.\(^8\)

An example helps illustrate why rent-shifting incentives cannot be internalized with nonlinear contracts. Let \(\psi_j(D_j, P_{-j})\) be the inverse demand for \(j\) given \(P_{-j}\). Consider the contracts \(\hat{T}_j(D_j) = \psi_j(D_j, P^1_{-j})D_j\). At the vertically integrated prices, these contracts transfer all retail revenues to the supplier. They might appear to eliminate incentives for opportunism, since shifting sales away from a retailer, and thus decreasing his revenue, appears to yield a corresponding reduction in his payment to the supplier. Furthermore, if rival retailers are choosing \(P^1_{-j}\), then it is a best response for retailer \(j\) to choose \(P'_j\). Notice, however, that under \(\hat{T}_j\), retailer \(j\)'s payment is equal to his revenue only at the joint profit-maximizing prices. If the supplier decreases the marginal price to retailer \(i\), inducing \(i\) to cut \(P_i\) by a

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\(^7\) Since the supplier and retailer \(i\) can always sign a quantity-forcing contract to induce any price \(P_i\), we can think of them as choosing the retail price.

\(^8\) One could argue that the need to develop a reputation might prevent the upstream firm from taking actions that knowingly induce retailers to earn negative profits. For if a downstream firm observed a lower than expected retail price by a rival, or if it incurred losses over a short period, it could simply terminate the relationship. Although reputation can sometimes mitigate the problem, there are circumstances in which this mechanism breaks down. For example, if downstream orders are infrequent, then short-term gains from private offers may dominate the supplier's interest in developing a reputation. Furthermore, retailers may believe that the upstream firm will not be around long enough to reap the benefits of building a reputation. This suggests that the opportunism problem may be especially relevant for new upstream entrants or small suppliers who have not yet established themselves. Finally, the notion that reputation is not a panacea may be inferred from the complex franchise-contract law on disclosure and dealer termination.

\(^9\) Note that the retailer is constrained to zero profit regardless of the price he sets.
small amount, then retailer j’s revenue will be lower than his payment. Formally, since 
\( \frac{\partial \psi_j}{\partial P_i} > 0 \), if \( P_i < P_i^f \) and the other retailers price at \( P_i^{\Pi_j} \), then

\[
\text{retailer } j \text{'s payment } = \psi_j(D_j(P_j^f, P_i, \textbf{P}_i^{\Pi_j}), P_i^{\Pi_j}, \textbf{P}_i^{\Pi_j}) D_j(P_j^f, P_i, \textbf{P}_i^{\Pi_j}) \\
> \psi_j(D_j(P_j^f, P_i, \textbf{P}_i^{\Pi_j}), P_i^{\Pi_j}, \textbf{P}_i^{\Pi_j}) D_j(P_j^f, P_i, \textbf{P}_i^{\Pi_j})
\]

= retailer j’s revenue.

Since joint profits will not change with a small reduction in \( P_i \), the combined profits of the supplier and retailer \( i \) will increase. Thus \( \tilde{T} \) does not form a contract equilibrium.\(^{10}\)

More insight is gained by characterizing the marginal transfer prices that arise in a contract equilibrium. Retailer \( i \)'s first-order condition is \( D_i + (P_i - T_i')D_i/\partial D_i = 0 \). Substituting this expression into equation (2) gives \( N \) necessary conditions for \( \textbf{T}^*, \textbf{P}^* \) to arise in a contract equilibrium:

\[
\sum_{k=1}^{N} (T_{i'}^* - C') \frac{\partial D_k}{\partial P_i} = 0, \quad i = 1, \ldots, N,
\]

where \( C' \) is evaluated at \( \sum_{k=1}^{N} D_k(\textbf{P}^*) \). In matrix notation, this expression can be written as \((\textbf{T}' - C') \textbf{D}_p = 0 \), where \( \textbf{T}' = (T_{i'}^1, T_{i'}^2, \ldots, T_{i'}^N) \), \( \textbf{C}' = (C', C', \ldots, C') \), and \( \textbf{D}_p \) is the \( N \)-by-\( N \) matrix of demand derivatives. By our assumptions on demand, \( \textbf{D}_p \) is invertible. This gives the following proposition.

