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Manufacturer Cartels and Resale Price Maintenance

by

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Manufacturer Cartels and Resale Price Maintenance

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Abstract

In a model with manufacturer and retailer competition, we show that RPM facilitates manufacturer cartels when retailers have an outside option to selling the manufacturer's product. Because retailers have an effective outside option, the manufacturer can only ensure contract acceptance by leaving a sufficient margin to the retailers. This restricts the wholesale price level even when manufacturers collude. In this context, collusion can only become profitable for manufacturers if they use resale price maintenance. We thus provide a novel theory of harm for resale price maintenance when manufacturers collude and illustrate the fit of this theory in competition policy cases.

JEL classification: D43, K21, K42, L41, L42, L81.

Keywords: resale price maintenance, collusion, retailing.

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1 Introduction

Resale price maintenance (RPM) has been used by colluding manufacturers of beer, gummi bears, chocolate, and coffee.¹ The case reports contain indications that RPM indeed helped to make manufacturer collusion successful. Regarding these cases, Germany's competition authority (Bundeskartellamt) states:

'Most of the fines imposed in the proceedings concerned infringements relating to confectionery, coffee and beer. In these cases, the infringements were particularly anti-competitive and anti-consumer, because horizontal agreements between the manufacturers, which were also sanctioned by the Bundeskartellamt, were accompanied by vertical price-fixing measures in which major retailers participated.'²

A recent report by an OECD roundtable also describes cases where colluding manufacturers struggled to convince retailers to accept higher wholesale prices absent price coordination through RPM.³ Holler and Rickert (2019) illustrate that a coffee cartel apparently only became successful in sustaining higher wholesale prices when the coffee producers started using RPM in addition to coordinating their wholesale prices. Why should this be the case? For an upstream cartel, jointly increasing the wholesale prices should be an option if prices are too low from their perspective. Why is it helpful to control the retail prices as well?

While the suspicion that RPM facilitates collusion is not only backed by recent cases but is also prevalent in competition policy circles,⁴ there is still very limited economic theory in support of this link between RPM and collusion. The work of Jullien and Rey (2007) is a notable exception. They show that RPM can facilitate upstream collusion when retailers face privately observed shocks on demand or costs. Without RPM, a drop in demand can induce retailers to cut the retail price. Other manufacturers may mistakenly think that the manufacturer is deviating from the cartel agreement, leading to a price war. With RPM, manufacturers can prevent such ambiguous retail price cuts and thereby stabilize their cartel. However, private information and sudden retail price cuts do not appear to be the main driver for the use of RPM in at least some of the above-mentioned cases, such as the coffee cartel.⁵

We start with the question why colluding manufacturers would facilitate retailer price increases which likely reduce demand. Increasing the wholesale price appears to be a more attractive alternative for colluding manufacturers if, from their perspective, the retail prices are too low. We provide a model in which manufacturers do not find it profitable to increase the wholesale prices even if they prefer higher retail prices, as a

¹The cases concern Anheuser Busch, Haribo, Ritter, and Melitta; (last access 2020/02/03).

²See the Bundeskartellamt's press release "Fine proceedings for vertical price fixing in the German food retail sector concluded". of December 15, 2020 (last access 2020/02/03).

³'Roundtable on Hub-and-Spoke Arrangements – Background Note by the Secretariat 3-4 December 2019'; OECD; (last access 2020/02/03). Similarly, there have been instances where manufacturers helped retailers to coordinate on higher retail prices through hub-and-spoke cartels and organizing information exchanges.

⁴'Roundtable on Hub-and-Spoke Arrangements – Background Note by the Secretariat 3-4 December 2019'; OECD; (last access 2020/02/03).

⁵We discuss the coffee cartel more in detail in section 6.

higher wholesale price would not be accepted by the retailers. The reason is that, in order to accept the wholesale contracts, the manufacturers need to ensure that the retailers will make sufficient profits. In other words, retailers have a relevant outside option.

We set up a model of two competing manufacturers, each selling through an exclusive retailer, a market structure similar to Bonanno and Vickers (1988) and Piccolo and Reisinger (2011). The key addition in our model is that each retailer has an outside option, which is a valuable alternative to selling a manufacturer's product. For instance, if a retailer has limited shelf space, she may need to decide whether to stock one or the other product. In our model, we consider the cases of both out-of-market-alternatives (e.g., stocking more chocolate instead of one more brand of coffee) and within-market alternatives (e.g., selling a private label coffee).

In this setting where retailers have relevant alternatives to selling a manufacturer's product, manufacturers have to offer sufficiently low wholesale prices for the retailer to sell their products. We compare manufacturer competition to manufacturer collusion with and without resale price maintenance (RPM). Our main finding is that collusion may only be effective, that is, yield higher prices than manufacturer competition, if the manufacturers can use RPM. We show that RPM facilitates manufacturer collusion when it imposes a floor for the retail price (minimum RPM). Minimum RPM is used when the products of the different firms are close enough substitutes. It tends to increase the manufacturers' profits under collusion but decreases their profits under competition.⁶ This shows that RPM may only be desirable for manufacturers when they collude.

In section 3, we derive our results with a model of competition between two vertical supply chains in which the manufacturers offer public linear take-it-or-leave-it contracts and the outside option of each retailer is a fixed amount. This simple approach with a fixed outside option helps to highlight the mechanism of how RPM facilitates manufacturer collusion. In real-world cases, the market structure can be more complex and may include multi-product retailers, more sophisticated contracts and negotiations, and the vertical contracts may be secret. We extend our model in section 5 to show how these features affect our results. We highlight that, when two-part tariff contracts can be used by manufacturers, RPM can still facilitate manufacturer collusion if the retailer actions cannot be fully contracted on, such that the manufacturers have to ensure that retailers have sufficiently high margins. We also explain how our results can be obtained with secret contracting, in the case of multi-product retailers, and when the retailers can alternatively sell private labels when not selling a manufacturer's brand product. Finally, we study the incentives of a manufacturer to unilaterally introduce RPM.

2 Related literature

The market structure of two manufacturers and two exclusive retailers that we analyze is similar to the one in Bonanno and Vickers (1988). We extend the model by allowing the retailers to have a substantial outside option to selling a manufacturer's product. We first study linear wholesale prices and provide an extension with two-part tariffs. Furthermore, we compare the competitive outcome to the outcome under a manufacturer cartel with

⁶In the latter case, RPM acts as a price ceiling (maximum RPM).

and without RPM. Similarly to Rey and Stiglitz (1995) and Bonanno and Vickers (1988), we find that, under competition, the use of RPM, which is similar to vertical integration as regards pricing, can result in a dilemma for the manufacturers in the sense that they would be better off if RPM was banned.

Besides the aforementioned article of Jullien and Rey (2007), a strand of literature studies how the retail organization affects manufacturer collusion but it does not formally analyze RPM (Reisinger and Thomes, 2017; Piccolo and Reisinger, 2011; Liu and Thomes, 2020). Reisinger and Thomes (2017) compare multi-product retailers with exclusive retailers and Liu and Thomes (2020) study vertical integration versus delegation. Piccolo and Reisinger (2011) show that, compared to a situation of perfect retail prices competition, exclusive territories tend to make manufacturer collusion easier as the manufacturers benefit from instantaneous retail price reactions when a manufacturer deviates from the collusive agreement and cuts its wholesale price. In the framework of Piccolo and Reisinger (2011), RPM would have the same effect as perfect retail price competition and would thus be rather detrimental to manufacturer collusion.⁷ It is noteworthy that, in their framework, RPM would take on the form of a price ceiling (maximum RPM) whereas in our model it is a price floor (minimum RPM) that facilitates collusion.

Other related articles study different vertical aspects of collusion, such as the effects of vertical integration on collusion (Nocke and White, 2007) and whether a monopoly manufacturer can facilitate retailer collusion (Gilo and Yehezkel, 2020).

Rey and Vergé (2010) show that resale price maintenance can result in higher prices even without collusion in a setting of interlocking vertical relations, where multiple manufacturers sell through competing common retailers. Different from our model, their result relies on two-part tariff contracts that allow manufacturers to internalize the total industry profits. Dobson and Waterson (2007) consider a model where manufacturers negotiate linear wholesale prices with retailers. In this context, RPM can increase the equilibrium market prices, particularly when retailers have strong negotiation power. Neither Rey and Vergé nor Dobson and Waterson study collusion.

In our model, the market power of each manufacturer is limited by an outside option of each retailer that can be interpreted as a cost of providing promotional services for the manufacturer's product. In so far, our argument is related to the literature on retail services. According to the service argument, which goes back to Telser (1960) and was refined by Mathewson and Winter (1984) alongside others, a monopoly manufacturer may use RPM in order to improve the service incentives of its retailers. Similar to Hunold and Muthers (2017), the opportunity cost of selling a product might be driven by an outside option of promoting different products. For example, the 'service cost' of a supermarket for selling a coffee brand could be the opportunity cost of not being able to use the shelf space (and possibly the space in the promotional flyer) for other products. Asker and Bar-Isaac (2014) highlight the externality of vertical restraints on competing manufacturers and show that different vertical restraints can prevent market entry at the manufacturer level. Similarly, Dertwinkel-Kalt and Wey (2020) show in a setting with linear tariffs that a single manufacturer can benefit from RPM when selling to a multi product retailer who also sells also a product of a competitive fringe. RPM increases the retail margin and

⁷In their analysis, RPM is equivalent to the baseline case of perfect competition between retailers.

thus can incentivize the multi-product retailer to increase the price for the fringe product.

As in Bonanno and Vickers (1988) and the related literature, we study observable tariffs in our main analysis. When we extend the model to allow for secret contracts, we consider a market structure that is similar to Pagnozzi and Piccolo (2011). They consider a model of strategic delegation à la Bonanno and Vickers (1988) with private contracts and show that, under symmetric beliefs, vertical separation increases the manufacturer’s profits.

Colluding manufacturers may face the same type of problems as an upstream monopolist. Whereas the main analysis focuses on observable contract offers, we show in an extension in section 5 that our argument on manufacturer collusion and RPM can also be related to the opportunism problem of a monopoly manufacturer. When the manufacturer lacks the ability to publicly commit to the vertical contracts, each retailer fears that the other retailer may get a better deal from the manufacturer (opportunism). This limits the manufacturer’s ability to realize monopoly profits (Hart et al., 1990; Segal, 1999). Rey and Verge (2004) show that RPM can solve the opportunism problem. Gabrielsen and Johansen (2017) add retail services and show that a monopoly manufacturer can evade the opportunism problem only with public commitment to RPM but not with purely vertical price controls. In so far as an opportunism problem can also arise for colluding manufacturers when vertical contracts are private, this strand of the literature is related to our prediction that RPM facilitates collusion – with both observable and private wholesale contracts.

Schinkel et al. (2008) point to a different reason, an ‘Illinois Wall’ why colluding manufacturers want to provide rents to retailers. Their argument applies to a context where cartel damage claims are limited to direct purchasers of a cartel. When the cartel provides rents to a direct purchaser, it ensures their cooperation and reduces the risk of detection.

3 Model

Procedure

We study contracting and pricing in a market with two manufacturers and two retailers. We compare the market outcomes under manufacturer competition and collusion both with and without RPM. The retailers compete in any case. We number the four scenarios as depicted in Table 1a.

Manufacturers	without RPM	with RPM
compete	(I)	(IV)
collude	(II)	(III)

(a) Scenarios of our analysis

For scenarios II and III with collusion, we assume that the manufacturers behave as if they maximize joint profits while we do not explicitly model how their coordination

is achieved. In section 4.7, we study the incentives to collude when the pricing game is repeated infinitely often, such that the manufacturers can sustain collusion with a punishment mechanism.

