Resale price maintenance with secret contracts and retail service externalities

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Abstract

The received literature on the use of resale price restraints has produced results that show that RPM may be anti-competitive and lead to increased prices to consumers, but also that RPM may be beneficial because it may induce more retail sales effort. These results have been derived either in models with secret contracts and no retail sales effort, or with public contracts and where retail sales effort are important. In most real life markets retail sales effort are at least of some importance, and contracts are secret. In this paper we propose a unifying approach where both these central ingredients are present. We show that purely bilateral price restraints, irrespective of type, have no implication whatsoever on the equilibrium outcome. In equilbirum the standard Bertrand prices and effort levels prevail. We show that if manufacturers can commit to industry-wide resale price floors, the manufacturer can obtain higher prices and effort levels, but he will generally not be able to achieve the first-best collusive outcome. Moreover, we show that when industry wide price floors are implemented, consumers' are hurt.

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1 Introduction

Resale price maintenance (RPM), i.e. the practice that manufacturers limits the freedom of its retailers to determine resale prices, is much debated in the economic literature and in policy circles. Until recently both competition authorities and courts in both EU and US frowned at the practice, but after the so-called Leegin-case, US has adopted a softer approach[1]. In general, competition policy in many countries tends to be more hostile against minimum of fixed resale restrictions than when the restraint is a maximum RPM. In fact, in most jurisdictions maximum RPM is regarded as unproblematic from a competition policy perspective. The predictions from the economic literature on RPM are confusing and partly conflicting. As usual with vertical restraints there are models that show that the use of RPM may be anti-competitive as it will raise prices, and others that claim that the use of RPM may be efficiency enhancing because it fosters value creating retail services.

In the economic literature both the anti-competitive and the efficiency arguments for RPM have been analysed, and basically within two broad classes of models. There are some models assume that contracts offered by manufacturers to its retailers are public (e.g. Innes and Hamilton, 2009; Gabrielsen and Johansen, 2013; Rey and Vergé, 2010; Mathewson and Winter, 1984) and other were retail contracts are secret (e.g. O'Brien and Shaffer, 1992; Rey and Vergé, 2004; Montez, 2012). In addition, the models developed in the economic literature differ with respect to the importance of retail sales effort for consumer demand and to the extent that there are externalities between retailers in effort provision.

The tension between different views on RPM can be illustrated by O'Brien and Shaffer (1992) (OS) and Mathewson and Winter (1984) (MW). OS show that RPM may be used by an upstream monopolist to remonopolize the market by allowing the monopolist to escape from an opportunism problem[2] arising from secret contracting with competing downstream retailers. Absent RPM the manufacturer is unable to avoid the temptation to offer each individual retailer a sweetheart deal in order to free-ride on the margins of competing retailers, and ends up losing all his market power. The solution proposed by OS is to offer each retailer a maximum resale price and then squeeze retail margins with a high wholesale price. This will eliminate retail margins, and thereby also the incentive

[1] See *Dr. Miles Medical Co. v. John D. Park and Sons,* 220 U.S. 373 (1911) and *Leegin Creative Leather Products, Inc. v. PSKS, Inc.* Slip Op. no. 06-480.

[2] The term is due to Williamson (1975), and many examples of the problem arise in industrial organization.

for opportunism, and allow the manufacturer to achieve the vertically integrated prices and profit in the market. The results from OS challenge current competition policy as maximum RPM is considered unproblematic everywhere. MS on the other hand, formalize the classic Telser-argument (Telser, 1960) saying that RPM may be efficiency enhancing. In a model with observable contracts MS show that RPM may be efficiency enhancing because it may solve vertical externalities when there are spillovers between retailers from retail sales effort.

Both arguments are convincing and intuitive given the setting in which they are developed. OS have secret contracts and no importance of retail sales effort, and MW have public contracts but where retail sales effort matter. The contradicting effects of RPM calls for more unified approach. We think that retail sales effort is of importance in every market. It might be that sales effort is of lesser or bigger importance depending of the product in question, but we think it is really hard to come by an example where retail sales effort is of no importance at all. We also think that in real life markets contracts offered to retailers are basically secret (Katz, 1991).

We therefore propose a model with secret contracts (where opportunism is an issue) and where retail sales effort is at least of some importance. This model allows us to disentangle the arguments and effects of RPM proposed by OS and MS. Specifically, we do this by introducing retail sales effort with spillovers in the framework of OS (or unobservable contracts in the framework of MW). By doing this, new insights emerge.

We show that RPM works dramatically different in our model than in OS and MW. In fact we show that the RPM mechanisms and effects proposed by both OS and MW totally evaporate once demand depends to any extent of retail sales effort and contracts are secret. We show that purely bilateral price restrictions (as in OS and MW), irrespective of type, have no effect whatsoever on the equilibrium outcome. The monopolist manufacturer will sell at marginal cost, and the equilibrium outcome at the retail level involves Bertrand prices and effort levels as opposed to monopoly prices in OS and monopoly effort levels in MW. Importantly, this result holds irrespective of the importance of retailers' effort as long as it is positive, and irrespective of the type of spillovers in effort. Hence, short of any 'horizontal' agreement that restrict the manufacturer's contracts with rival retailers, there exists no vertical own-sale contracts or (combination of) own-sale restraints that can solve the opportunism problem and provide prices and retail effort above the Bertrand level. With secret contracts, retail sales effort and purely bilateral RPM, irrespective of type, there is *no* anti-competitive effect and *no* efficiency effect.

Our next result is that industry-wide RPM, i.e. the practice that a manufacturer commits to a common RPM to all its retailers, may mitigate both problems. We show that with industry-wide RPM, equilibrium retail prices and effort levels can be lifted above the Betrand level. Importantly, to elicit a price increase and to induce retail effort, the price restraint will here have to be introduced as a minimum price (as in MW), not as a maximum price as in OS. However, we show that the manufacturer is generally not able to realize the vertically integrated outcome except in one very special case. This case is when there are no spillovers from sales effort at the retail level.

More generally, industry-wide RPM will have one negative effect - it increases retail prices - and one positive - it may spur retail sales effort. The question then is what is the net effect from this on consumers' surplus. To evaluate the effect on consumers surplus from RPM we use a specific utility function to produce our third result. We show that, even if consumers value sales effort, and even if there is freeriding among retailers, the consumers are hurt by a industry-wide price floor. Hence, the policy implication from our analysis is that we find no support for the harsh treatment of *bilateral* price restraints that we see in for instance the EU. Our analysis do however show that when manufacturers may commit to *industry-wide* RPM, this may be more problematic.

The rest of the papers is organized as follows. The next section briefly reviews the literature related to the opportunism problem under secret contracting and RPM. Then, in Section 3 we present our model, our basic assumptions and our benchmark. Section 4 contains the analysis and presents our main results assuming individual RPM contracts, and in Section 5 we derive our results with industry-wide RPM contracts. Section 6 concludes.

2 The opportunism problem

The opportunism problem underlying OS is arising when a manufacturer contracts secretly with downstream retailers and has been recognized in the literature for a long time. An upstream manufacturer with market power has an interest of restricting supply to its retailers to preserve its market power which in turn can be shared with the retailers. However, due to secret contracts when contracting with each retailer, the manufacturer has an incentive to free-ride on the margins earned by his other retailers. This incentive has been shown and analyzed by several authors in different settings[3]. In general, the problem prevents a manufacturer with market power upstream from realizing its market power when selling to downstream retailers. The flavour of the problem is similar to the

[3] Hart and Tirole (1990) with downstream Cournot competition, O'Brien and Shaffer (1992) with Bertrand competition and also by McAfee and Schwartz (1994) and Marx and Shaffer (2004).

durable good monopolist; the monopolist can not avoid reducing his price.