**Proposition 2.** In all contract equilibria, the marginal transfer payments are the same for each retailer and are given by marginal cost pricing of the supplier’s product.

Intuitively, at \( T''^* = C' \), the supplier earns zero profit at the margin from additional sales to each retailer. For small bilateral deviations from \( T''^* \), the bilateral profit of the supplier and retailer \( i \) is the same as it would be if they were a vertically integrated oligopolist with marginal cost \( C' \). Their optimal bilateral strategy is to choose a marginal transfer price that induces retailer \( i \) to choose the Bertrand-Nash best response to other retailers’ prices. An immediate implication is that the externality that arises from downstream price competition is not internalized. Hence, contract equilibria may yield retail prices well below the vertically integrated level.

□ **Bargaining.** These results extend straightforwardly to situations where bargaining power is more evenly distributed. Following Harsanyi (1977) and Horn and Wolinsky (1988), assume that the supplier is simultaneously engaged in bilateral relations with each retailer. A bargaining equilibrium (with unobservable contracts) is a set of contracts, and prices induced by those contracts, that simultaneously solve asymmetric Nash bargaining solutions between the supplier and each retailer. Without loss of generality, assume that retailer \( i \)'s contract consists of a fixed fee, \( F_i \), and a remaining (possibly nonlinear) component, \( T_i \). The profits of the supplier and retailer \( i \) are then given by \( \pi_M + F_i \) and \( \pi_i - F_i \). Their bargaining problem is described by the disagreement points, \((d_M, 0)\), and by the convex

\(^{10}\) At this point it is useful to ask why our results differ from those of Crémer and Riordan (1987), who in a related model find that a first-best contract equilibrium exists. The crucial difference is that in our model, retailers have interrelated demands for the supplier’s product. Thus the contracting decision by the supplier and retailer \( i \) affects rival retailers directly through their receipts. In Crémer and Riordan, on the other hand, the interrelationship between bilateral pairs of firms arises from the nonlinearity of the seller’s cost and from buyers’ and the supplier’s private information. Given the joint profit-maximizing input of rival retailers, the supplier cannot shift rents away from those retailers toward retailer \( i \) by altering the terms of \( i \)'s contract. Hence, the first-best contracts are not subject to the same type of opportunism as they are in our article.
set of payoff pairs, $\Omega_i = \{ (\pi_M + F_i, \pi_i - F_i) \mid \pi_M + F_i, \pi_i - F_i \geq 0 \}.^{11}$ A set of asymmetric Nash bargaining solutions is a vector of nonlinear contracts that maximize the Nash products, $\phi_i = (\pi_M + F_i - d_{M_i})^{\alpha_i}(\pi_i - F_i)^{(1-\alpha_i)}$, where $\alpha_i \in (0, 1)$ is a measure of the supplier’s bargaining power in negotiations with retailer $i$.

The first-order condition with respect to $F_i$ yields $F_i = \alpha_i \pi_i - (1 - \alpha_i)(\pi_M - d_{M_i})$. Substituting this into the Nash product $\phi_i$ yields

$$\phi_i = \alpha_i^{\alpha_i} (1 - \alpha_i)^{1-\alpha_i} (\pi_M - d_{M_i} + \pi_i).$$

Observe that choosing $P_i$ to maximize (4) is the same as choosing $P_i$ to maximize (1). Hence, a bargaining equilibrium is a contract equilibrium with a particular distribution of rents. This is not surprising; it is well known that in Nash bargaining games with transfer payments (i.e., fixed fees) the Nash bargaining solution can be found in two steps. First, firms choose marginal transfer prices to maximize the surplus to be divided. Second, they negotiate fixed fees to transfer surplus. This requires choosing each retail price to maximize bilateral profits. From Propositions 1 and 2, we therefore have the following.