In section 5 we discuss the incentives of a manufacturer to unilaterally introduce RPM.

Contracting and pricing

Let us abstract from any costs of production or retailing. Assume that each retailer is an exclusive seller of one of the manufacturer's products. The manufacturer offers contracts with a linear wholesale price (we relax the assumptions on exclusivity and linear pricing later on).

The timing is as follows:

1. Each manufacturer $i \in \{A, B\}$ offers its retailer a contract (a wholesale price w_i ; with RPM also a retail price p_i).⁸
2. Each retailer i observes both contract offers, rejects the offer of manufacturer i or accepts it and sets the price p_i (absent RPM).
3. Consumers choose where and whether to buy.

We take the market structure as given. To ensure that all vertical contracts are accepted in equilibrium when the manufacturers compete, for simplicity, we assume that both manufacturers make zero profits if the contract of one manufacturer is not accepted.⁹ We solve the game for symmetric subgame perfect Nash equilibria. We compare price competition among the manufacturers with a manufacturer cartel, assuming first that it is public knowledge whether using RPM is feasible or not.¹⁰

Demand for each product is given by a symmetric function $D_i(p_i, p_{-i})$. We assume all costs of production and distribution (except for the wholesale price) to be zero, as this simplifies the expressions and does not affect our results. The profit of retailer i when accepting the contract and selling the product of manufacturer i is

$$\pi_i = (p_i - w_i) \cdot D_i(p_i, p_{-i}),$$

and the profit of manufacturer i is

$$\Pi_i = w_i \cdot D_i(p_i, p_{-i}).$$

A retailer only accepts the contract offer in stage 2 if the expected profits exceed a fixed outside option of value Ω :

⁸We model RPM as a fixed price that the manufacturer sets. One can then study whether, in equilibrium, this effectively amounts to a price floor or a price ceiling.

⁹This ad hoc assumption ensures equilibrium existence for the case of public take-it-or-leave-it contracts (as in related models, such as Rey and Vergé (2010)). We show in Annex A that we do not need the ad hoc assumption but instead obtain the same results when including a renegotiation stage in the contracting game. The non-existence problem does not occur either when the contract offers are private instead of public (section 5.3).

¹⁰This also means that the retailers observe not only the wholesale prices but also the retail prices in stage 2 when there is RPM.

$$\pi_i \geq \Omega. \quad (1)$$

The outside option encompasses the shelf space opportunity costs and marketing costs as well as other retailing opportunity costs. The outside option can also be interpreted as retailer bargaining power. We assume $\Omega > 0$, such that retailers do not accept contracts that leave them zero profits.

The exogenous outside option value of Ω allows for a relatively simple analysis of the model but the results are more general. Annex B contains the analysis for the case of within-market alternatives where each retailer can alternatively stock a perfect substitute to the manufacturer's product with a marginal cost of $c > 0$.

Assumptions on demand and profits

Let us first consider the retailers' price setting without RPM after each has accepted the manufacturer's contract. Each retailer faces a wholesale price w_i and both retailers set prices simultaneously, each solving the problem to

$$\max_{p_i} \pi_i = (p_i - w_i) D_i(p_i, p_{-i}).$$

In equilibrium, the retailers set a pair of prices $p_i(w_i, w_{-i})$ that are mutual best-responses. We assume that the pricing game has a unique equilibrium. For the case in which the input prices are known to both retailers, we make

Assumption 1. *The reduced profit of each retailer, $\pi_i(w_i, w_{-i})$, is monotonically decreasing in the own input price w_i and monotonically increasing in the competitor's input price w_{-i} .*

Moreover, for the case where both retailers accept the manufacturers' contracts and the input prices are equal ($w_A = w_B = w$), we focus on a symmetric subgame equilibrium with equilibrium prices denoted by $p^*(w)$, and make

Assumption 2. *The competitive downstream price level $p^*(w)$ increases in the uniform input price: $\frac{dp^*(w)}{dw} > 0$. The retail profit $\pi_i(w, w)$ decreases in the uniform input price w .*

On the upstream profits we form

Assumption 3. *Absent RPM, a manufacturer's reduced profit, $\Pi_i(w_i, w_{-i})$, which takes the retailers' equilibrium pricing into account, gives rise to well-defined reaction functions that are strictly increasing and have a slope below one.*

This assumption ensures that the wholesale pricing game has a unique and stable equilibrium. Because this is an assumption on the reduced manufacturer profits, it entails implicit assumptions on the demand function. These assumptions are standard and are satisfied with, for instance, demand functions where the relationship between quantities and prices is linear (see equation (15) in section 4.6).¹¹

¹¹See section 4.6 for a parametric example.

We solve the game for symmetric subgame perfect Nash equilibria. We compare price competition among the manufacturers with a manufacturer cartel, assuming first that it is public knowledge whether using RPM is feasible or not.¹²

We focus on the case in which competition is sufficiently strong. For this, denote by p^U the unrestricted competitive retail price absent RPM and by p^C the monopoly price that maximizes the integrated industry profit.

Assumption 4. *The equilibrium prices without RPM are below the monopoly level: $p^U < p^C$.*¹³

We go into more precise details in the analysis below.

4 Solution (binding outside option, exclusive retailers)

Table 1 puts the different scenarios into perspective.

	Manufacturer competition	Manufacturer collusion
no RPM	<i>Scenario (I):</i> This scenario defines the competitive wholesale and retail prices. The wholesale prices are at a level such that the resulting retail profits equal the outside option Ω .	<i>Scenario (II):</i> There is no gain over scenario 1: the manufacturers cannot increase the wholesale prices as they cannot raise the retail prices above the competitive level absent RPM.
RPM	<i>Scenario (IV):</i> The equilibrium wholesale and retail prices are lower than absent RPM (scenario I) if the offers made to consumers are sufficiently differentiated. Minimum RPM tends to be unprofitable for the manufacturers. The retailers always obtain Ω and the industry profits are lower.	<i>Scenario (III):</i> The manufacturers set the retail prices at the monopoly level and adjust the wholesale prices such that the retailers get their outside options.

Table 1: Summary of the different scenarios

4.1 No RPM and manufacturer competition (scenario I)

Let us first consider that the manufacturers set the wholesale prices and the retailers set the retail prices. In stage 2, each retailer observes the wholesale price offers of the

¹²This also means that the retailers observe not only the wholesale prices but also the retail prices in stage 2 when there is RPM.

¹³In general, double marginalization can result in prices above the industry profit maximum if the intensity of competition is low. In this uninteresting case, the cartel would solve the double marginalization problem of the successive monopoly, effectively lowering prices.

manufacturers. Simultaneously, each retailer either rejects the received offer or accepts it and sets the retail price. Each retailer accepts its contract offer if the expected profit exceeds the value of the outside option.

For given wholesale prices, the resulting competitive retail prices can either be higher or lower than the prices that an integrated industry would charge. Denote the industry profit-maximizing outcome by p^C . There would be (*excessive*) *double marginalization* if the resulting retail prices under competition are larger than $p^C = p^*(w^M)$. If the retailers have had enough outside options, each manufacturer i would choose w_i to maximize its profit of $w_i \cdot D_i$. We denote the mutual best-responses of this unconstrained manufacturer-pricing game by w^U and the resulting retail price level by

$$p^U = p^*(w^U).$$

This unconstrained equilibrium is the competitive equilibrium of the game if the retailers' resulting profits are larger than the outside option value:

$$\pi_i(w^U, w^U) \geq \Omega. \quad (2)$$

Otherwise, the outside option Ω affects the equilibrium wholesale prices as condition (2) is violated. In this case, the retailer's participation constraints determine the competitive wholesale prices. In the equilibrium with binding outside options, each manufacturer sets the largest wholesale price that satisfies its retailer's participation constraint, given the wholesale price of the other manufacturer.

As the manufacturers are symmetric, there is a unique symmetric combination of wholesale prices w^* under Assumption 1, such that each retailer's participation constraint binds:

$$\pi_i(w^*, w^*) = \Omega. \quad (3)$$

There is thus an effective outside option that reduces the equilibrium prices if $w^U > w^*$.

Lemma 1. *The participation constraint of the retailer is binding if $\pi_i(w^U, w^U) < \Omega$ or, equivalently, if $w^U > w^*$.*

We focus on analyzing the interesting case where the participation constraint in equation (3) is binding, which corresponds to Ω being large enough.

It follows directly from Assumption 2 and equation (1) that w^* decreases in Ω . In equilibrium, the retailers observe the wholesale prices of w^* and non-cooperatively set prices of

$$p^*(\Omega) = p(w^*(\Omega)). \quad (4)$$

Thus, the retail prices decrease in the level of the outside option. This yields

Proposition 1. *If the participation constraints of the retailers bind (equation (3) holds): Under manufacturer competition, there is an equilibrium with retail prices of $p^*(\Omega)$ and wholesale prices of $w^*(\Omega)$, which both decrease in Ω , the value of the outside option.*

Proof. Consider an equilibrium with binding participation constraints (equation (3) holds). This implies $\pi_i(w_i^*, w_{-i}^*) = \Omega$ for $i = A, B$. In equilibrium, each manufacturer chooses

the largest w_i that is compatible with the participation constraint of the retailer. Under Assumption 1, there is exactly one w_i for each w_{-i} .

With increasing best-response functions with a slope of less than one (Assumption 3), the best-response of each manufacturer is to choose $w_i > w_{-i}$ for any $w_{-i} < \min \{w^*(\Omega), w^u\}$. Thus, the wholesale price equilibrium is at $w_i = w_{-i} = w^*(\Omega)$, where no manufacturer has an incentive to increase the price, as this would violate the participation constraint, and no incentive to lower the price, as its profits are maximized by choosing a price at least as large as the competitor for prices below the unconstrained equilibrium price level (w^u).

Any asymmetric combination of wholesale prices cannot be an equilibrium because for any combination that satisfies the participation condition (1) for both retailers with $w_i < w_{-i}$, the profit of i could be increased by increasing w_i . Thus, a profitable deviation would be possible for the manufacturer with the lower wholesale price such that the participation condition of the retailer is still satisfied for both manufacturers. \square

Summary. Whenever the outside option of the retailers is sufficiently attractive, the prices are pinned down by the retailers' participation constraints and not by the level of manufacturer competition.

4.2 No RPM and manufacturer collusion (scenario II)

Suppose the manufacturers collude on w_A and w_B to maximize their joint profits. The underlying idea is that, in an infinitely repeated game, the manufacturers can sustain higher wholesale prices by employing a dynamic strategy that punishes deviations to lower wholesale prices with, for example, grim trigger strategies. We focus on the case of symmetric collusion, where the symmetric manufacturers collude using symmetric wholesale prices. In any symmetric equilibrium, both manufacturers' contracts will be accepted and both products will be sold.

We assume that the retailers are not colluding. Thus, the retailers react to the wholesale prices in the same way as without collusion.

Proposition 2. *If, absent RPM, the manufacturers collude (with both products on offer at the same price) and the retailers' outside options were binding under competition (condition (3)), the resulting symmetric collusive wholesale prices equal the competitive prices of $w^*(\Omega)$. The retail prices equal the competitive retail prices of p^* .*

Proof. Recall that $\pi_i(w^*, w^*) = \Omega$ holds under both upstream and downstream competition for both $i = 1, 2$ in the symmetric equilibrium where the retailers' outside options bind. The colluding manufacturers want to increase their profits by increasing the wholesale prices. For any symmetric level of $w > w^*$, it follows from Assumption 1 that $\pi_i(w, w) < \Omega$. Such contracts would not be accepted by both retailers. Hence, the best that the manufacturers can achieve under symmetric collusion is to choose the symmetric level w^* . \square

The main insight is that, by colluding, the manufacturers cannot implement higher wholesale prices than under competition. The underlying intuition is that manufacturers do not have sufficient instruments to ensure simultaneously that

1. the retailers have the right incentives to stock and promote the manufacturers instead of realizing the outside option, and that
2. the retail prices maximizes the industry profits.