There are evidence suggesting that the problem is perceived as real by retailers. For instance, in a recent EU merger case concerning Unilever and a smaller upstream competitor, the the EU competition authority, DG-Comp, presented evidence where retailers expressed explicit concerns for the opportunism problem. As usual in merger cases in upstream markets, the fear was that the merger would allow the merged entity to increase its prices to retailers. The EU-commission found evidence indicating that retailers across the concerned EU member states "would accept (input)price increases if applied generally in the market" and Unilever presented evidence where "retailers expressed doubts on how they can be sure that Unilever indeed would uniformly increase prices across all customers", indicating the awareness of the opportunism problem among retailers.[4]

The essence of the problem can be illustrated with downstream price competition. In this case, when negotiating with each retailer, the manufacturer and each retailer are maximizing their bilateral profits, and thus ignores quasi-rents earned by the other retailers. This induces each retailer and the manufacturer to free-ride on these rents, and in equilibrium they end up setting transfer prices at the manufacturer's marginal cost. There has been several proposals in the literature suggesting how the manufacturer may circumvent the problem. Hart and Tirole (1990) argue that vertical integration may be a way to remonopolize the market. If an upstream monopolistic firm can vertically integrate with one of several homogeneous retailers, he will have no incentive to supply the unintegrated retailers and the manufacturer can restore the monopoly outcome. Also, as noted by Hart and Tirole (1990) and Rey and Tirole (2006) signing an exclusive dealing contract with one retailer may also solve the problem. However, if retailers serve partially overlapping markets there will be a loss of potential profit from selling though a single retailer in the downstream market. In these cases vertical integration and exclusive contracts will generally not be enough to fully solve the problem. As noted above, OS proposed an efficient solution for the manufacturer.

The result that maximum RPM can eliminate opportunism has later been confirmed also by Rey and Vergé (2004) and Montez (2012), but in different settings. Montez (2012) shows that a monopolist producer may eliminate opportunism by using buybacks and (sometimes) a price ceiling. In a similar setting as OS, Rey and Vergé (2004) show that equilibria with wary beliefs (as opposed to passive beliefs as in OS exist and reflect opportunism, and that a maximum RPM with a price squeeze will eliminate the scope for opportunism also in this case. In sum, these papers suggest that a maximum price may

[4]See case M.5658 UNILEVER / SARA LEE BODY CARE (2010), #216 and 219.

be detrimental to consumers because it eliminates the scope for opportunism. We now deveop our model.

3 The model

We follow OS and consider the classic setup for the opportunism problem with downstream price competition. We have a vertically related industry with an upstream monopolist, M, who produces an intermediate good which he sells to two downstream differentiated retailers, R_1 and R_2, using unobservable non-linear contracts. The two retailers transform the manufacturer's good on a one-to-one basis into two symmetrically differentiated final goods, and sell them to consumers.

In contrast to OS, but as in MW, retailers may excert sales effort that enhances demand. We denote retailer R_i's demand by $D_i(\mathbf{e}, \mathbf{p})$, where $\mathbf{e} = (e_1, e_2)$ denotes the vector of the retailers' sales effort, and $\mathbf{p} = (p_1, p_2)$ denotes the vector of retail prices. We will assume that retail demands are symmetric, and for all $D_i(.) > 0$, demand is assumed to be downward sloping in the own-price p_i and increasing in own-effort e_i, with $\partial_{e_i} D_i > 0$ and $\partial_{e_i e_i} D_i \leq 0$.[5] For some of our results, we will invoke the following set of assumptions about the retailers' demand (assuming both D_i and D_j are positive):

A1. *All else equal, a uniform increase in p_1 and p_2 causes D_i to fall, which implies that $\partial_{p_i} D_i + \partial_{p_j} D_i < 0$*
A2. *All else equal, a uniform increase in e_1 and e_2 causes D_i to rise, which implies that $\partial_{e_i} D_i + \partial_{e_j} D_i > 0$*
A3. *All else equal, a marginal increase in p_i causes total demand to fall, $\partial_{p_i} D_i + \partial_{p_i} D_j < 0$*
A4. *All else equal, a marginal increase in e_i causes total demand to rise, $\partial_{e_i} D_i + \partial_{e_i} D_j > 0$*

For any p_j, we also assume that there is a choke-price, $p_i = \overline{p}(p_j)$, implicitly defined by $D_i(p_i, p_j) = 0$, above which demand for good i is zero. Because the retailers are substitutes, we have that $\overline{p}'(p_j) > 0$.

We make no specific assumption about the effect of R_i's effort on the rival's demand, $\partial_{e_i} D_j$. Hence, we allow for both positive, negative and no spillovers in retail effort. We denote the retailer's effort cost by $C_i = C(e_i)$, which is assumed to be twice continuously differentiable, with $C_i'(e_i) > 0$ and $C_i''(e_i) > 0$ $\forall e_i > 0$, and it is assumed to satisfy the Inada conditions at 0 and ∞. We will denote R_i's average effort cost by $\mu_i = \mu(e_i) :=$

[5] We will sometimes denote by $\partial_{x_i} f$ the parital derivative of f with respect to x_i, $\partial_{x_i x_i} f$ the second partial derivative, $\partial_{x_i x_j} f = \partial^2 f / \partial x_i \partial x_j$ the cross-partial derivative, and so on.

C_i/D_i. All other retailing costs are assumed to be zero. We assume throughout the analysis that a retailer's sales effort is non-verifiable and hence also non-contractable.

We consider the following simple two-stage game played between the manufacturer and the two retailers: At stage 1 (the contracting stage), the manufacturer makes take-it-or-leave-it contract offers T_1 and T_2 simultaneously and secretly to each retailer, which the retailers subsequently either accept or reject. A retailer never observes his rival's contract terms. At stage two (the competition stage), accepted contracts are implemented and retailers compete by simultaneously choosing their prices and effort levels.

A contract $T_i(.)$ can take various (non-linear) forms. We will consider three classes of contracts used by M at the contracting stage:

1. Simple two-part tariffs, of the form $T_i(D_i) = F_i + w_i D_i$, where F_i is a fixed fee and w_i is a per-unit transfer price. We will denote these contracts by (F_i, w_i).

2. 'General own-sale contracts'. A (non-linear) contract T_i between M and R_i is called an own-sale contract if it *does not* put restrictions on M's trade relationship (contract) with retailer R_j.

   Own-sale contracts can in general include any restriction or requirement for the quantity resold by R_i, and any restriction or requirement for the price that R_i is allowed to charge in the downstream market. I.e., own-sale contracts can put restrictions on the buyer's actions in the downstream market but do not put restrictions on the seller's actions vis-a-vis other retailers in the upstream market.

   Examples of restrictions that can be included in own-sale contracts are individual price floors or ceilings, restrictions on the customers/ geographic area that the retailer is allowed to sell to; restrictions or requirements for the quantity bought or resold (quantity or sales forcing), retroactive discounts, market-share discounts, etc.

3. 'Horizontal contracts'. A (non-linear) contract between M and R_i is called a horizontal contract if it puts restrictions on M's trade relationship (contract) with the rival retailer R_j.

   Examples of this are industry-wide vertical price fixing; any commitments from M to sell exclusively to R_i; agreements that give R_i exclusive rights to a specific set of consumers or over a specific geographic area, non-discrimination clauses, etc. All of these provisions put restrictions on the contract that M can legally offer to R_j. In Section 5 we will consider industry-wide vertical price restraints.