*Proposition 3.* In any bargaining equilibrium, joint profits are not maximized. Further, marginal transfer payments are the same for each retailer and are given by $T' = C'$.

4. Closed-territory distribution and RPM

We have shown that supply contract payments which depend only on own quantity cannot support the vertically integrated outcome in a contract equilibrium. From condition (2), one can see that the opportunism arises because when firms are maximizing bilateral profits, they do not take into account rival retailers’ quasi-rents. In equilibrium this leads to marginal cost transfer pricing. To avoid the corresponding dissipation of profits, the contract set must be expanded in such a way as to make quasi-rents independent of rival retailers’ prices. This section discusses how this can be done with vertical restraints.

In some markets, the opportunism we identify can be eliminated through closed-territory distribution (CTD), which grants each downstream firm monopoly rights to all customers within a specified area.$^{12}$ For this to work, it must not be in the interest of the supplier to encourage tacitly downstream firms to violate each other’s territories. This might be so because of the threat of legal action by any injured firm. CTD can then achieve the first best with payment schedules that make each downstream firm the residual claimant to profits within his territory.

An alternative way to make quasi-rents independent of rivals’ prices is to eliminate them entirely. This can be done with maximum resale price maintenance contracts (max RPM) in which retailer $i$’s price ceiling and wholesale price are both set at $P'_i$. $^{13}$ Max RPM can be thought of as playing two roles. First, it assures each retailer that his profit will not be adversely affected if his rivals’ prices decrease.$^{14}$ Second, it removes incentives for the supplier and other retailers to engage in opportunism. The former means

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11 We leave the supplier’s disagreement points unspecified, as they affect only the distribution of the rents.

12 For example, in *White Motor Co. v. U.S.* (372 U.S. 253, 261, 263 (1963)), a manufacturer of trucks assigned its wholesalers to exclusive areas. Though CTD is used in some final-goods markets, it is more likely to be feasible for intermediate goods. The problem is that it may be too costly to allocate buyers across downstream firms.

13 If retailer $i$ has marginal cost $v_i$ and fixed cost $K_i$, then the supplier offers him a wholesale price of $P'_i - v_i$ and a negative fixed fee equal to $-K_i$.

14 From this observation it is not difficult to show that when price ceilings are allowed, the supplier receives the vertically integrated profit in every perfect Bayesian equilibrium of the take-it-or-leave-it game. Thus, in addition to overcoming opportunism, max RPM overcomes the coordination problem associated with multiple perfect Bayesian equilibria.
that retailers' out-of-equilibrium beliefs about their rivals' contracts do not matter. The latter enables the vertically integrated outcome to be supported in a contract equilibrium.

Our model can also explain industrywide retail price floors (min RPM), which historically appear to have a higher incidence than retail price ceilings. Notice, however, that retailer-specific price floors do not suffice. This is so because if all retailers other than \( i \) abide by the price floors \( P^i \), the supplier and retailer \( i \) would want to set \( i \)'s floor below \( P^i \). Thus, our model suggests that min RPM can be beneficial to the firms only when a commitment to an industrywide price floor is made. Historically, when RPM was legal in the United States, this was provided by state "nonsigner" laws. These laws required all retailers to abide by the upstream firm's RPM contract as long as at least one retailer had signed it.\(^{15}\) Further, nonsigner laws were often state-enforced. Although the supplier may have had incentives to condone tacit price cuts by individual retailers, she did not always have enforcement discretion.

The effect of an industrywide retail price floor is to prevent lower transfer prices from inducing downstream firms to cut retail prices. Although this is not sufficient to maximize joint profits under asymmetry, some price floor is likely to raise joint profit above the contract equilibrium level. A sufficient condition is that retailers have upward-sloping reaction functions. To see this, consider introducing a price floor that is binding on only the retailer (or retailers) charging the lowest retail price given marginal cost transfer pricing. If reaction functions slope upward, this will cause rivals' prices and joint profit to rise.