Summary. Whenever the retailers' outside option is binding and absent RPM, the resulting price level under collusion and competition is identical. Because of double marginalization, the resulting prices can be lower or higher than the industry profit-maximizing prices, depending on the intensity of the competition. As the retailers' outside option pushes the wholesale prices down, double marginalization arises less, the more attractive the outside option is.

Remark (on symmetric versus asymmetric collusion). We focus our analysis on symmetric equilibria. When explicitly studying a repeated game, one could potentially construct an equilibrium with asymmetric collusion that yields larger profits than symmetric collusion and relies on only one manufacturer selling in each period. This could only be part of a collusive equilibrium if there are side payments between manufacturers or they could alternate whose product is accepted in-between periods. In such an equilibrium, because of product differentiation, there is some profit lost from not offering both products in the same period. Our motivation for focusing on symmetric strategies in each period is that we consider the alternating supplies as impractical.

4.3 RPM and manufacturer collusion (scenario III)

Suppose manufacturers also set the retail prices (RPM) and they collude on both a symmetric wholesale price of w and a retail price of p . The colluding manufacturers aim to extract all retail profits net of the outside option and maximize the residual industry profits. The sum of retailer and manufacturer profits (industry profits) is maximized at retail prices of

$$p^C = \arg \max_p \sum_i p \cdot D_i(p, p).$$

Proposition 3. *If the manufacturers use RPM and, in addition, collude on both the wholesale price w and the retail price p , the resulting symmetric retail prices, p^C , maximize the industry profits and the manufacturers set a wholesale price of w^C to satisfy the retailers' participation constraints. RPM increases the manufacturer profits under collusion compared to a situation of collusion absent RPM if the retailers' outside options constrain the manufacturers absent RPM (condition 3 holds).*

Proof. With RPM, the colluding manufacturers choose the retail price level that maximizes the industry profits. This is the case because, with RPM, the manufacturers can choose the wholesale price level w such that the retailers' outside options are binding for any given retail prices. Formally, the manufacturers jointly choose p and w to maximize $w \sum_i D_i(p, p)$, subject to $(p - w)D_i(p) \geq \Omega$. As this constraint is binding and thus fixes w , the manufacturers' problem can be rewritten as

$$\max_p \sum_i p D_i(p, p) - 2\Omega.$$

The industry profit-maximizing price p^C is a solution to the problem because the fixed sum of $2 \cdot \Omega$ has no effect on the optimal retail price. That is, the manufacturers have sufficient instruments to choose retail prices and extract all retail rents, up to the outside option of each retailer. As the outside options are fixed, the manufacturers effectively maximize industry profits. The retail profits equal Ω , as in the scenarios absent RPM studied before when the outside options restricted the wholesale prices (condition 3 holds). Starting from competitive prices below the monopoly level (assumption 4) that are defined by the outside options, the industry profits increase with RPM and collusion and the manufacturer profits increase as well. As the industry profits are maximized in the equilibrium with RPM and collusion while the outside options are satisfied with equality, the outcome is the best that the manufacturers can achieve. \square

4.4 RPM and manufacturer competition (scenario IV)

Suppose that both manufacturers use RPM and the retailers are aware of this. Confronted with the prices w_i and p_i offered by manufacturer i , retailer i chooses whether to accept and sell the manufacturer's product. With RPM, each manufacturer can choose the retail price at a level that maximizes the joint profits with her retailer. As the outside option is a fixed sum, each manufacturer effectively maximizes the product line profit $p_i \cdot D_i(p_i, p_{-i})$ with respect to p_i . Instead, without RPM, the retailers set the retail prices based on positive input costs of $w_i > 0$.

Proposition 4. *If the outside option of each retailer is binding and the manufacturers compete, the symmetric equilibrium retail prices (p^{RPM}) are lower with RPM than without RPM: $p^{RPM} < p^*(\Omega)$. The competing manufacturers make lower profits with RPM than without.*

Proof. The problem for manufacturer i is to

$$\begin{aligned} & \max_{w_i, p_i} w_i \cdot D_i(p_i, p_{-i}) \\ & \text{s.t. } (p_i - w_i)D_i(p_i, p_{-i}) \geq \Omega. \end{aligned}$$

For given retail prices, the manufacturer will choose the highest possible w_i that just satisfies the constraint:

$$w_i = p_i - \Omega/D_i(p_i, p_{-i}).$$

This allows us to write the problem solely in terms of p_i :

$$\max_{p_i} (p_i - \Omega/D_i)_i \cdot D_i = p_i \cdot D_i(p_i, p_{-i}) - \Omega. \quad (5)$$

As the outside options are fixed, the manufacturers thus set the retail prices with RPM as if there were no retail margins. The symmetric equilibrium retail price, denoted p^{RPM} , is thus defined by the FOC

$$p^{RPM} \cdot \partial D_i / \partial p_i (p^{RPM}, p^{RPM}) + D_i (p^{RPM}, p^{RPM}) = 0, \quad (6)$$

and the corresponding symmetric wholesale price by

$$w^{RPM} = p^{RPM} - \Omega/D_i(p^{RPM}, p^{RPM}). \quad (7)$$

Equation (6) and Assumption 2 ($\frac{dp^*(w)}{dw} > 0$) imply that the symmetric equilibrium retail prices under RPM are lower than without RPM. Suppose that, with RPM, the manufacturers choose the same retail prices as the retailers in the case without RPM as well as the same wholesale prices. With RPM, a manufacturer does not have an incentive to increase its retail price unilaterally as the price was a best-response of the retailer to the other retail price, taking into account the wholesale price $w^* > 0$ as the marginal costs of the retailer. However, the marginal costs of the manufacturer are zero and thus lower (see equation (5)). Thus, each manufacturer would have an incentive to reduce its retail price in order to increase the joint profits for the manufacturer-retailer pair, leading to a lower fixed point of the retail prices with RPM.

As the retailers get a profit of Ω both with and without RPM, introducing RPM affects both the industry and the manufacturer profits equally. As the price level absent RPM is below the monopoly level (that means $p^*(\Omega) < p^C$) by Assumption 4, the manufacturers make less profit when they both use RPM compared to a situation without RPM as the retail prices are lower. \square

Remark (RPM and vertical integration). When manufacturers compete, the price effects of resale price maintenance and vertical integration are similar. It is thus not surprising that RPM can result in a dilemma for manufacturers. The argument is similar to that of Bonanno and Vickers (1988) and Rey and Stiglitz (1995). Delegation of pricing to the retailers (which means *no RPM* in our model) tends to yield higher prices and manufacturer profits than vertical integration, which corresponds to RPM in our model. Please note that this relies on the assumption that there is no intra-brand competition. Thus, RPM cannot reduce retail price competition, which could, by itself, also have a price-increasing effect.

4.5 Price ceiling or price floor?

Competition policy often distinguishes between minimum and maximum RPM. While maximum RPM is usually considered to solve double marginalization problems in the interest of manufacturers and consumers, minimum RPM is considered to be more ambivalent and more likely to be illegal.¹⁴

We model RPM as a fixed price. To distinguish between maximum and minimum RPM, we can evaluate whether a retailer would want to deviate from the fixed price by lowering or by increasing its retail price. Indeed, we find that when manufacturers collude and use RPM to increase the prices, the result is always a price floor (minimum RPM).

When manufacturers collude and use RPM, they can raise the wholesale prices to a level where, absent RPM, the resulting retail profits would have a lower value than their outside options. Given the high collusive wholesale price, the colluding manufacturers thus raise the retail prices by means of – effectively – price floors (minimum RPM) to a level where the retail margins yield retail profits at the level of the outside options. Each

¹⁴See, for instance, the EU Vertical Block Exemption of 2010, Article 4a.

retailer has the same profit as without RPM, equal to Ω , but the wholesale price w is larger than absent RPM and/or absent collusion.

For the case in which manufacturers compete with RPM, it always takes on the form of maximum RPM in our model. While the retailers would set retail prices based on the positive wholesale price they face, the manufacturers choose the retail prices based only on the true marginal costs of zero. Apart from this, the manufacturers face the same level of competition as the retailers. Consequently, the resulting competitive retail price absent RPM, when the retailers set the retail prices, are always higher than the competitive retail prices with RPM, when the manufacturers set the retail prices. This implies that RPM acts as a price ceiling, that is, the maximum RPM.

Lemma 2. *When manufacturers collude and use RPM to increase the prices to the detriment of consumers, they effectively impose a price floor (minimum RPM).*

4.6 Parametric example

We provide explicit outcomes of the model for the linear demand function

$$D_i(p_i, p_{-i}) = 1 - p_i + \gamma(p_{-i} - p_i), \quad (8)$$

with $\gamma > 0$. A higher value of γ corresponds to a higher substitutability of the two products at the two retailers.

Lemma 3. *With the linear demand function in equation (8) and binding outside options (condition (3) holds), the equilibrium prices are*

absent RPM under both manufacturer collusion and competition with the binding constraint

$$w^*(\Omega) = 1 - (2 + \gamma)\sqrt{\frac{\Omega}{1+\gamma}} \text{ and } p^*(\Omega) = 1 - \sqrt{\Omega(1 + \gamma)},$$

with RPM under collusion

$$w^C = 1/2 - 2\Omega \text{ and } p^C = 1/2, \text{ and}$$

without RPM and competition

$$w^{RPM} = 1/(2 + \gamma) - \Omega\frac{2+\gamma}{1+\gamma} \text{ and } p^{RPM} = 1/(2 + \gamma).$$

Proof. See annex C for the derivations. □

Are the competitive upstream profits higher with or without RPM? Without RPM, the retailers make a profit of Ω if the outside options bind. With RPM, the retailers always make a profit of Ω as their outside options always bind. With binding outside options, the manufacturers' profits equal the industry profits net of the constant of $2 \cdot \Omega$. A sufficient condition for the industry profits being lower with RPM than without it is that the retail price level without RPM is below the monopoly level of $1/2$. We have assumed that for the general demand case (assumption 4). For $\gamma \geq 2.32$, the unrestricted retail price p^U is smaller than the monopoly level of $1/2$, which implies that the restricted retail price is lower as well. Absent RPM, the retailers make a profit of at least Ω . Consequently, with sufficiently high substitutability, RPM lowers the manufacturers' competitive profits.

Numerical example. Suppose that $\gamma = 3$ and $\Omega = 0.1$. We summarize the resulting prices and manufacturer profits for the four scenarios in Table 2. When comparing the profit on the left with the profits on the right, manufacturer collusion and RPM are only profitable when used in combination.

The numerical example illustrates that the presence of the outside option can have a quantitatively substantial effect on the retail price. This can induce the manufacturers to collude and use RPM.

Manufacturers	without RPM	with RPM
compete	$w^* = 0.21$ and $p^* = 0.37$. manufacturer profit: $w^* \cdot (1 - p^*) \approx 0.13$.	$w^{RPM} = 0.075$ and $p^{RPM} = 0.2$, manufacturer profit: $w^{RPM} \cdot (1 - p^{RPM}) = 0.06$
collude		$w^M = 0.3$ and $p^M = 0.5$ manufacturer profit: $w^M \cdot (1 - p^M) = 0.15$

Table 2: Prices – numerical example with linear demand.