We let M's profit be given $\pi_M = \sum_{i=1}^{2} (T_i - cD_i)$, and let R_i's profit be given by $\pi_i = (p_i - \mu_i) D_i - T_i$.

To stick as close as possible to OS' original analysis, we will employ the "contract equilibrium" concept formalized by Cremér and Riordan (1987).

Definition 1. *Let* $\mathbf{A}$ *be the set of allowable contracts and* $\mathbf{s} = (s_i)$ be the vector of retailers strategies in the downstream market. *A contract equilibrium with unobservable contracts is then a vector of supply contracts* $\mathbf{T}^* \in \mathbf{A}$*, and Nash equilibrium* $\mathbf{s}^*$ *induced by these contracts, such that* $\forall i$ *and* $\forall T_i \in \mathbf{A}$*,* T_i^* *is the contract that maximizes the bilateral joint profit of* M *and* R_i*, taking* $\left(T_j^*, s_j^*\right)$ *as given. Formally,* $\mathbf{T}^* \in \mathbf{A}$ *constitutes a contract equilibrium iff*

$$\pi_M\left(\mathbf{T}^*, \mathbf{s}^*\right) + \pi_i\left(\mathbf{T}^*, \mathbf{s}^*\right) \geq \pi_M\left(T_i', s_i', T_j^*, s_j^*\right) + \pi_i\left(T_i', s_i', T_j^*, s_j^*\right),$$

$\forall i$ and $\forall T_i' \in \mathbf{A}$, and where, the contract T_i' induces the strategy s_i' by R_i at the final stage, given $\left(T_j^*, s_j^*\right)$.

This equilibrium concept is very simple and tractable. It says that in a contract equilibrium, there is no room for a retailer-manufacturer pair $M - R_i$ to revise their contract and increase their bilateral joint profit, holding fixed M's contract with R_j, and holding fixed R_j's choice of effort and price. A contract equilibrium's defining characteristic is therefore that it survives bilateral deviations, i.e. where a pair $M - R_i$ decides to secretly renegotiate their contract terms.[6] Note that, with restrictions on the set of allowable contracts, there may exist a contract outside the set, $T_i' \notin \mathbf{A}$, that, if T_i' could be enforced by a court, would allow $M - R_i$ to increase their bilateral joint profits.

3.1 Two benchmarks

Under our assumptions on the demand, when marginal transfer prices are constant and equal to M's marginal cost c, the final-stage Bertrand game has a unique equilibrium where both retailers exert the same effort and set the same prices, characterized by

$$\left\{p^B, e^B\right\} = \arg\max_{p_i, e_i} \left(p_i - c - \mu_i\right) D_i\left(e_i, e^B, p_i, p^B\right) \tag{1}$$

[6] As noted by Rey and Vergé (2004), however, a weakness with contract equilibria is that they do not always survive multilateral deviations, where the manufacturer revises his offers and deviates (secretly) with both retailers simultaneously. Hence, a contract equilibrium does not always constitute a perfect Bayesian equilibrium (with passive beliefs). To avoid the latter, one could imagine a contracting game where the manufacturer uses a pair of agents that simulatenously and independently negotiates contracts with the retailers on the manufacturer's behalf. This would rule out multilateral deviations per construction.

In the following we will refer to $\{p^B, e^B\}$ as the 'standard Bertrand levels of price and effort'. We denote respectively by $D^B := D_i\left(e^B, e^B, p^B, p^B\right)$ and $\pi^B = \left(p^B - c - \mu\left(e^B\right)\right) D^B$ the quantity sold and the profit earned (gross of any fixed transfers) by each retailer in this standard Bertrand equilibrium.

Next, we characterize the outcome when the industry is fully integrated (both vertically and horizontally). The overall industry profit can be written

$$\Pi = \sum_{i=1}^{N=2} (p_i - c - \mu_i) D_i \tag{2}$$

The integrated monopolist's first-order conditions for the retail price and sales effort, can be written as

$$\partial_{p_i}\Pi = \sum_{k=1}^{N=2} (p_k - c)\, \partial_{p_i} D_k + D_i = 0,\ i = 1, 2 \tag{3}$$

and

$$\partial_{e_i}\Pi = \sum_{k=1}^{N=2} (p_k - c)\, \partial_{e_i} D_k - C_i' = 0,\ i = 1, 2 \tag{4}$$

We let $p_1 = p_2 = p^I$ and $e_1 = e_2 = e^I$ denote the prices and effort levels respectively that simultaneously solves the monopolist's first order conditions, and denote by $\Pi^I > 2\pi^B$ the resulting integrated profit. We will refer to $\left\{p^I, e^I\right\}$ as the integrated/collusive/monopoly levels of prices and effort.

4 Analysis and main results

In this section the aim is to analyze the equilibrium outcome when the manufacturer may use general non-linear own-sale contracts and RPM. We start off this section by quickly veryfying that the opportunism problem exist also with demand enhancing effort in the demand function. Then we proceed by investigating the equilibrium outcome under the OS contract assumptions, i.e. allowing general non-linear contracts and RPM. We then expand the set of allowable contracts by investigating any type of 'own-sale' contracts (as defined above). We show that there is no contract of this type that is able to mitigate the opportunism problem.

4.1 Two-part tariffs

For completeness, we first verify that the opportunism problem persists with two part tariffs and where the retailers exert some sales effort. Suppose M has offered a contract $\left(w_j^*, F_j^*\right)$ to R_j, and that this contract induces price and effort $\left(p_j^*, e_j^*\right)$ by R_j at the final stage. Given this, we can write the retailers' profit as

$$\pi_i = \left(p_i - w_i - \mu_i\right) D_i\left(e_i, e_j^*, p_i, p_j^*\right) - F_i,\ i = 1,2 \tag{5}$$

which yields the first-order conditions

$$\left(p_i - w_i\right) \partial_{p_i} D_i + D_i = 0,\ i = 1,2 \tag{6}$$

and

$$\left(p_i - w_i\right) \partial_{e_i} D_i - C_i' = 0,\ i = 1,2 \tag{7}$$

Then we can show the following result.

Lemma 1. *(Two-part tariffs) There exist a unique contract equilibrium where the marginal wholesale prices* $\left(w_1^*, w_2^*\right)$ *are the same and equal to* M*'s marginal production cost* c*.*

Proof: see the appendix.

Lemma 1 confirms the unsurprising result that the opportunism problem that arises with unobservable contracting persists also when the retailers also exert some sales effort downstream.

4.2 General own-sale contracts and RPM

We now turn to the situation where M is allowed to use RPM together with more general non-linear contracts. In fact, we allow the manufacturer to impose any restrictions on the retailer's own-sales. Before we move on, we state the following Lemma, which we have adopted from OS' original paper and generalized to a setting that allows for retailers' sales effort

Lemma 2. *If* $(\mathbf{T}^*, \mathbf{s}^*)$ *forms a contract equilibrium with general own-sale contracts (and RPM), then* $\forall j$, T_j^* *is continuous and differentiable at the quantity* D_j^* *induced by* $(\mathbf{T}^*, \mathbf{p}^*)$. *If the contracts entail a commitment to industry-wide price fixing, then the same result holds, as long as there are spillovers in retailers' sales effort.*

Proof. See the Appendix.