There is substantial anecdotal evidence suggesting that min RPM has been used to prevent countervailing buyer power from exerting a constraining influence on monopoly pricing. For example, in testimony before Congress, one retailer stated:

The pressure of competition begins at the retail level. When retailers are very competitive, they make demands on their wholesalers and brokers for price relief, such as quantity trade discounts. The wholesalers and brokers, in an effort to protect their retail customers, plead with the manufacturer for a lower price. The manufacturer, in turn, strives to improve his efficiency to lower costs and thereby reduce his price... If the retail price is fixed, all prices down the line of distribution are stable and everyone is happy, except the consumer.\(^{16}\)

More recently, this reason for min RPM has also been given by a spokesman for an upstream manufacturer of golf balls. Commenting on the effects of discounting by a retail chain, he said:

If Nevada Bob's lowers prices on our balls, other outlets eventually will have to lower prices, too. Eventually, it could force us to lower the price at which we sell balls to our retailers. That's not good for us and it's why we put the policy in place.\(^{17}\)

5. Conclusion

This article challenges the conventional wisdom that nonlinear supply contracts can achieve the vertically integrated outcome in a relatively simple setting: there is no uncertainty, no role for demand-creating services, and no sunk investments. Nevertheless, we have shown that there is good reason to believe that contracting sans restraints will not be sufficient to maximize joint profits. For at the set of joint profit–maximizing nonlinear contracts, there exist incentives for the supplier and individual retailers to deviate by cutting prices. We showed that closed-territory distribution and max RPM can support the vertically integrated outcome by removing the influence of rivals' prices on retailers' quasi-rents. We also showed

\(^{15}\) By the early 1940s most state governments had passed such laws, and in 1952 the McGuire Act extended them to interstate trade. The McGuire Act was repealed in 1975.


\(^{17}\) Wally Uihlein, president of Titleist, as quoted in Golf Digest, December 1991, p. 12.
that a commitment to an industrywide retail price floor eliminates the opportunism and will increase joint profit if reaction functions are upward sloping.

Turning to the welfare implications of our analysis, the model implies that retail prices will tend to rise with closed-territory distribution, min RPM, and max RPM.\textsuperscript{18} In each case, total welfare (profit plus consumer surplus) is higher when these restraints are prohibited than when they are allowed.

Recent U.S. Supreme Court decisions have substantially narrowed the evidentiary standards necessary to prove a per se illegal RPM agreement. By allowing the supplier to terminate dealers unilaterally, current antitrust practice borders on a tacit acceptance of a supplier’s right to choose an RPM policy. This shift appears to be based on the conventional view that restraints will be used either to share risk, enhance services, reduce transaction costs, or eliminate double markups, all of which may be socially beneficial. Our model suggests a less benign view. If there is a case to be made for allowing CTD and RPM, it will lie outside the scope of our model, perhaps in the above-mentioned efficiency considerations. The task of incorporating these aspects into a model with unobservable contracts is left for future research.

Appendix

- This appendix proves Lemma 1. The proof utilizes three steps. Let \((T^*, P^*)\) form a contract equilibrium with unobservable contracts.

**Step 1.** For all \(j = 1, \ldots, N\), \(T_j^*\) is continuous at the quantity induced by \(T^*\).

**Proof.** Let \(D_j^*\) be the quantity induced by \(T^*\), and suppose that \(T_j^*\) were not continuous at \(D_j^*\). Then for some infinitesimal change in \(D_j^*, T_j^*\) would either jump up or jump down. It cannot jump down, for if it did, retailer \(j\) would adjust his price by a small amount and induce a discrete reduction in its payment. It cannot jump up, for then the supplier and some other retailer \(k\) could jointly adjust \(P_k\) (via a wholesale price \(w_k\)) and induce a discrete jump in their bilateral profits. Hence \(T_j^*\) must be continuous at \(D_j^*\). \(Q.E.D.\)

**Step 2.** For all \(j = 1, \ldots, N\), retailer optimality implies that \(T_{j*}^* \geq T_{j*}^*\), where the (+) and (−) symbols indicate right-hand and left-hand partial derivatives, and it is understood here and henceforth that the derivatives are evaluated at \(D_j^*\).