4.7 Cartel stability

We analyze how vertical contracting and RPM affect the stability of a manufacturer cartel.

Following the literature, we study the stability of cartels in an infinitely-repeated period game by analyzing whether a firm would benefit when deviating from the collusive agreement in the current period. The central question is whether the short-term gains, when setting a lower price while the other cartel members stick to the high price, outweigh the loss resulting from punishment by the other cartel members or even the collapse of the cartel in future periods.

Suppose that the pricing game we introduced in section 3 is repeated infinitely often and the future per-period profits are discounted with a common discount factor of $\delta \in (0, 1)$. Differing from the standard model of collusion, each repetition of the game consists of three stages: contract offer, acceptance, and retail price competition. We maintain the assumption that there is no discounting between the three stages and add the standard assumption of discounting between periods. We assume that the manufacturers collude using grim-trigger strategies to support an outcome that maximizes their joint profits. As before, we focus on the manufacturer cartel and exclude retailer collusion by assuming that the retailers still play short-term strategies that are best-responses in each period.

In the case of grim trigger strategies with Nash-reversal, the incentive condition for a manufacturer to stick to the collusive agreement can be written as follows:

$$\Pi^C + \delta\Pi^C + \delta^2\Pi^C + \dots \geq \Pi^D + \delta\Pi^N + \delta^2\Pi^N + \dots, \quad (9)$$

where Π^C denote the period profits of a manufacturer in the cases of collusion, Π^D for a deviating firm, and Π^N competitive profits.

Cartel stability without RPM. Recall that without RPM, even a perfectly working manufacturer cartel cannot implement a higher price than the competitive equilibrium

price and cannot extract larger profits than under competition (Proposition 2). Formally, this means that $\Pi^C = \Pi^D = \Pi^N$.

Cartel stability with RPM. Suppose that manufacturers collude on both wholesale and retail prices. The optimal collusive outcome is to implement the joint profit-maximizing price as shown before. Recall that, with grim-trigger strategies, the manufacturers would start by playing the collusive strategy with the per-period outcome as described in Proposition 3. If any manufacturer deviates by setting a different wholesale price and/or retail price, the manufacturers return to the stage game Nash equilibrium in the next period (that is, the competitive market outcome characterized in Proposition 4).¹⁵

One can rewrite the deviation profit as a scaled collusive profit, that is, $\Pi^D = \alpha \cdot \Pi^C$, with $\alpha \in [0, 2]$ where $\alpha = 2$ yields the industry monopoly profit at the upstream level, which is the maximal profit that could be obtained by a deviating firm. Substituting in equation (9) results in

$$\Pi^C \cdot \frac{1}{1-\delta} \geq \alpha \Pi^C + \Pi^N \frac{\delta}{1-\delta}.$$

Solving this for the critical discount factor yields

$$\Rightarrow \delta \geq \hat{\delta} \equiv \frac{\alpha \Pi^C - \Pi^C}{\alpha \Pi^C - \Pi^N}.$$

The critical discount factor $\hat{\delta}$ is negative for $\alpha < 1$. Hence, collusion is stable for any δ . For $\alpha > 1$, the critical discount factor $\hat{\delta}$ is strictly positive. Collusion is thus stable if the manufacturers are sufficiently patient (δ high enough)

The deviation profit of a manufacturer depends on the assumptions in the stage game. In our baseline model with public tariff offers, it is impossible for a deviating firm to realize any profits. The deviating firm has still to also ensure that the contract of the other manufacturer is accepted because the market breaks down whenever a contract is not accepted.¹⁶ This assumption can be understood as characterizing a situation in which the vertical contracts can be renegotiated immediately when a retailer receives an offer that would result in the delisting of competing products. With the strict market breakdown assumption, deviations that aim to undercut the competitor thus result in zero profits for the deviating manufacturers. This corresponds to $\alpha = 0$ and means that the cartel is stable independent of the discounting between periods.

Alternatively, if one assumes that the market does not break down (but instead renegotiations occur), a manufacturer may be able to benefit from a price cut. A deviation may also be profitable when it is secret in the sense that the wholesale and retail prices of competing products are only visible afterwards. In these cases, α may well be positive and above 1.

Lemma 4. *If the stage game is repeated infinitely and the manufacturers play grim trigger strategies, the manufacturer cartel with RPM is stable for sufficiently high discount factors.*

¹⁵Note that competition with RPM yields even lower profits than competition without RPM and thus is an even stronger punishment than a return to competition without RPM.

¹⁶See footnote 9 for a discussion of the market breakdown assumption and alternatives to it.

Depending on the deviation profits, a discount factor of 0 may suffice.

A more general insight that can be drawn from the above analysis is that it can be difficult for a manufacturer to deviate profitably from a collusive agreement when the retailer has to implement the deviation and the market is transparent enough for the other retailer and/or manufacturers to react before its retailers implement the lower price.¹⁷ A case in point is the above-mentioned coffee cartel in Germany where, typically, retailers immediately informed manufacturers of each others' price adjustments.¹⁸

4.8 Welfare

The retail price level across the different scenarios has a clear order.

Manufacturers	without RPM	with RPM
compete	$\{w^*(\Omega), p^*(\Omega)\}$	w^{RPM} and p^{RPM} with $p^{RPM} < p^*(\Omega)$,
collude		w^C and p^C with $p^C > p^*(\Omega)$

Table 3: Prices – numerical example with linear demand.

Without RPM and binding outside options of the retailers, the retail prices equal $p^*(\Omega)$, under both competition and collusion. We start with a situation where the prices in the case of upstream and downstream competition are below the monopoly level (assumption 4). With RPM and manufacturer collusion, the retail prices increase to the industry profit-maximizing level of p^C that is larger than $p^*(\Omega)$.

With RPM and manufacturer competition, the wholesale and retail prices w^{RPM} and p^{RPM} prices are below $w^*(\Omega)$ and $p^*(\Omega)$. In all cases, the equilibria have symmetric prices for both products and retailers. Thus, RPM reduces consumer surplus under collusion, where it effectively imposes a retail price floor, but reduces prices under competition, where it effectively imposes a retail price ceiling.

As we have focused on the case where the outside option of the retailers binds, the retail profits are the same in all four scenarios and equal Ω . The manufacturer profits thus move in the same way as producer surplus and in the opposite direction to consumer surplus. The producer surplus is largest under collusion with RPM and smallest under competition with RPM. The clear implication from these results is that minimum RPM can facilitate collusion and increase the consumer harm of collusion. Total surplus is largest under (maximum) RPM absent collusion.

5 Extensions

In section 3, we derive our results with a model of competition between two vertical supply chains in which the manufacturers offer public linear take-it-or-leave-it contracts and the

¹⁷Piccolo and Reisinger (2011) have shown in a similar set up that, absent RPM, the ability of the retailers to react to a lower wholesale price of the deviating manufacturer makes deviations less attractive and can thus increase the stability of manufacturer collusion.

¹⁸Please see section 6 for more details and the court references.

outside option of each retailer is a fixed amount. This simple approach helps to highlight the mechanism of how RPM facilitates manufacturer collusion. In real-world cases, the market structure can be more complex and may include multi-product retailers, more sophisticated contracts and negotiations, and the vertical contracts may be secret. We therefore extend our model and show how the main effects can also result in these cases.

5.1 Outside option and two-part tariffs

So far, we have assumed that the contracts only contain linear tariffs and that the outside option is a fixed sum (Ω). When assuming a fixed outside option, the question arises of whether a fixed transfer, that is, a slotting fee for retailers, (as a lump-sum fee of a two-part tariff, for instance) could solve the manufacturers' problem with no need for RPM. One answer to this argument is that there are other reasons, like risk-aversion and wholesale arbitrage, that may render fixed transfers infeasible or limit their scope. We show that, even when this is not the case, the answer depends on the properties of the retailer's outside option.

Outside option to the contract. Two-part tariffs are sufficient in the case of an outside option that is fixed and vanishes with the contract acceptance if the manufacturer can compensate the retailer with a fixed transfer denoted by f_i . Formally speaking, the following condition needs to hold for the retailer to accept the contract

$$\underbrace{(p_i - w_i)D_i(p_i, p_{-i}) - f_i}_{\text{retail profit when accepting the contract}} \geq \underbrace{\Omega}_{\text{profit when not accepting the contract}} .$$

By choosing a sufficiently negative f_i , that is, with a slotting allowance paid to the retailer, this condition could be met. If there is no further constraint on the contract the wholesale prices could be freely adapted by manufacturers, for example, to implement industry profit-maximizing prices when colluding.

Outside option during the contract period. However, even if two-part tariffs are feasible, the fixed transfer can only cover the outside option in so far as it is an outside option to the contract itself. The situation is different for actions of the retailer post-contract acceptance that are not directly enforceable with the contract. For example, service decisions by the retailers during the contract period could constitute such an outside option. These actions could include decisions on the shelf space allocation, on the placement of the products in promotional leaflets, and on consumer advice. In these cases, RPM may still be necessary.

To illustrate this further, let us study the case of two-part tariffs when the retailers make a service decision post-contract acceptance. The timing is as follows:

1. each manufacturer $i \in \{U, V\}$ offers its retailer a contract with a wholesale price w_i , a fixed fee f_i that is paid upon contract acceptance and, with RPM, also a retail price p_i ;
2. each retailer observes its contract offer, rejects the offer or accepts it, and sets the retail price (absent RPM); rejecting the contract yields a profit of Ω .

3. in the case of contract acceptance, during the contract period:
 - (a) each retailer takes a service decision;
4. consumers choose where and whether to buy.

The service decision is not contractible, as is common in the literature (Mathewson and Winter, 1998; Telser, 1960; Hunold and Muthers, 2017). The decisions could take different forms. Let us first consider a binary choice of either putting the product on the shelf (and thus selling the product) or not selling it at all.

In stage 3, the fixed fees are sunk, so that only the retail prices p_i and linear wholesale prices w_i matter for the retailers' binary service decisions. Given contract acceptance, it is profitable for retailer i to put the product of manufacturer i on the shelf if the incremental profit is higher than the profit of using the shelf space otherwise (for a product from a different category, for instance). We denote the *ex-post* outside options by Δ , while the *ex-ante* outside option to the contract is denoted by Ω .¹⁹

The retailer will thus only sell the product in **stage 3** if the service constraint is satisfied, that is,

$$\pi_i = (p_i - w_i)D_i(p_i, p_{-i}) \geq \Delta. \quad (10)$$

This is independent of the fixed fee f_i . For Δ sufficiently large, condition (10) binds and thereby this service decision defines and limits the wholesale price w_i .

The retailer only accepts the contract in **stage 2** if

$$\max[\pi_i, \Delta] - f_i \geq \Omega. \quad (11)$$

The eventually relevant case is, of course, the one where the sales profit π_i is weakly larger than Δ , such that the retailer stocks the product of manufacturer i .

Suppose first that the ex-ante outside option Ω equals the ex-post outside option Δ . This means that accepting the contract does not diminish the outside option. Assume that condition (10) binds ($\pi_i = \Delta$). In this case, condition (11) simplifies to $\Delta - f_i \geq \Omega = \Delta$, which implies $f_i = 0$. In this case, the optimal tariff is linear.

Suppose now that Ω is larger than Δ . This could arise if rejecting the contract of manufacturer i at an early stage saves additional storage space or time that can be used to purchasing another product. In this case of $\Omega > \Delta$, it is optimal for the manufacturer to set a fixed transfer equal to the difference $\Omega - \Delta$ to cover the incremental value of the outside option before contract acceptance. This would result in a negative fixed fee $f_i = \Omega - \Delta$.