Lemma 2 greatly simplifies the rest of the analysis, and the intuition for the result is straightforward: First, notice that if $T_j^*(D_j)$ was not continuous at $D_j = D_j^*$, then either a marginal reduction or a marginal increase in D_j would cause the payment from R_j to M to either jump up or down. This means that either the pair $M - R_i$ could increase their bilateral joint profit by inducing a marginal change in p_i (or, with spillovers in effort, by inducing a marginal change in e_i) that would cause T_j^* to jump up, or R_j could increase his profit through marginal changes in either p_j or e_j that would cause T_j^* to jump down. For this reason, T_j^* has to be continuous at the equilibrium quantity D_j^*. From this it just remains to show that $T_j^*(D_j)$ also is differentiable at $D_j = D_j^*$, which is shown in the Appendix.

Next, notice that Lemma 2 has implications for what types of vertical restraints M can impose on its retailers in equilibrium. For example, any "sales-forcing" contracts, or contracts that seek to force the retailer to reach a certain market share threshold, would be ineffectual. The reason is simply that these tariffs (per definition) would have to jump when deviating slightly from the "forcing" quantity or market-share. Retroactive discounts would be ineffectual for exactly the same reason.

When proceeding the analysis, we first show that it is impossible for the manufacturer to induce the integrated profit Π^I when using general own-sale contracts and RPM.

Lemma 3. *(General own-sale contracts) In equilibrium, it is not possible for the manufacturer to induce the integrated profit* Π^I.

Proof: See the appendix.

The intuition for this result is as follows. To overcome the opportunism problem, the manufacturer has to take into account R_j's quasi-rents when making his contract offer to R_i, and vice versa. As suggested by OS, one way to do this is to eliminate the retailers' quasi-rents completely. For example, by fixing the retail prices and then squeezing the retailers' mark-ups through high marginal transfer prices. However, to induce the retailers to exert some effort, the retailers have to earn strictly positive quasi-rents on the margin, to cover their marginal effort cost. Because it is not possible for the manufacturer to achieve both simultaneously, the integrated outcome is unattainable.

We now show our first main result, namely that general own-sale contracts and RPM in fact yield the Bertrand level of prices and effort .

Proposition 1. *(General own-sale contracts) In all contract equilibria we have that i) the marginal transfer prices are the same for each retailer and equal to the manufacturer's marginal cost c, ii) retail prices are equal to* p^B*, and iii) each retailer's sales effort is equal to* e^B*.*

Proof: See the appendix.

Proposition 1 shows that when there is just a small effect of retailer sales effort on demand, the manufacturer's opportunism problem is restored with full force, and the RPM equilibrium introduced by OS breaks down. The intuition for this is the following: To overcome the temptation to offer the retailers sweetheart deals, that would allow a retailer to charge a lower price at its rival's expense, the manufacturer can impose a price ceiling equal to p^I and then squeeze the retailers' sales margins by charging high marginal transfer prices, $T_i^{*\prime} \to p^I$, $i = 1, 2$. However, this cannot arise in any contract equilibrium if retailers also can exert some sales effort that would influence demand. The reason is that, given that the retailers' mark-ups are squeezed, the manufacturer can profitably deviate with either retailer and charge it a slightly lower marginal transfer price. The reason is that this would induce the retailer to make (more) sales effort at the last stage of the game. This means that a strategy of squeezing the retailers' margins cannot arise in any contract equilibrium, and that each retailer has to earn strictly positive quasi-rents. This opens the door for opportunism again, and to such an extent that the outcome involves Bertrand prices and effort levels. The intuition for this is exacly the same as for opportunism without retailer sales effort; a positive margin drives the equilibrium all the way down to Bertrand. Note also that Proposition 1 implies that also the equilibrium proposed by MW breaks down once contracts are secret.

From Lemma 1 we also know that it does not work to combine RPM with any other own-sale restrictions or tariff schemes, such as restrictions on the retailer's customer base, sales forcing, market-share contracts, retroactive discounts, etc. A striking feature of the result in Proposition 1 is that the smallest effect of retail service on consumer demand shifts the equilibrium outcome from one extreme to the other, i.e. from the vertically integrated outcome as in OS, to the Bertrand outcome. This is surprising, as one might have expected that by introducing some effect of sales effort one would end up somewhere between the vertically integrated outcome and Bertrand.

In the next section we check the robustness of the result in Proposition 1. We do so by allowing the manufacturer to impose industry-wide RPM (i.e to commit to the same RPM clause to both retailers in our setting).

5 Horizontal contracts

Intuitively, the reason why general own-sale contracts cannot be used to curtail opportunism and induce higher prices, is that these contracts do not restrict the type of offers the manufacturer can (legally) make to rival retailers. Hence, imposing individual price ceilings and then squeezing the retailers' margins, for example, does not work because the manufacturer is allowed to secretly offer one of the retailers a lower marginal transfer price – which in turn would induce that retailer to make some sales effort downstream and increase her joint profit with the manufacturer. In turn this deviation provides an incentive to deviate on the resale prices as well, and the opportunism problem reappears.

Horizontal restraints, such as industry-wide RPM, on the other hand, may work, because these contracts (by definition) restricts the set of contracts that the manufacturer can establish with rival retailers. We now analyze whether a commitment to industry-wide RPM may help the manufacturer fully restore the first-best outcome.

5.1 Industry-wide price fixing

Industry-wide vertical price fixing describes a situation where the manufacturer is able to commit to adopting a common resale price throughout the downstream market. We can model this by incorporating a stage prior to the contracting stage, where the manufacturer commits publicly to an industry-wide resale price to be imposed on both of its retailers, before negotiating transfer prices privately and secretly with each retailer at stage 2.[7]

Definition 2. *Let p^S and $e^S := e^*\left(p^S\right)$ be the industry-wide resale price and the effort level induced by this price respectively, where*

$$e^*(p) := \arg\max_{e_i} [p - c - \mu_i] D_i (e_i, e^*(p), p, p)$$

[7] This resembles the set-up in Dobson and Waterson (2007), who analyze the use of observable *linear* tariffs and industry-wide RPM in a bilateral oligopoly setting.

and

$$p^S = \arg\max_p \left[p - c - \mu\left(e^*\left(p\right)\right)\right] \sum_i D_i\left(e^*\left(p\right), e^*\left(p\right), p, p\right).$$

Finally, Π^S *represent the resulting industry profit, where*

$$\Pi^S := \left(p^S - c - \mu\left(e^S\right)\right) \sum_i D_i\left(e^S, e^S, p^S, p^S\right)$$

We now show that the use of industry-wide price fixing may allow the manufacturer to induce the integrated profit Π^I, but only as long as there are no spillovers in sales effort. First we show that in all contract equilibria the marginal transfer prices are at manufacturer marginal cost.

Lemma 4. *(Industry-wide RPM) In all contract equilibria the marginal transfer prices are the same for each retailer and equal to the manufacturer's marginal cost* c.

Proof: See the appendix

With an industry-wide resale price equal to p set by the manufacturer at the first stage of the game, the unique Nash equilibrium at the final stage therefore has each retailer exerting sales effort equal to $e^*\left(p\right)$ (Definition 2). The manufacturer's optimal industry-wide resale price in this game is therefore characterized by

$$p^* = \arg\max_p \left[p - c - \mu\left(e^*\left(p\right)\right)\right] \sum_i D_i\left(e^*\left(p\right), e^*\left(p\right), p, p\right) \tag{8}$$

We then have the following result.

Proposition 2. *(Industry-wide RPM) If the manufacturer can commit to an industry-wide resale price he is able to induce the profit* $\Pi^S \leq \Pi^I$ *as defined in Definition 2.* $\Pi^S = \Pi^I$ *if and only if there are no spillovers in equilibrium, and* $\Pi^S < \Pi^I$ *otherwise. To induce a price increase, the price restraint will have to be a fixed price or a price floor.*

Proof: See the appendix.