**Proof.** By step 1, \(T_j^*\) has left-hand and right-hand derivatives at \(D_j^*\). Given \(T_j^*\), retailer \(j\)’s first-order conditions for optimal retail pricing can be written as

\[
\left( \frac{\partial \pi_j}{\partial P_j} \right)_+ = D_j + (P_j - T_{j*}^*) \frac{\partial D_j}{\partial P_j} \leq 0 \quad (A1)
\]

\[
\left( \frac{\partial \pi_j}{\partial P_j} \right)_- = D_j + (P_j - T_{j*}^*) \frac{\partial D_j}{\partial P_j} \geq 0, \quad (A2)
\]

where we have used the fact that \(D_j\) is decreasing in \(P_j\) to obtain the left-hand and right-hand derivatives of \(T_j(D_j)\). Combining (A1) and (A2) yields \(T_{j*}^* = T_{j*}^*\) as a necessary condition for retailer optimality. \(Q.E.D.\)

**Step 3.** The functions \(T_j^* (\forall j \neq i)\) satisfy

\[
\sum_{j \neq i} (T_{j*}^*) \frac{\partial D_j}{\partial P_i} = \sum_{j \neq i} (T_{j*}^*) \frac{\partial D_j}{\partial P_i}.
\]

**Proof.** By definition, \(T_i^*\) maximizes the bilateral profits of the supplier and retailer \(i\) given rival retailers’ contracts \(T_{-i}^*\). That is, \(T_i^*\) solves

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\textsuperscript{18} Perry and Besanko (1991) also find that max RPM can raise retail prices. This is surprising, since conventional wisdom holds that price ceilings correct for double markups associated with successive monopoly and therefore lead to lower retail prices. This wisdom stems from the view that in the absence of RPM, the benchmark for comparison is linear wholesale pricing. If nonlinear contracts are feasible, max RPM becomes redundant when contracts are observable. What we have shown is that when contracts are unobservable, price ceilings may be adopted, and when they are, retail prices rise.
\[
\max_{r \in \cdot} P_i D_i(P_i, P_{-i}) + \sum_{j \neq i} T_{ji}^*(D_j(P_j, P_{-j})) - C_i \left( \sum_{j=1}^{N} D_j(P_i, P_{-i}) \right).
\] (A3)

Since rival retailers cannot respond to changes in retailer \(i\)'s contract, altering \(T_{ji}^*\) affects bilateral profits only through its effect on \(P_i\). Since two-part tariffs are sufficient to control \(P_i\), we can solve (A3) by choosing \(P_i\) to maximize bilateral profits. The first-order conditions are given by

\[
D_i + P_i \frac{\partial D_i}{\partial P_i} = C_i \sum_{j=1}^{N} \frac{\partial D_j}{\partial P_i} \leq - \sum_{j \neq i} (T_{ji}^*) \frac{\partial D_j}{\partial P_i}
\] (A4)

\[
D_i + P_i \frac{\partial D_i}{\partial P_i} = C_i \sum_{j=1}^{N} \frac{\partial D_j}{\partial P_i} \geq - \sum_{j \neq i} (T_{ji}^*) \frac{\partial D_j}{\partial P_i},
\] (A5)

Combining (A4) and (A5) yields

\[
\sum_{j \neq i} (T_{ji}^*) \frac{\partial D_j}{\partial P_i} \leq \sum_{j \neq i} (T_{ji}^*) \frac{\partial D_j}{\partial P_i}
\]

as a necessary condition for the contracts \(T_{ji}^* (\forall j \neq i)\) to be bilateral best responses. Q.E.D.

The proof is completed by noting that steps 2 and 3 imply \(T_{ji}^* = T_{ji}^{**} (\forall j \neq i)\). Q.E.D.

References