However, for a sufficiently large opportunity cost of Δ post-contract acceptance, the wholesale price is still bound and defined by Δ , making it impossible for colluding manufacturers to achieve higher wholesale prices without further instruments (in particular, without RPM). This means that observing (non-zero) fixed fees does not imply that the manufacturers can achieve high collusive wholesale prices (w_i) absent RPM.

¹⁹In Annex B, we consider that the ex-post outside option for the retailer is to stock a store brand that is a substitute to the manufacturers' products and consider two-part tariffs. In that case, the outside option can still be used post-contract acceptance but has additional effects in the market. However, the results are qualitatively unaffected by these effects.

Finally, when $\Omega \leq \Delta$, it is optimal for the manufacturer to use positive fixed transfers ($f_i > 0$) as, post-contract acceptance, it has to provide a lower wholesale price in order to ensure the high sales incentives anyways (condition 10).

Proposition 5. *When the non-contractible outside option post-contract acceptance (Δ) is large enough, RPM is necessary for colluding manufacturers to obtain monopoly prices even when two-part tariffs are feasible. In this case, the optimal two-part tariff may be linear or have a fixed upfront payment (in either direction), depending on the size of the outside option before contract acceptance (Ω).*

When the retailers' outside options after contract acceptance (Δ) is zero or sufficiently small, colluding manufacturers may be able to implement monopoly prices without RPM by means of (observable) two-part tariffs with an upfront payment.

Proof. In stage 3, the analysis is completely analogous to that resulting in propositions 1 and 2, with Ω being replaced by Δ . This means that for a large enough Δ , the wholesale prices absent RPM are defined by w^* according to equation (3), with both manufacturer competition and symmetric collusion. Analogously to Proposition (3), with RPM, the colluding manufacturers could implement higher wholesale and retail pricing, subject to the constraint that each retailer's profit before the fixed fee equals Δ . This proves the first sentence of the proposition.

Given $\pi_i = \Delta$ (with or without RPM), the condition (11) for contract acceptance simplifies to $\Delta - f_i \geq \Omega$. Each manufacturer optimally chooses the highest feasible fixed fee, which is defined by $f_i = \Delta - \Omega$. For $\Delta = \Omega$, the optimal tariff is linear. The optimal tariff contains a positive fixed fee for $\Delta > \Omega$, and a negative one (like a "slotting allowance") for $\Delta < \Omega$. This proves the second sentence of the proposition.

For $\Delta = 0$, colluding manufacturers can raise the wholesale price w to a level of w^M that results in $p(w^M) = p^C$ without violating the service participation constraint (10). The same holds for a positive but small enough Δ , such that $(p^M - w^M) \cdot q(p^M, p^M) > \Delta$. The manufacturers then set a fixed fee of $f_i = \pi_i - \Omega$ to satisfy the contract acceptance constraints. \square

(The intuition behind the result) is that the fixed component of the vertical contract can only compensate for the outside option to the contract but not for actions that the retailers can take after contract acceptance, whenever these actions are not contractible. As regards typical retail markets, one could speculate that the outside option to a contract becoming less valuable post-contract acceptance ($\Delta \leq \Omega$) is the more typical case. This is at least consistent with descriptions whereby the manufacturers of coffee in Germany pay fixed amounts to the retailers.²⁰

Partial contractability of retailer actions. Let us consider a less extreme service decision than above. This might apply in a case where putting the product on a shelf is something that the manufacturer and retail can contract upon.

A less extreme retail service decision might be whether to put the product in a more or less prominent shelf space, which may, for example, depend on which other products

²⁰OLG Düsseldorf, court decision 4 Kart 3/17 (OWi), February 18, 2018, par. 81, 2 c) "Agreement on prices of 4 November 2005".

are located on the same shelf. Another part of the service decision may be whether to promote or advise one product more than another product.

In these cases, the service decision may again affect the sales volume q_i and may depend on the margins that the retailer makes on additional sales of the one or other product. Again, the decision would depend on the retail price (p_i) and the linear wholesale price (w_i), but not the sunk fixed fee (f_i). Consequently, the fixed fee may still not be enough to ensure sufficiently high margins of the product, hence RPM may be necessary, especially in the case of high wholesale prices.

5.2 In-market alternatives (store brands)

In addition to the case of “out-of-market” outside options (modeled as Ω and also Δ), we also consider the case in which the alternative consists of selling a (perfect) substitute to the manufacturer’s product within the market even after accepting one manufacturer’s contract. We allow for this by assuming that each retailer can additionally introduce a product from a competitive fringe that is identical to its manufacturer’s product (“store brand”). The fringe offers this product at constant marginal costs of $c > 0$ to the retailer. The store brands of the different retailers are still differentiated just like the brand products of the manufacturers A and B. In order to exclude that RPM is enforced when it only benefits the store brand, we assume that each manufacturer-retailer pair can renegotiate the contract terms if the rival retailer unexpectedly offers a store brand. Otherwise, the store brand could free ride on the high prices implemented with RPM at the competing retailer.

The store brand acts as an outside option which limits the wholesale price manufacturers can charge. With RPM, however, manufacturers can ensure the profitability of their product without needing to lower the wholesale price.

Summary 1. Studying both linear and two-part tariffs, we find that RPM facilitates manufacturer collusion when the retailers’ outside option consists of the possibility to introduce substitute products.

This confirms the results obtained for “out-of-market” outside options. Please see Annex B for the detailed analysis.

5.3 Unobservable linear tariffs

In certain industries, it is conceivable that the contracts offered to competing retailers are not observable when a retailer decides on her own supply contracts.

To study such instances, we now change the information structure and end up in a model that is similar to Pagnozzi and Piccolo (2011). Each retailer observes the contract offered to her, but not the contract offered to the competing retailer. Hence, the retailers set prices and decide whether to accept contracts based on their wholesale price and the belief they have about the other wholesale price. Let us assume that the retailers hold passive beliefs about the other’s wholesale price. We maintain the assumption that the manufacturers can publicly commit to using RPM in scenarios 3 and 4. We solve the new

game for perfect Bayesian Nash Equilibria (PBNE) with passive beliefs.²¹ With passive beliefs, a retailer who receives an out-of-equilibrium offer assumes that the other retailer still receives the equilibrium offer.

A direct consequence of not observing the contract offered to a competitor is that the contract acceptance of a retailer cannot depend on the wholesale price offered to its competitor. Recall that the equilibrium may fail to exist if a marginal lowering of the wholesale price causes the other manufacturer's offer to not be accepted (fn. 9). The non-existence problem vanishes with unobservable contract offers.

Manufacturer collusion absent RPM. Under public contracts, we obtained the equilibrium that each manufacturer sets $w^*(\Omega)$. This is still an equilibrium outcome with unobservable contracts. Suppose a retailer observes a contract offer with $w = w^*(\Omega)$ and expects that its competitor has received the same contract offer. Both retailers would accept such a contract, yielding prices of $p^*(\Omega)$ and a retail profit of Ω .

Would the colluding manufacturers want to deviate? Offering a larger wholesale price is not profitable, as such a contract would not be accepted by any retailer. Offering a lower wholesale price is also not profit-increasing for a manufacturer. Hence, the equilibrium outcome is the same under observable contracts as under unobservable contracts.

Manufacturer collusion with RPM. As the RPM prices of both manufacturers are observable to both retailers, the retailers face no uncertainty with respect to their own profit when accepting a contract and will only accept contracts that, given the fixed retail price, ensure a retail profit of at least Ω . Hence, again, the outcome is the same as under observable contracts. Each manufacturer offers the industry profit-maximizing price and chooses the highest feasible wholesale price (such that each retailer gets a profit equal to Ω).

The comparison of these two cases already highlights that RPM increases profits under collusion.

Competition without RPM. Suppose that the manufacturers compete without RPM. Again, suppose that the equilibrium wholesale prices equal $w^*(\Omega)$. Faced with such an offer, it is a best-response for each retailer to accept the contract and set $p^*(\Omega)$. Would a manufacturer want to deviate? Increasing the wholesale price under passive beliefs does not change the expectation for the wholesale price of the competing retailer. Thus, a contract with a higher proposed wholesale price would not be accepted by the retailer.²² Lowering the wholesale price would not change the acceptance decision but would lead to lower manufacturer profits as well.

Competition with RPM. With RPM, again, the same result is obtained as with observable wholesale tariffs. The same logic as in the previous case of competition without RPM applies.

²¹As before, we solve the contracting and pricing game under the assumption that the cartel maximizes their joint profits. We treat the scenarios individually, such that the passive beliefs are correct in each of the four scenarios.

²²Note that even under symmetric beliefs, since there is no larger symmetric combination of w that satisfies the participation constraint of the retailers, a price increase is not profitable.

Proposition 6. *With private contracting over the wholesale prices, for each scenario (RPM/no RPM, competition/collusion), there exists a perfect Bayesian equilibrium with passive beliefs where the same prices result as in the same scenario with observable tariffs.*

5.4 Multi-product retailers

Supermarkets usually sell multiple brands of each product. We study now how multi-product retailing affects our results. For this, we sketch a simple extension of our model under which the results we obtained under single product retailers qualitatively hold in a context of multi-product retailing.

In this extension each brand is sold at both retailers, which corresponds to the interlocking relationships of Rey and Vergé (2010). Following Rey and Vergé (2010), we maintain the assumptions that manufacturers offer public take-it-or-leave-it contracts.

There are recent alternative approaches, like Rey and Vergé (2020), that feature more detailed negotiations between manufacturers and retailers and a more complex information structure.²³ However, using a more complex approach is beyond the scope of our analysis.

The retailers have an exogenous outside option to accepting the contracts of the two manufacturers. If any contract offer is not accepted, the game ends with both retailers realizing their outside options. Assume that the outside option for both products has the value 2Ω for the retailer. In the competitive symmetric equilibrium without RPM, each manufacturer thus has to make sure that each retailer j makes sufficient profits with both products (with index i):

$$\pi_j(w^*, w^*) \equiv \sum_i (p_i - w^*) D_{ij} \geq 2\Omega, \quad (12)$$

where D_{ij} is a retailer's demand for manufacturer i 's product, which depends on all retail prices. This condition pins down the symmetric wholesale price, similar to the case of single product retailing above. The difference is that D_{ij} depends on all four prices, such that each retailer partially internalizes the brand competition when setting prices but not the retail competition. The unrestricted (disregarding the outside options) competitive price level is below the industry profit-maximizing if the levels of manufacturer and retailer competition together are large enough. The competitive prices are further reduced by the outside options when the latter are large enough, such that condition (12) binds with equality.

A cartel that only coordinates wholesale prices (without RPM) cannot improve on the competitive outcome as increasing the wholesale price level would still lead to a rejection of the contracts by the retailers.

In contrast, a cartel that uses RPM sets industry profit-maximizing retail prices and uses the wholesale prices, which are then decoupled from the retail prices, to ensure participation of the retailers.

²³Our key assumption is that the contract offered by the competing manufacturer does not impact the retailer's outside option. Taking that additional effect into account makes the analysis sensitive to assumptions on the timing and information structure of the contract offers that are beyond the scope of the present analysis.