The intuition is as follows. Each retailer will only take into account the effect of its sales effort on its own demand. Hence, when facing a marginal transfer price equal to the true marginal cost of the manufacturer, and the manufacturer fixes the retail price at the integrated level p^I, each retailer will provide too little service with positive spillovers and too much service when spillovers are negative. Hence, $p^S = p^I$ and $e^S = e^I$ cannot both hold when there are spillovers in effort.

Without spillovers in sales effort, on the other hand, allowing for industry-wide RPM fully restores the manufacturer's ability to induce the integrated outcome: The manufacturer can then commit to the integrated price p^I at the first stage of the game, and marginal transfer prices equal to c – which characterizes the unique equilibrium at the contracting stage – and this is sufficient to induce each retailer to exert the integrated level of sales effort e^I at the final stage.

Note also that $\Pi^S \geq 2\pi^B$ has to hold, because the manufacturer could always replicate the outcome $2\pi^B$ by committing to the standard Bertrand price p^B at the first stage. Moreover, we may also note that to elicit a price increase relative to the Betrand outcome, the industry-wide resale price would have to be introduced either as a fixed price or as a price floor – it cannot be a price ceiling as in OS. The reason is that all contract equilibria are again characterized by marginal cost pricing for the manufacturer's product. Hence, a minimum or fixed price $\underline{p} > p^B$ is needed to prevent retailers from charging the standard Bertrand price at the final stage. Therefore, according to our analysis, minimum or fixed RPM may be harmful in some cases – especially when the effect of sales effort is relatively small and insignificant – whereas maximum RPM is never harmful in this case.

To provide a sense for the potential welfare implications of allowing for an industry-wide price floor in our setting, we will evaluate consumers' welfare using a commonly used representative utility function[8].

$$U = Y + v\sum_{i=1}^{2} q_i - \frac{1}{1+\gamma}\left\{\frac{1}{2}\sum_{i=1}^{2}\left(2q_i - A_i\right)q_i + \frac{\gamma}{2}\left(\sum_{i=1}^{2} q_i\right)^2\right\} \tag{9}$$

where

$$A_i = \left(2 + \gamma\left(1+\alpha\right)\right)e_i + \left(2\alpha + \gamma\left(1+\alpha\right)\right)e_j,\ \ i \neq j \in \{1,2\}$$

and $\alpha \in [0,1]$ is a measure for spillovers in effort provision. I.e., we consider here positive spillovers only, but of a varying degree. Y is consumers' income, q_i is the quantity purchased by the consumer from retailer $i \in \{1,2\}$, and $\gamma \in [0,\infty)$ is a measure for the substitutability between retailers. Note that when $e_1 = e_2 = 0$, U yields Shubik-Levitan (1980) demand functions. Finally, we assume that the retailers' effort cost is given by $C_i = \theta e_i^2/2$, $i = 1,2$, where $\theta > 1$.

By comparing the representative consumer's net utility when retailers set the standard Bertrand prices and effort levels $\left(p^B, e^B\right)$, with the consumer's net utility under industry-wide RPM and effort levels $\left(p^S, e^S\right)$, we get the following result.

[8] See for instance Motta (2004, pp 326-331).

Proposition 3. *Given the utility function U, consumer surplus always falls when we allow the manufacturer to commit to an industry-wide price floor.*

Proof: See the appendix.

This result is potentially important, because it challenges the claim that – in a setting where retailers freeride on each other's service provisions – price floors create efficiencies that ultimately benefit the end consumers. This claim is based on the earlier literature that investigates the manufacturer's rationale for using vertical restraints (e.g., RPM) in a game with perfect information (e.g. Mathewson and Winter, 1984). The crucial assumption that differentiates the results in this literature from ours, is the assumption that the manufacturer can commit to a set of public contracts. In MW the manufacturer inflates retail margins by subsidizing the retailers with wholesale price below the manufacturer's marginal cost. This will spur the retailers to provide retail sales effort. However, with unobservable contracts, the opportunism problem locks the marginal wholesale prices to marginal costs, and instead the manufacturer inflates the margins by increasing the minimum resale price. In fact here the price is raised to such an extent that retail prices are set *above* the monopoly price for a given level of effort.

Motta (2004) use this utility function, but in model with observable contracts. In his book Motta shows that price floors in that case always increase both consumer and overall welfare. On the other hand, our proposition states that if the manufacturer can commit to a common price floor for both retailers, and that retailers otherwise do not have information about rivals' contract terms, the result in Motta is turned around; consumers then always lose when we allow the manufacturer to commit to a set of minimum prices. However, on an intuitive level the welfare implications for consumers may depend on how demand reacts to retailers' effort. It might be that if effort is critical for generating consumer demand (unlike the utility function specified above), then we should be open to that consumers' surplus *may* increase with public price floors. That could for instance be the case if very little retail effort would be provided without the publicly observable price restraint (i.e., when competition is very fierce).

To sum up, the analysis above shows that in a setting where retailers provide valuable services, consumers will lose when we allow for a publicly imposed price floor, given that the retailers' contract terms are otherwise unobservable.

6 Conclusion

The received literature on the use of resale price restraints has produced results that show that RPM may be anti-competitive and lead to increased prices to consumers, but also that RPM may be beneficial because it may induce more retail sales effort. These results have been derived either in models with secret contracts and no retail sales effort, or with public contracts and where retail sales effort are important. In most real life markets we have argued that retail sales effort are at least of some importance, and also that contracts in most cases are secret. In this paper we have proposed a unifying approach where both these central ingredients are present. This leads to new insights.

We have shown that purely bilateral price restraints, irrespective of type, have no implication whatsoever on the equilibrium outcome. Bilateral price restraints can not be used neither for anti-competitive, nor for efficiency purposes, e.g. to induce retail sales effort. In equilibrium the standard Bertrand prices and effort levels prevail. Next we have shown that if manufacturers can commit to industry-wide price floors, the manufacturer can obtain higher prices and effort levels, but he will generally not be able to achieve the first-best collusive outcome. Hence, the claim from Mathewson and Winter (1984) that minimum RPM is beneficial for effort provision has some merit, but it comes at the cost of increased retail prices. We show that that retail prices in fact will be higher than the monopoly prices for a given effort level, and in sum consumers' surplus is hurt.

The anticompetitive argument for RPM with secret contracts is based on the idea that a maximum RPM coupled with high marginal wholesale prices can solve the manufacturer's opportunism problem. On a general level, we have shown that the opportunism problem arising from contract unobservability in vertical relations may be significant harder to solve than has been recognized in the literature before. Specifically, the result that maximum RPM mitigates opportunism, as proposed by O'Brien and Shaffer (1992), breaks down once retail demand depends to any extent of service provided at the retail level. Since the basic problem stems from positive margins at the retail level, and the intrinsic temptation to free-ride on the margins, OS's solution simply was to eliminate these margins by using maximum RPM and high transfer prices. This is true if retail service has no impact whatsoever on retail demand. If retail sales effort only has a minimal effect on demand this equilibrium breaks down, as the manufacturer would wish to lower its transfer price to each retailer, inducing higher sales. Positive margins, in turn, completely reopens the door for opportunism again, and returns the outcome to Bertrand prices and effort levels. We have shown that when retail service has any positive impact on demand, and for any size and sign of spillovers from such activity, then there are no own-sale contracts that will solve the opportunism problem.