Proposition 7. *When each retailer sells the products of both manufacturers, RPM allows the colluding manufacturers to implement the retail prices that maximize the industry profits, as in the case of single product retailers.*

The results for competition with RPM depend on the demand assumptions: Are brands or retailers closer substitutes? RPM shifts pricing to manufacturers who internalize retailer competition but not brand competition. This compares to the case without RPM where retailers internalize brand competition but not retail competition. If brand competition is relatively intense, RPM may still cause a manufacturer dilemma. Recall from section 4.4 that there is an additional incentive for manufacturers to lower prices as they face lower perceived marginal costs than the retailers who instead face a positive wholesale price.

5.5 Unilateral introduction of RPM

So far, we have only discussed industry-wide RPM. Suppose each manufacturer can introduce RPM unilaterally. Would the manufacturers use RPM? Consider the following extension of the game:

- In stage 1, in addition to the wholesale price, each manufacturer can fix a retail price in the contract offered to its retailer, or can leave this to the retailer later on.

This means that both manufacturers simultaneously decide whether to include RPM in the contract with their retailer and thus determine retail and wholesale prices at the same time.

Is the competitive equilibrium still an equilibrium? Suppose manufacturer A fixes p^* in addition to setting w^* . Manufacturer B has no incentive to deviate from w^* as an increase would result in delisting, whereas a decrease of the wholesale price would result in lower profits.

Would manufacturer A want to charge different prices? Whenever p^* does not maximize the joint manufacturer-retailer profits, manufacturer A can deviate by playing the best-response to p^* and adjusting the wholesale price w , such that retailer A is still indifferent to rejecting the contract offer. Hence, a unilateral introduction of RPM is always (at least weakly) profitable for the manufacturer.

Given that retailer B chooses p^* as a best-response to a price of p^* at retailer A when she faces marginal costs of w^* , manufacturer A controlling the retail price and facing marginal costs of zero would always choose a price smaller than p^* as a best-response to p^* . Thus, the competitive equilibrium prices that result absent RPM cannot be part of an equilibrium with RPM, as each manufacturer would use RPM and choose a lower price. Consequently, there can only be equilibria with RPM that have prices that are strictly below the competitive equilibrium prices. In turn, the equilibrium wholesale price has to be below w^* as well. Although this could be profitable in certain cases, this cannot be profitable whenever the outside option is binding under competition.

Summary. If the manufacturers can use RPM, both manufacturers will individually choose to control the retail price. When the manufacturers compete, the equilibrium prices and manufacturer profits are lower than when the manufacturers could not control the retail

prices through RPM. RPM is thus a dilemma for manufacturers that compete in prices in the present setting as, collectively, the manufacturers would prefer to ban RPM.

6 The coffee cartel in Germany 2003–2008

Key brand manufacturers formed a cartel in the period from 2003 to 2009 to coordinate their sale of coffee to supermarkets in Germany.²⁴ In the following we highlight some of the features of this cartel. The features of this case are likely shared by similar cartels on consumer goods sold through supermarkets, such as those mentioned in the introduction.

Success of collusion with and without RPM. The brand manufacturers coordinated various wholesale price increases. According to the case descriptions, they had been coordinating wholesale price increases since 2003.²⁵ Initially, the use of resale price maintenance and the coordination of the retail price increases was limited, as was the success of the price increases. Although the coordinated wholesale price increase of April 2003 was followed by price increases of some retailers, the retail prices dropped again after some time and the manufacturers took back the wholesale price increase in September 2003. The cartelists used RPM more successfully since 2004 and achieved higher price increases in the period from December 2004 to 2008 (see Holler and Rickert (2019) for an econometric analysis). The cartel ended in 2008 after the German competition authority raided several coffee manufacturers.

Our theory explains the observation that the manufacturer cartel only became successful in sustaining higher prices with RPM. Moreover, we can also rationalize why the manufacturers started using RPM when they were coordinating their prices. Our theory predicts lower wholesale prices and manufacturer profits when the manufacturers use RPM without coordinating their wholesale prices when compared to a situation of wholesale price competition absent RPM.

Transparency. According to court evidence, for the limited number of brand manufacturers of coffee in Germany, transparency in the sales markets is high (par. 52).²⁶ Not only would the manufacturers have good visibility of the competitors' retail prices, the manufacturers would even have good visibility of the competitors' wholesale prices, as the retailers would regularly immediately inform the manufacturers of each others' wholesale conditions (par. 34).²⁷

The evidence indicates that RPM is not necessary for the manufacturers to overcome a lack of transparency of the retail market conditions and, most importantly, the wholesale prices of their competitors. These are the conditions under which Jullien and Rey (2007) show that RPM may facilitate collusion.

Moreover, the manufacturers having a high wholesale and retail price transparency and getting timely updates on the price changes of competitors speaks in favor of our

²⁴OLG Düsseldorf, court decision 4 Kart 3/17 (OWi), February 18, 2018.

²⁵Case report "Bußgelder wegen vertikaler Preisabsprachen beim Vertrieb von Röstkaffee" of the Bundeskartellamt, January 18, 2016.

²⁶OLG Düsseldorf, court decision V-4 Kart 5/11 (OWi) of February 10, 2014.

²⁷OLG Düsseldorf (2004), see fn. 26 above.

model assumption of public wholesale tariffs. The observation also indicates that the manufacturers can react very quickly if one of them undercuts a certain price level – a collusion facilitating factor.

Price sensitivity. The court decision emphasizes the high price sensitivity of coffee. For instance, it states that a small increase in the retail price of coffee could lead to changes in the market shares of the coffee brands of 5 or even 10 percentage points (par. 52).²⁸ Overall, this justifies focusing our formal analysis on the price elasticities of demand that are not very low.

7 Conclusion

We started from the empirical observation that resale price maintenance (RPM) has been used by colluding manufacturers in various cases and even appeared to be an important factor in making collusion successful. Studying these cases, we found that the explanation of Jullien and Rey (2007) does not seem to apply there as it relies on information asymmetries about demand, which we could not identify as a driving force.

In light of the case material, we have developed a new theory of how RPM can facilitate upstream collusion absent any information asymmetries. We start with the assumption that retailers have an effective outside option to each manufacturer’s contract, such that manufacturers can only ensure contract acceptance by leaving a sufficient margin to the retailers. This restricts the wholesale price level even when manufacturers collude. We show that collusion may only be effective, that is, yield higher prices than competition, if the manufacturers can use minimum RPM. The reason is that minimum RPM allows the manufacturers to ensure sufficiently high retail profits on their products, even if the wholesale prices are at the collusive level. Otherwise, without RPM, selling the cartelized products at high wholesale prices becomes unprofitable for the competing retailers.

Our baseline model features two competing manufacturers, of which each sells through an exclusive retailer, similar to Bonanno and Vickers (1988). Each retailer has an outside option and manufacturers offer linear take-it-or-leave-it contracts. In this setting, we study manufacturer competition as well as collusion, both with and without RPM. We extend our model in various ways and show that our theory applies under various market conditions, including secret contracting, two-part tariffs, contract re-negotiations, and “in-market”-alternatives of the retailers, like store brands.

This article studies manufacturer collusion and vertical restraints, in particular RPM. It raises additional questions that require further economic research. One question asks what retailers know about collusion upstream when deciding on the supply contracts. This is particularly relevant with secret contracting when the retailers need to form beliefs about their competitors’ contracts.

Beyond our formal analysis that relies on the effective outside options of retailers, our theory addresses a general puzzle regarding the relevance of RPM for collusion. The

²⁸OLG Düsseldorf (2004), see fn. 26 above.

more general insight is that an upstream cartel still suffers various fundamental problems regarding the coordination of competing downstream firms that also an upstream monopolist suffers. RPM is capable of solving various of these problems. These problems may be less of an issue when there is no, or only limited, market power upstream, such that RPM is less needed. Then, RPM can even intensify manufacturer competition and thereby reduce manufacturer profits. However, once the manufacturers collude and act similarly to an upstream monopolist, RPM becomes, quite generally, a desirable tool to increase collusive profits or even enable collusion at all.

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Annex A: Renegotiation subgame

For this analysis, we need to be more precise about the reaction functions of the manufacturers. We assume that the manufacturer equilibrium is stable:

Assumption 5. *The reaction functions of the (unconstrained) manufacturer pricing game absent RPM are upward sloping with a slope below 1.*

This standard assumption is consistent with our previous assumptions and holds, for instance, when demand is linear in prices, as in equation (8).²⁹

To ensure that all vertical contracts are accepted in equilibrium when the manufacturers compete, we assumed that both manufacturers make zero profits (“market breakdown”) if the contract of one manufacturer is not accepted (see section 3).

Without this assumption, there is the following non-existence problem when both manufacturers set symmetric wholesale prices, such that the retailers’ participation constraints (1) bind: By marginally lowering the input price, manufacturer A can ensure that the contract of manufacturer B is not accepted because the competing retailer B will make a lower profit, which violates its participation constraint. The problem exists similarly in other models (for instance, see Rey and Vergé (2010); Bonanno and Vickers (1988)). Schutz (2013) explains the non-existence problem in more detail. Intuitively, this non-existence problem arises because, by assumption, the game ends after a move that leaves the other manufacturer wanting to respond. Thus, it is natural to extend the model by allowing for a richer negotiation between manufacturers and retailers.

In this extension, we show that we do not need the ad hoc assumption of zero profits for the manufacturers. We demonstrate that we obtain the same results when including a single renegotiation stage in the contracting game.

We extend the game presented in section 3 by inserting stage 2b:

1. each manufacturer $i \in \{A, B\}$ offers its retailer a contract (a wholesale price w_i ; with RPM also a retail price p_i);
2. contract acceptance/rejection and renegotiation:
 - (a) each retailer observes both contract offers, rejects the offer or accepts it, and sets the price p_i (absent RPM);
 - (b) *if a retailer does make a profit lower than the outside option value of Ω when accepting the contract, it can reject the contract and ask its manufacturer for another offer; in this case, the manufacturer can make another offer and the retailer then decides whether to accept or reject;*
3. consumers choose where and whether to buy.

The renegotiation stage 2(b) ensures that a manufacturer, say A , has no incentive to lower its wholesale price below the level at which the retailers’ participation constraints bind. In the following steps we analyze the extended game with and without RPM.

²⁹See equation (15) for the parametric reaction functions.

Contract renegotiation under manufacturer competition absent RPM

Proposition 8. *Absent RPM and with manufacturer competition, the wholesale prices of w^* as stated in Proposition 1 are an equilibrium in the modified game with renegotiation absent the assumption of market breakdown.*

Proof. To verify this result we rule out profitable deviations by manufacturers. Suppose that in stage 1, absent RPM, manufacturer B offers retailer B the linear wholesale price of w^* , as defined in the equation (3), and expects manufacturer A to offer retailer A the same price of w^* . We need to check whether it is optimal for manufacturer A to indeed offer a price of w^* .

First, if manufacturer A chooses a slightly lower wholesale price of $w^* - \epsilon$, then retailer B would make a profit of

$$\pi_B^*(w^*, w^* - \epsilon) < \Omega$$

when accepting the offer, provided that retailer A has accepted its offer as well (which turns out to be optimal for retailer A). In this case, retailer B rejects the offer in stage 2(a) and asks manufacturer B for a new offer in stage 2(b). Manufacturer B then optimally makes a new offer with a wholesale price $w^* - \gamma$, such that

$$\pi_B^*(w^* - \gamma, w^* - \epsilon) = \Omega.$$

This offer is accepted by retailer B . Note that $\gamma < \epsilon$ because manufacturer B offers a slightly larger wholesale price as a best-response than manufacturer A as $\pi_B^*(w^* - \epsilon, w^* - \epsilon) > \Omega$ and the retailer's profit is monotonously decreasing in each manufacturers' wholesale price. A further reduction of the wholesale price is not optimal for retailer B as this lowers its profits, while it has no effect on the acceptance of manufacturer A 's contract. Note that the fact that manufacturer B does not want to react with wholesale prices below that of manufacturer A follows from the stability Assumption 5.

Under the condition specified in Lemma 1 (binding outside options), the resulting profit of manufacturer A is lower than if manufacturer A had chosen a price of w^* in stage 1. To see this, denote by $\Pi(x, y)$ the reduced profit absent the RPM of a manufacturer with a wholesale price of x , when the other manufacturer sets a wholesale price of y . The above statement can be written as

$$\Pi(w^*, w^*) > \Pi_i(w^* - \epsilon, w^* - \gamma).$$

One can extend the statement to

$$\Pi(w^*, w^*) > \Pi_i(w^* - \gamma, w^* - \gamma) > \Pi_i(w^* - \epsilon, w^* - \gamma).$$

The first inequality holds because higher symmetric wholesale prices mean higher manufacturer profits in a range where the retailers' outside options bind. The second inequality holds because, with single peaked manufacturer profits and reaction functions with a positive slope below one (assumptions 3 and 5), a price $w^* - \gamma$ is a better response to a price of $w^* - \gamma$ than a price of $w^* - \epsilon$.

If manufacturer A makes a deviating offer of $w^* - \epsilon$ and retailer A does not accept the offer, it gets the outside option value of Ω . When accepting the offer, retailer A ends up

making a profit of $\pi_B^*(w^* - \epsilon, w^* - \gamma) > \Omega$. Retailer A thus accepts the deviating offer of manufacturer A .

Suppose now that manufacturer A chooses a higher price of $w^* + \epsilon > w^*$. Retailer A would not accept the contract as the $\pi_B^*(w^* + \epsilon, w^*) < \Omega$ while retailer B would get at least a profit of Ω and thus accept the contract of manufacturer B . Manufacturer A can now make another offer to retailer A . Given strategic complementarity and a unique fixed point of the manufacturer's (unconstrained) reaction functions above w^* , the best offer of manufacturer A is w^* . Retailer A accepts this offer as it yields a profit of Ω . Charging a higher price than w^* in stage 1 is thus not a profitable deviation for a manufacturer in stage 1.

As a result, a manufacturer has no incentive to make a deviating offer. This holds for both a marginally different wholesale price (when ϵ is arbitrarily close to 0) and the case of a larger deviations. \square

Contract renegotiation under manufacturer competition with RPM

Proposition 9. *With RPM and manufacturer competition, the wholesale prices of w^* as stated in Proposition 4 are an equilibrium in the modified game with renegotiation absent the assumption of market breakdown, provided that $\Omega < \bar{\Omega}$ as defined in equation (13).*

Proof. Suppose that in stage 1, absent RPM, manufacturer B offers retailer B prices of w^{RPM} and p^{RPM} , as defined by equations (7) and (6), and expects manufacturer A to offer retailer A the same prices.

Analogous to the case without RPM, the critical deviations are price reductions that might exclude product B from the market – but with RPM this concerns reductions of the retail price p_A .

Suppose that manufacturer A lowers the retail price to $p^{RPM} - \epsilon$ to achieve that retailer B does not accept the contract that manufacturer B offers in stage 2a.

Suppose that retailer A still accepts the deviating contract (manufacturer A can ensure this by lowering w_A appropriately, so that retailer A gets a profit of Ω). Retailer B will reject, so that manufacturer B can make another contract offer in stage 2b. This contract offer is a best-response to $p_A = p^{RPM} - \epsilon$. Manufacturer B solves the problem

$$\begin{aligned} & \max_{p,w} w \cdot D(p, p^{RPM} - \epsilon) \\ \text{s.t. } & (p - w) D_i(p, p^{RPM} - \epsilon) \geq \Omega. \end{aligned}$$

As the constraint optimally holds with equality, the problem decreases to

$$\max_p p \cdot D(p, p^{RPM} - \epsilon) - \Omega.$$

As the best-response in retail prices has a slope of less than one and the best-response functions have a unique fixed point at p^{RPM} , the best-response price $p_B = p^{RPM} - \gamma$ is in the interval $(p^{RPM} - \epsilon, p^{RPM})$. Retailer B accepts the contract (provided it is possible for manufacturer B to provide retailer B with a profit of Ω – we come back to this point below). The resulting profit for manufacturer A is thus

$$(p^{RPM} - \epsilon) \cdot D(p^{RPM} - \epsilon, p^{RPM} - \gamma) - \Omega.$$

Let us now demonstrate that this profit is below the profit of

$$p^{RPM} \cdot D(p^{RPM}, p^{RPM}) - \Omega$$

that manufacturer A gets without a deviation. Manufacturer A prefers the prices p^{RPM}, p^{RPM} over $p^{RPM} - \gamma, p^{RPM} - \gamma$ as the RPM prices are the result of competition, which means that the industry profit-maximizing prices are higher.

Manufacturer A prefers the prices $p^{RPM} - \gamma, p^{RPM} - \gamma$ over the prices $p^{RPM} - \epsilon, p^{RPM} - \gamma$ because, according to our assumption 3 and a unique fixed point (at p^{RPM}, p^{RPM}), a best-response to $p^{RPM} - \gamma$ is strictly higher than $p^{RPM} - \gamma$ and not lower. The profit resulting from $p^{RPM} - \gamma, p^{RPM} - \gamma$ is thus better than that from $p^{RPM} - \epsilon, p^{RPM} - \gamma$.

This shows that it is impossible for manufacturer A to prevent retailer B from selling the competing product by means of a small price cut as long as retailer B 's participation constraint is satisfied. The constraint of retailer B is not satisfied if $\max_p p \cdot D(p, p^{RPM} - \epsilon) < \Omega$. In this case, manufacturer B cannot satisfy retailer B 's participation constraint without making a loss.

Exclusion will occur if Ω is such that $w^{RPM} = 0$, as this implies $p^{RPM} D(p^{RPM}, p^{RPM}) = \Omega$. By marginally undercutting p^{RPM} , the deviating manufacturer A can ensure that B cannot break even anymore as $\max_p p D(p, p^{RPM} - \epsilon) < \Omega$ for $\epsilon > 0$. Manufacturer A benefits as the product-line profit for product A jumps up from $p^{RPM} D(p^{RPM}, p^{RPM})$ to approximately $p^{RPM} D(p^{RPM}, \infty)$. Manufacturer A can thus raise w_A and make a positive profit by reducing p^{RPM} and excluding product B .

A renegotiation between manufacturer B and retailer B does not help as it is no more advantageous for products A and B to profitably co-exist on the market and retailer A has already agreed to sell product A .

As shown before, given $w^{RPM} = 0$, a retail price p_A slightly below p^{RPM} is sufficient for excluding B , when $w^{RPM} > 0$, a larger retail price cut is necessary as otherwise manufacturer B can profitably reduce w_B and thereby ensure that the participation constraint of retailer B is nevertheless satisfied.

Exclusion cannot occur if

$$\Omega \leq \bar{\Omega} \equiv \max_p p \cdot D(p, 0) \quad (13)$$

because a manufacturer then cannot reduce the product-line profit of the other product below Ω .

In summary, a manufacturer thus has no incentive to deviate from symmetric pricing with a wholesale price of w^{RPM} and a retailer price of p^{RPM} if $\Omega < \bar{\Omega}$. \square

Annex B: Within-market alternatives (store brands)

Before, we assumed that each retailer has an exogenous outside option with value Ω that materializes when rejecting a manufacturer's contract. We now consider the case in which the alternative consists of selling a (perfect) substitute to the manufacturer's product within the market even after accepting one manufacturer's contract. We analyze

this setting first with linear and then with two-part tariffs.

Assume that each retailer can additionally acquire a product produced by a competitive fringe that is identical to its manufacturer's product. This product is sold and produced at constant marginal costs of c to the retailer. The store brands of the different retailers are still differentiated just like the brand products of the manufacturers A and B.

Assumption 6. *The outside option is sufficiently attractive (c low enough), such that, without the fringe products and under manufacturer competition with linear tariffs, each manufacturer would unilaterally charge a larger wholesale price than c if the other manufacturer charges a wholesale price of c .*

Let us first consider linear tariffs and then two-part tariffs. The timing is:

1. Each manufacturer $i \in \{A, B\}$ offers its retailer a contract (a wholesale price w_i ; with RPM also a retail price p_i);
2. Each retailer i observes both contract offers, rejects the offer of manufacturer i or accepts it;
3. Each retailer decides whether to purchase the perfect substitute from the competitive fringe;
4. Each retailer observes whether a store brand (one of the retailers resells products from the competitive fringe) is offered in the market;
5. Simultaneously:
 - Each retailer who observes a store brand at the other retailer and who has previously accepted the manufacturer's contract can offer his manufacturer a different contract (w_i and an RPM price in the case of RPM); the manufacturer accepts or declines the retailer's offer; in the case of rejection, the previous contract is in force.
 - Each retailer sets the retail price p_i (possibly bound by RPM).³⁰
6. Consumers choose whether and where to buy.

In stage 5 we allow retailers to react to the presence of store brands. Without renegotiation, the store brand would allow each retailer a 'free-ride' on RPM that still binds the other retailer. Although, in this case, enforcing RPM is in the interest of neither the retailer nor its supplier. Alternatively to a full renegotiation of the contract, one could assume that manufacturers do not enforce RPM in case store brands are offered, which yields qualitatively similar results.

³⁰As for each retailer i the fringe product and the product of manufacturer i are perfect substitutes, there is only one retail price at the retailer

Solution for the case of linear tariffs

Manufacturer competition without RPM. If the outside option is sufficiently attractive, c is below the unconstrained wholesale price, then w_i is limited by c . This is the case due to Assumption 6.

In equilibrium, each manufacturer offers $w_i = c$ and the resulting consumer prices are $p^*(c, c)$. No manufacturer can set a larger wholesale price and expect the retailer to sell any quantity of its product. Moreover, no manufacturer has an incentive to lower its wholesale price as this results in lower profits. In summary, the result is comparable to the case of a fixed outside option.

Proposition 10. *Note that with wholesale prices of c , no retailer has an incentive to purchase the perfect substitute from the competitive fringe in stage 3. If a retailer were to stock the fringe product, the renegotiation that would become possible at the other manufacturer-retailer pair would not lead to a different wholesale price. With linear contracts, there is no scope of renegotiation of a $w = c$ when the competitor has costs of c , as the manufacturer prefers increasing the wholesale price while the retailer wants to reduce the price.*

In equilibrium, $w = c$ as if renegotiation were not possible (absent stage 5).

Cartel without RPM. Given negative price externalities, a manufacturer cartel that maximizes the joint manufacturer profits would find it profitable to increase prices above the competitive level if there was no fringe competition. However, similar to the previous case of manufacturer competition, the manufacturer cartel is limited by the fringe cost of c , which again results in $w_i = c$ and $p^*(c, c)$. If the cartel charged a price above c both retailers would rather sell their store brand. This occurs whenever the competing manufacturers are limited by c as well (Assumption 6). Again, the possibility to renegotiate has no impact as there is no scope to reduce the wholesale price below c , such that, when selling, both retailers facing costs of c is the relevant outside option.

The cartel could increase its profits compared to competition only if the outside option was not sufficiently attractive to affect the competitive equilibrium, that is, when $w^* < c$. This case is excluded under Assumption 6.

Proposition 11. *The same prices and profits as absent a cartel and absent RPM result.*

Cartel with RPM. With linear tariffs, the cartel could make larger profits with RPM if and only if it can increase the wholesale price above c . So when does a retailer accept a contract with a larger wholesale price?