Our results confirm that, generally purely bilateral, vertical contracts cannot solve the manufacturer's opportunism problem. To fully restore the integrated outcome, the manufacturer's contract with one retailer would have to be (indirectly) contingent on the price set, and the quantity sold, by rival retailers, and vice versa. I.e., the contracts need to include a credible horizontal commitment from the manufacturer, and this may be difficult to implement in practice.

One solution that has been proposed in the literature, is for the manufacturer to condition each retailer's contract terms explicitly on the terms offered to rival retailers – e.g., through non-discrimination or most-favoured customer clauses (MFC). This requires the *actual* marginal wholesale terms of rival retailers to be verifiable in court. However, given the widespread practice in many industries of negotiating secret, "backroom" discounts that do not show up on the retailers' invoices, it is reasonable to assume that the actual wholesale terms are at least difficult to verify.

Other industry-wide practices, such as price fixing agreements, may be a more viable solution, e.g. when facilitated through industry trade agreements. The latter we have seen implemented in European book markets, e.g. in Spain, France and Germany. Yet, in general, even these types of horizontal agreements will not suffice to implement the first-best as long as the rest of the contract terms are individually negotiated. With differentiated retailers as in our model, it also follows that the integrated outcome cannot be achieved through exclusion of retailers.

As noted above, competition policy in many countries tends to be more hostile against minimum of fixed RPM than maximum RPM. In fact, in most jurisdictions maximum RPM is regarded as unproblematic. Several recent articles has challenged this view by showing that also maximum RPM may be detrimental to consumers (Montez, 2012; O'Brien and Shaffer, 1992; Rey and Vergé, 2004). They all suggest that maximum RPM may be detrimental to consumers because it is an instrument to solve the opportunism problem. An important policy implication from our analysis is that this suggestion is not very robust. If retail demand depends to any extent of retail sales effort, maximum RPM has no effect on the outcome. Another importnat policy implication is that bilateral vertical price restraints, irrespective of its type, are harmless for consumers. Industry-wide price floors on the other hand, are detrimental for consumers.

Appendix

Proof of Lemma 1

Let $p_i^*(w_i)$ and $e_i^*(w_i)$, $i = 1, 2$, be the price and effort levels that simultaneously solve (6) and (7), where $\partial_{w_i} p_i^* > 0$ and $\partial_{w_i} e_i^* < 0$, and $p_i^*\left(w_j^*\right) = p_j^*$ and $e_i^*\left(w_j^*\right) = e_j^*$ (due to symmetry). Let the joint profit of $M - R_i$, which we denote by V_{M-R_i}, as a function of R_i's contract terms, be

$$V_{M-R_i} = \left\{ \sum_{k=1}^{N=2} \left(p_k^* - c - \mu\left(e_k^*\right)\right) D_k^* \right\} - \left(p_j^* - w_j^* - \mu_j\left(e_j^*\right)\right) D_j^* + F_j^*,\ i \neq j \in 1, 2 \quad (10)$$

The first-order condition for maximizing (10) wrt. w_i, is

$$\begin{aligned} \partial_{w_i} V_{M-R_i} =& \partial_{w_i} p_i^* \left[D_i + \left(p_i^* - c\right) \partial_{p_i} D_i\right] + \partial_{w_i} e_i^* \left[\left(p_i^* - c\right) \partial_{e_i} D_i - C_i'\right] \\ &+ \left(w_j^* - c\right) \left(\partial_{w_i} p_i^* \partial_{p_i} D_j + \partial_{w_i} e_i^* \partial_{e_i} D_j\right) = 0,\ i \neq j \in 1, 2 \end{aligned} \quad (11)$$

Substituting (6) and (7) into (11), and simplifying, gives the following necessary conditions for $(\mathbf{F}^*, \mathbf{w}^*, \mathbf{p}^*, \mathbf{e}^*)$ to form a contract equilibrium:

$$\sum_{k=1}^{N=2} \left(w_k^* - c\right) \left\{ \partial_{w_i} p_i^* \partial_{p_i} D_k + \partial_{w_i} e_i^* \partial_{e_i} D_k \right\} = 0,\ i = 1, 2 \quad (12)$$

We can rewrite (12) using matrix notation as $(\mathbf{w}^* - \mathbf{c})\,\mathbf{D_d} = \mathbf{0}$, where $\mathbf{w}^* = (w_1^*, w_2^*)$, $\mathbf{c} = (c, c)$ and

$$\mathbf{D_d} = \begin{bmatrix} \partial_{w_1} p_1^* \partial_{p_1} D_1 + \partial_{w_1} e_1^* \partial_{e_1} D_1 & \partial_{w_1} p_1^* \partial_{p_1} D_2 + \partial_{w_1} e_1^* \partial_{e_1} D_2 \\ \partial_{w_2} p_2^* \partial_{p_2} D_1 + \partial_{w_2} e_2^* \partial_{e_2} D_1 & \partial_{w_2} p_2^* \partial_{p_2} D_2 + \partial_{w_2} e_2^* \partial_{e_2} D_2 \end{bmatrix} \quad (13)$$

Note that, if consumer demand is unaffected by retailers' effort, as is the setting in OS' original model, then $\mathbf{D_d}$ reduces to a 2-by-2 matrix of demand derivatives with respect to prices only. By assumptions A1-A4, $\mathbf{D_d}$ is always invertible. By assumptions A1-A2, contract equilibria with $w_1 = w_2 > c$ or $w_1 = w_2 < c$, do not exist. By assumptions A1-A4, the contract equilibrium with $w_1^* = w_2^* = c$ is unique.Q.E.D.

Proof of Lemma 2.

The following proof follows closely the proof in O'Brien and Shaffer (1992), which we have modified to encompass both retailers' sales effort and RPM.

The proof consists of three steps.

Step 1. For all $j \neq i \in \{1, 2\}$, $T_j^* (D_j)$ is continuous at the quantity induced by $\mathbf{T}^*$.

Proof. Let D_j^* be the quantity induced by $\mathbf{T}^*$, and suppose that $T_j^* (D_j)$ 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, because retailer j could then adjust his effort by a small amount and induce a discrete reduction in its payment. It cannot jump up, for then M and R_i could jointly adjust p_i and/ or e_i, and induce a discrete jump in their bilateral profits. Hence, T_j^* must be continuous at D_j^*. *Q.E.D.*

Step 2. The function $T_j^* (D_j)$ satisfy $T_{j+}^{*\prime} \geq T_{j-}^{*\prime}$, for all $j \neq i \in \{1, 2\}$, where $T_{j+}^{*\prime}$ and $T_{j-}^{*\prime}$ are the right-hand (+) and left-hand (-) partial derivatives of T_j^*, respectively, evaluated at D_j^*.

Proof. From step 1, we know that T_j^* has both a left-hand (-) and a right-hand (+) derivative at D_j^*. Retailer j's first-order conditions for optimal effort then requires that

$$\left(\partial_{e_j} \pi_j\right)_- = \partial_{e_j} D_j \left(p_j^* - T_{j-}^{*\prime}\right) - C' (e_j) \geq 0 \tag{A1}$$

and

$$\left(\partial_{e_j} \pi_j\right)_+ = \partial_{e_j} D_j \left(p_j^* - T_{j+}^{*\prime}\right) - C' (e_j) \leq 0 \tag{A2}$$

using the fact that $\partial_{e_j} D_j > 0$. Together, (A1) and (A2) yields $T_{j+}^{*\prime} \geq T_{j-}^{*\prime}$ as a necessary condition for retailer optimality. *Q.E.D.*

Step 3. The function $T_j^* (D_j)$ satisfies $T_{j-}^{*\prime} \geq T_{j+}^{*\prime}$ for all $j \neq i \in \{1, 2\}$, when evaluated at $D_j = D_j^*$.

Proof. In every contract equilibrium with general own-sale contracts and RPM, the M's contract with R_i per definition solves

$$\max_{p_i, e_i} \left\{ (p_i - c) D_i \left(e_i, p_i, e_j^*, p_j^*\right) + T_j^* - C (e_i) \right\} \tag{A3}$$

This yields the following first-order conditions for the price p_i:

$$(p_i - c) \partial_{p_i} D_i + D_i \geq -\partial_{p_i} D_j T_{j-}^{*\prime} \tag{A4}$$

and

$$(p_i - c) \partial_{p_i} D_i + D_i \leq -\partial_{p_i} D_j T_{j+}^{*\prime} \tag{A5}$$

using the fact that $\partial_{p_i} D_j > 0$. Together, (A4) and (A5) imply that $-\partial_{p_i} D_j T_{j-}^{*\prime} \leq -\partial_{p_i} D_j T_{j+}^{*\prime}$, or $T_{j-}^{*\prime} \geq T_{j+}^{*\prime}$ because $-\partial_{p_i} D_j < 0$. Together with step 1, this implies that $T_{j-}^{*\prime} = T_{j+}^{*\prime}$ for the contracts to be bilateral best responses with general own-sale contracts and RPM.

The rest of the proof considers the case where deviations on the price are not possible (i.e., the case of industry-wide price fixing). Note first that, even though M cannot deviate with R_i on the price p_i, as is the case with an industry-wide resale price p^*, M's contract with R_i still has to solve

$$\max_{e_i} \left\{ (p^* - c) D_i \left(e_i, p^*, e_j^*, p^* \right) + T_j^* - C(e_i) \right\} \tag{A6}$$

The case without spillovers is trivial and not important to our results. In the following we therefore consider only the cases with negative and positive spillovers, respectively.

With negative spillovers, the first-order conditions for (A6) are

$$(p^* - c) \partial_{e_i} D_i - C'(e_i) \geq -\partial_{e_i} D_j T_{j+}^{*\prime} \tag{A7}$$

and

$$(p^* - c) \partial_{e_i} D_i - C'(e_i) \leq -\partial_{e_i} D_j T_{j-}^{*\prime} \tag{A8}$$

Together, (A4) and (A5) yield the condition $-\partial_{e_i} D_j T_{j-}^{*\prime} \geq -\partial_{e_i} D_j T_{j+}^{*\prime}$, or $T_{j-}^{*\prime} \geq T_{j+}^{*\prime}$, because $-\partial_{e_i} D_j > 0$ in this case.

With positive spillovers, the first-order conditions for (A6) are

$$(p^* - c) \partial_{e_i} D_i - C'(e_i) \geq -\partial_{e_i} D_j T_{j-}^{*\prime} \tag{A9}$$

and

$$(p^* - c) \partial_{e_i} D_i - C'(e_i) \leq -\partial_{e_i} D_j T_{j+}^{*\prime} \tag{A10}$$

Together, (A9) and (A10) yield the condition $-\partial_{e_i} D_j T_{j+}^{*\prime} \geq -\partial_{e_i} D_j T_{j-}^{*\prime}$, or $T_{j-}^{*\prime} \geq T_{j+}^{*\prime}$, because $-\partial_{e_i} D_j < 0$ in this case. *Q.E.D.*

The proof is completed by noting that steps 2 and 3 together imply that $T_{j-}^{*\prime} = T_{j+}^{*\prime}$ when evaluated at $D_j = D_j^*$, both for the case with general own-sale contracts and RPM, and for the case with general non-linear contracts, industry-wide price fixing and spillovers in effort. Q.E.D.

Proof of Lemma 3.

Because the manufacturer can use RPM, he is free to use T_i to induce the right level of effort e_i. Hence, we can think of the pair $M-R_i$ as choosing both p_i and e_i directly at the contracting stage. In any contract equilibrium $(\mathbf{T}^*,\mathbf{s}^*)$, p_i^* and e_i^* must solve

$$\left\{\sum_{k=1}^{N=2}(p_k^*-c)\,\partial_{p_i}D_k+D_i^*\right\}-\partial_{p_i}D_j\left(p_j^*-T_j^{*\prime}\right)=0 \tag{14}$$

and

$$\left\{\sum_{k=1}^{N=2}(p_k^*-c)\,\partial_{e_i}D_k-C_i'\right\}-\partial_{e_i}D_j\left(p_j^*-T_j^{*\prime}\right)=0. \tag{15}$$

Note that the terms in the curly brackets are equal to zero when both $p_i^*=p_j^*=p^I$ and $e_i^*=e_j^*=e^I$. Hence, given that $p_j^*=p^I$ and $e_j^*=e^I$, for it to be optimal for the pair $M-R_i$ to induce $p_i^*=p^I$ and $e_i^*=e^I$, at the quantity D_j^* the marginal transfer price $T_j^{*\prime}$ would have to be equal to the integrated price, p^I. However, R_j's first-order condition for optimal sales effort at the final stage is $\left(p_j^*-T_j^{*\prime}\right)\partial_{e_i}D_j-C_j'=0$. At $T_j^{*\prime}=p^I$, R_j's profit on the last unit sold when exerting sales effort $e_j=e^I>0$, is negative. Hence, $p_i^*=p_j^*=p^I$ and $e_i^*=e_j^*=e^I$ cannot both hold in equilibrium. Q.E.D.

Proof of Proposition 1.

Note that first-order maximizing condition for R_i at the final stage is $(p_i^*-T_i^{*\prime})\,\partial_{e_i}D_i-C_i'=0$. Substituting this into (15) from the proof of Lemma 3, and simplifying, yields the following necessary conditions for $(\mathbf{T}^*,\mathbf{s}^*)$ to form a contract equilibrium:

$$\left\{\sum_{k=1}^{N=2}(p_k^*-c)\,\partial_{p_i}D_k+D_i^*\right\}-\partial_{p_i}D_j\left(p_j^*-T_j^{*\prime}\right)=0,\ i=1,2 \tag{16}$$

and

$$\sum_{k=1}^{N=2}(T_k^{*\prime}-c)\,\partial_{e_i}D_k=0,\ i=1,2 \tag{17}$$

Condition (17) can be rewritten with matrix notation as $(\mathbf{T}'-\mathbf{c})\,\mathbf{D_e}=0$, where $\mathbf{T}'=(T_1^{*\prime},T_2^{*\prime})$ and $\mathbf{D_e}$ is the 2-by-2 matrix of demand derivatives with respect to retailer sales effort. By assumption A2, $\mathbf{D_e}$ is always invertible. Q.E.D

Proof of Lemma 4.

Note first that, in any contract equilibrium $(\mathbf{T}^*,\mathbf{s}^*)$ with industry-wide RPM, e_i^* would have to solve the condition

$$\left\{\sum_{k=1}^{N=2}(p^*-c)\,\partial_{e_i}D_k-C_i'\right\}-\partial_{e_i}D_j\left(p^*-T_j^{*\prime}\right)=0,\ i=1,2 \tag{18}$$

Substituting in retailer i's condition for optimal sales effort, $(p^* - T_i^{*\prime})\,\partial_{e_i} D_i - C_i' = 0$, we obtain the following necessary condition for $(\mathbf{T}^*, \mathbf{s}^*)$ to arise as a contract equilibrium:

$$\sum_{k=1}^{N=2} (T_k^{*\prime} - c)\,\partial_{e_i} D_k = 0,\ \ i = 1, 2 \tag{19}$$

which is identical to condition (17) above. Hence, in all contract equilibria, the marginal transfer prices are again equal to the manufacturer's marginal cost c. Importantly, this result is independent of the industry-wide resale price chosen by M at the first stage of the game. Q.E.D.

Proof of Proposition 2.

From Lemma 4 we have that the marginal transfer prices will be set equal to manufacturer marginal cost c. Suppose the industry-wide resale price is set to the integrated level p^I. Then the first-order condition for retailer i is

$$\left(p^I - c\right)\partial_{e_i} D_i - C_i' = 0$$

whereas for the integrated firm it would be

$$\sum_{k=1}^{N=2} \left(p^I - c\right)\partial_{e_i} D_k - C_i' = 0$$

These coincides if and only if $\partial_{e_i} D_j = 0$. Hence, $p^S = p^I$ and $e^S = e^I$ cannot both hold when there are spillovers in effort Q.E.D.

Proof Proposition 3.

U yields the following direct demands

$$q_i = D_i = \frac{1}{2}\left(v + e_i + \alpha e_j - (1+\gamma)\,p_i + \frac{\gamma}{2}\,(p_1 + p_2)\right)\ ,\ i = 1, 2$$

Without (industry-wide) RPM each retailer solves

$$\max_{p_i, e_i}\ (p_i - c)\,\frac{1}{2}\left(v + e_i + \alpha e_j - (1+\gamma)\,p_i + \frac{\gamma}{2}\,(p_1 + p_2)\right) - \frac{\theta\,(e_i)^2}{2}$$

yielding symmetric prices and effort levels

$$p_i^B = -\frac{2c\theta - c - c\alpha + 2v\theta + c\theta\gamma}{-4\theta + \alpha - \theta\gamma + 1},\ \ e_i^B = \frac{c - v}{-4\theta + \alpha - \theta\gamma + 1}$$

And plugging these back into the utility function U we get consumers' surplus under Bertrand levels of prices and effort levels, S_B

$$S_B = U_B - q_1 p_1 - q_2 p_2 = \frac{1}{2}\theta^2 (\gamma + 2)^2 \frac{(c-v)^2}{(\alpha - 4\theta - \theta\gamma + 1)^2}$$

With industry-wide RPM each retailer for a given p chooses e_i to solve

$$\max_{e_i} (p-c) \frac{1}{2} (v + e_i + \alpha e_j - (1+\gamma) p + \gamma p) - \frac{\theta (e_i)^2}{2}$$

which yelds

$$e_i(p) = \frac{(p-c)}{2\theta}, i = 1, 2$$

and plugging these into the expression for industry profit the manufacturer chooses p to maximize

$$\max_{p} \sum_i \left((p-c) \frac{1}{2} (v + e_i(p) + \alpha e_j(p) - (1+\gamma) p + \gamma p) - \frac{\theta (e_i(p))^2}{2} \right)$$

yielding p^S, e_i^S

$$p^S = \frac{c - 2c\theta + 2c\alpha - 2v\theta}{-4\theta + 2\alpha + 1}, e_i^S = \frac{v-c}{4\theta - 2\alpha - 1}, i = 1, 2$$

and plugging this back into the utility function U_1 we can derive consumers' surplus under industry-wide RPM: S_{RPM}

$$S_{RPM} = U_{RPM} - q_1 p_1 - q_2 p_2 = \frac{1}{2} (c-v)^2 \frac{(\alpha - 2\theta)^2}{(2\alpha - 4\theta + 1)^2}$$

Let $\Delta S = S_B - S_{RPM}$, and we have

$$\Delta S = \frac{\theta^2 (\gamma+2)^2 (c-v)^2}{2 (\alpha - 4\theta - \theta\gamma + 1)^2} - \frac{(c-v)^2 (\alpha - 2\theta)^2}{2 (2\alpha - 4\theta + 1)^2}$$

The difference is increasing in γ

$$\frac{\partial \Delta S}{\partial \gamma} = \theta^2 (\gamma + 2) (c-v)^2 \frac{\alpha - 2\theta + 1}{(\alpha - 4\theta - \theta\gamma + 1)^3} > 0$$

Hence, if $\Delta S > 0$ for $\gamma = 0$ it is always positive.

$$\begin{aligned}
\lim_{\gamma\to 0}\Delta S &= -\frac{1}{2}\alpha\left(\alpha-2\theta+1\right)\left(-4\theta+\alpha+16\theta^2+\alpha^2-10\theta\alpha\right)\frac{(c-v)^2}{\left(4\theta-2\alpha-1\right)^2\left(4\theta-\alpha-1\right)^2}\\
\lim_{\gamma\to 0}\Delta S &> 0 \Leftrightarrow \Psi(\alpha,\theta) = -4\theta+\alpha+16\theta^2+\alpha^2-10\theta\alpha > 0
\end{aligned}$$

we have that $\frac{\partial\Psi(\alpha,\theta)}{\partial\alpha} = 2\alpha-10\theta+1 < 0$, hence if $\Psi(1,\theta) > 0$, $\Psi(\alpha,\theta) < 0$ for all $\alpha \in [0,1]$. We have $\Psi(1,\theta) = 16\theta^2 - 14\theta + 2 > 0$ because $\theta > 1$, hence $\Delta S > 0$ always. Q.E.D.

References

Cremér, J. and Riordan, M.H. (1987). On governing multilateral transactions with bilateral contracts. RAND Journal of Economics, (18), 436-451.

Dobson, P. and Waterson, M. (2007). The competition effects of industry-wide vertical price fixing in bilateral oligopoly. International Journal of Industrial Organization (25), 935-962.

Gabrielsen, T.S and Johansen, B.O (2013). Resale price maintenance and up-front payments: achieving horizontal control under seller and buyer power. WP 02/2013, Department of Economics, University of Bergen.

Hart, O. and Tirole, J. (1990). Vertical integration and market foreclosure. Brookings Papers on Economic Activity: Microeconomics, 205-286.

Innes, R. and Hamilton, S. F. (2009). Vertical restraints and horizontal control. RAND Journal of Economics, (40), 120-143.

Katz, M. L. (1991). Game playing agents: unobservable contracts as precommitments. RAND Journal of Economics, (22), 307–328.

Marx, L. M. and Shaffer, G. (2004). Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity: Comment. American Economic Review, (94): 796-801

Mathewson, G. and Winter, R. (1984). An Economic Theory of Vertical Restraints, RAND Journal of Economics , 15: 27-38

McAfee, R.P. and Schwartz, M. (1994). Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity. The American Economic Review, (84), 210-230.

Montez, J. (2012). How buybacks eliminate opportunism in vertical contracting. Working paper, London Business School.

O'Brien, D. P. and Shaffer, G. (1992). Vertical control with bilateral contracts. RAND Journal of Economics, (23), 299-308.

O'Brien, D. P. and Shaffer, G. (1994). The welfare effects of forbidding discriminatory discounts: A secondary line analysis of Robison-Patman. The Journal of Law, Economics and Organization, (10), 296-317.

Rey, P. and Tirole, J. (2006). A Primer on Foreclosure. In Armstrong M. and Porter, R. (eds.) Handbook of Industrial Organization, vol.3, North Holland, 2007.

Rey, P. and Vergé, T. (2004). Bilateral control with vertical contracts. RAND Journal of Economics, (35), 728-746.

Telser, L. (1960). Why Should Manufacturers Want Fair Trade?, Journal of Law and Economics, 3: 86-105.

Williamson, O. (1975). Markets and Hierarchies: Analysis and Antitrust Implications. New York: The Free Press.