With RPM, we characterize an equilibrium in which each manufacturer offers a contract with a price fixed at the industry profit maximum p^C and an accompanying wholesale price $w^C > c$ in stage 1. Both retailers accept the symmetric offers and do not purchase from the fringe.

To establish that this is an equilibrium, we have to rule out that a retailer, say $-i$, purchases the perfect substitute from the fringe in stage 3 at a lower wholesale price of c and is free to choose its retail price. The downside of buying from the fringe is that the other retailer can react to this unexpected market behavior by renegotiating its contract with the manufacturer.

If retailer $-i$ decided to sell a store brand, the downstream prices and profits depend on how retailer i reacts to this deviation in stage 5a. Retailer i makes manufacturer i an offer with a retail price that best-responds to the marginal costs of c that retailer $-i$ has based on the marginal production cost of 0 for product i . The wholesale price is set in a way that manufacturer i accepts the offer. This yields a deviation profit of the retailer $-i$ when stocking the fringe product of $\pi(c, 0)$. The deviation profit of a retailer is given by the profit a retailer makes when having marginal costs of c and competing in prices against a competitor with marginal costs of 0.

Let us now find the optimal contracts of the colluding manufacturers in stage 1. Suppose each manufacturer offers a contract with a price fixed at the industry profit maximum p^C and an accompanying wholesale price $w^C > c$. The resulting profit of each retailer has to be larger than the one obtained from selling the store brand. As the deviation profits are $\pi(0, c)$ independent of the equilibrium contract, the manufacturers will optimally choose the monopoly retail price of p^C and set the wholesale price w to satisfy

$$(p^C - w) \cdot D(p^C, p^C) = \pi(c, 0).$$

Note that $\pi(c, 0)$ is smaller than the profit $\pi(c, c)$ which a retailer makes when the competitor has marginal costs of c as well. This is the equilibrium profit absent RPM (see above). Moreover, $(p^C - c) \cdot D(p^C, p^C) > \pi(c, c)$ as the latter results under retailer competition. This implies that $w > c$ is feasible with RPM for the colluding manufacturers. Moreover, as the industry profits are higher with retail prices of p^C than without RPM and the retailers make lower profits, the colluding manufacturers make higher profits and thus benefit from RPM.

Summary. The manufacturer cartel achieves monopoly prices with RPM and benefits from RPM and collusion, whereas the retailers are worse off than in the cases absent RPM.

Competition with RPM. As in the previous case with RPM, a retailer's deviation profit when sourcing from the fringe is again independent of the initial contracts as the renegotiated prices are best-responses to the fringe costs and given by $\pi(c, 0)$.

If manufacturers compete using RPM, they will set retail prices that maximize the joint surplus of a manufacturer and its retailer net of the retailer's outside option. This means that the retail price is set based on the true costs of 0. The resulting retail prices on the equilibrium path are thus based on the true marginal costs of 0 as well. The industry profit per product thus equals $\pi(0, 0)$ and is lower than the industry profit absent RPM as long as the retail price level at fringe costs ($p^*(c)$) is below the monopoly level (we assume this).

Each manufacturer sets the wholesale price to satisfy the retailer's participation constraint with equality:

$$(p^*(0) - w) \cdot D(p^*(0), p^*(0)) = \pi(c, 0).$$

Again, the retailers make lower profits than absent RPM where the profit is $\pi(c, c)$. Whether the competing manufacturers make less profit with RPM than without depends on whether the reduction in industry profits dominates the reduction in retail profits.

Setting (below)	Industry profits (per product)	Retail profits	Manufacturer profit
No RPM (either competition or collusion)	$\pi(c, c) + c \cdot D_i(p^*(c), p^*(c))$	$\pi(c, c)$	$c \cdot D_i(p^*(c), p^*(c)) = p^*(c)D_i(c, c) - \pi(c, c)$
RPM and competition	$\pi(0, 0)$	$\pi(c, 0)$	$\pi(0, 0) - \pi(c, 0) = p(0, 0) \cdot D_i(0, 0) - \pi(c, 0)$
RPM and collusion	$p^C \cdot D_i(p^C, p^C)$	$\pi(c, 0)$	$p^C \cdot D_i(p^C, p^C) - \pi(c, 0)$

Table 4: Summary of prices and profits for the case of linear tariffs

Summary. When manufacturers compete, the introduction of RPM leads to lower retail prices (as absent renegotiations).

Summary of the linear tariff case when the retailers can sell a perfect substitute. Without RPM, the market outcome is again identical in the cases of manufacturer competition and an optimally organized manufacturer cartel. Hence, there is no scope for a cartel without RPM. The use of RPM does not affect the equilibrium profits of competing manufacturers. However, colluding manufacturers can use RPM to increase the wholesale price and retail prices if the RPM is sufficiently flexible, such that an industry-wide RPM collapses or is adapted when the retailers deviate by introducing store brands. This makes the introduction of store brands less attractive.

Solution for the case of two-part tariffs

Suppose that the game is as above, with the exception that the manufacturers use observable two-part tariffs that include a fixed transfer f_i from retailer i to manufacturer i in the contract. The fixed transfer takes place upon contract acceptance in stage 2. We exclude below marginal cost pricing, which implies $w \geq 0$.

Manufacturer competition without RPM. If retailer $-i$ rejects the offer of the manufacturer and buys from the fringe, the retailer i can make a new offer to manufacturer i . This offer is independent of the equilibrium tariff and equals $\pi(c, 0)$.³¹

Each manufacturer faces the following problem:

³¹Note that in stage 5 the renegotiation and downstream price setting are simultaneous.

$$\begin{aligned} \max_{w_i, F_i} \Pi_i &= f_i + w_i \cdot D_i(p_i, p_{-i}) \\ \text{s.t. retailer ex-ante participation:} & (p_i - w_i)D_i(p_i, p_{-i}) - f_i \geq \pi(c, 0), \\ \text{retailer ex-post incentive constraint:} & (p_i - w_i)D_i(p_i, p_{-i}) \geq \pi(c, 0). \end{aligned}$$

In equilibrium, at least the ex-ante participation constraint has to bind as otherwise manufacturer i could increase f_i until it binds. Given the ex-ante constraint binds, the ex-post constraint can only hold if f_i is non-negative. This yields

Lemma 5. *The fixed fees cannot be negative in equilibrium.*

The problem can be rewritten as, with $f_i \geq 0$, the ex-post constraint always holds when the ex-ante constraint is fulfilled:

$$\begin{aligned} \max_{w_i, F_i} \Pi_i &= f_i + w_i \cdot D_i(p_i, p_{-i}) \\ \text{s.t.} & (p_i - w_i)D_i(p_i, p_{-i}) - f_i = \pi(c, 0), \\ & f_i \geq 0. \end{aligned}$$

Solving for F_i and substituting into the objective function yields

$$\begin{aligned} \max_{w_i} \Pi_i &= p_i^* \cdot D_i(p_i^*, p_{-i}^*) - \pi(c, 0) \\ \text{s.t.} & f_i = (p_i^* - w_i)D_i(p_i^*, p_{-i}^*) - \pi(c, 0), \\ & f_i \geq 0. \end{aligned} \tag{14}$$

Each manufacturer effectively maximizes the joint manufacturer and retailer profits with its product. Strategic delegation plays a role with observable wholesale tariffs, that is, an increase in a manufacturer's wholesale price increases the retail price of the competing manufacturer's product. Thus, the marginal wholesale prices are positive in equilibrium: $w^* > 0$. Note that the deviation profit $\pi(c, 0)$ only affects the fixed transfer f_i .

The equilibrium price level thus corresponds to the competitive outcome of direct price competition between manufacturers, dampened by the effects of strategic delegation as in Bonanno and Vickers (1988).

Cartel without RPM. The manufacturers could now coordinate on charging the highest possible marginal wholesale prices. These are achieved at the lowest possible fixed fees of $f_i = 0$, which implies that the retailer's participation constraint becomes $\pi(w, w) - \pi(c, 0) = 0$. Note that marginal wholesale prices above c are – in principle – feasible because at $w^* = c$ $\pi(c, c) - \pi(c, 0) > 0$, leaving scope to increase w . Depending on the wholesale price level under competition, the cartel may thus be able to raise the price level – to some extent.

Cartel with RPM. Suppose each manufacturer offers a contract with a price fixed at the industry profit maximum (p^C) and a wholesale price \tilde{w} .

The cartel's maximization problem is

$$\begin{aligned} \max_{p_i, w_i, f_i} \sum \Pi_i &= \sum_i f_i + w_i \cdot D_i(p_i, p_{-i}) \\ \text{s.t.} & (p_i - w_i)D_i(p_i, p_{-i}) - f_i \geq \pi(c, 0), \\ & f_i \geq 0. \end{aligned}$$

The renegotiation if one retailer purchases from the fringe is as before and implies a profit of $\pi(c, 0)$ for the deviator. The deviation profit is as before because if retailer $-i$ deviates and buys from the fringe, retailer i will make an offer to manufacturer i . The retail price will be a joint best-response of the manufacturer(s) and retailer i against retailer $-i$ with its fringe supply.

The cartel has sufficient instruments to maximize the industry profit and ensure that each retailer gets a profit equal to the outside option of $\pi(c, 0) \geq 0$. Given $p_i = p^C$, the retailer's contract acceptance condition becomes

$$(p^C - w_i)D_i(p^C, p^C) - f_i \geq \pi(c, 0).$$

Different feasible combinations of w_i and f_i fulfill this condition with equality; for instance, $w_i = 0$ and $f_i = p^C D_i(p^C, p^C) - \pi(c, 0) > 0$. We summarize in

Lemma 6. *With RPM, colluding manufacturers implement the industry profit maximum and extract all profits from the retailers up to the outside option $\pi(c, 0)$.*

Competition with RPM. Each manufacturer's problem is

$$\begin{aligned} \max_{w_i, f_i, p_i} \Pi_i &= f_i + w_i \cdot D_i(p_i, p_{-i}) \\ \text{s.t.} & (p_i - w_i)D_i(p_i, p_{-i}) - f_i \geq \pi(c, 0), \\ & f_i \geq 0. \end{aligned}$$

The outside option profit that results when rejecting the contract and purchasing the fringe good is still $\pi(c, 0)$ as this triggers a renegotiation of the other retailer and manufacturer.

Suppose that manufacturer $-i$ sets the retail price equal to the candidate equilibrium price p^* . Manufacturer i will set a retail price that is an unconstrained best-response which maximizes the joint profits of manufacturer i and retailer i . This is the case because, with RPM, the manufacturer has enough instruments to satisfy the participation constraint of the retailer with equality while $f_i \geq 0$. For instance, the prices $w_i = 0$ and $f_i = p^* D_i(p^*, p^*) - \pi(c, 0)$ achieve this. In this case, the fixed fee is strictly positive as $p^* D_i(p^*, p^*) = \pi(0, 0)$, which yields $f_i = \pi(0, 0) - \pi(c, 0) > 0$.

As a result, the retail prices equal the prices that would result under direct price competition between the manufacturers. Note that there are no dampening effects of

Setting (below)	Industry profits (per product)	Retail profits	Manufacturer profit
No RPM (either competition or collusion)	$\pi(c, c) + c \cdot D_i(p^*(c), p^*(c))$	$\pi(c, c)$	$c \cdot D_i(p^*(c), p^*(c)) = p^*(c)D_i(c, c) - \pi(c, c)$
RPM and competition	$\pi(0, 0)$	$\pi(c, 0)$	$\pi(0, 0) - \pi(c, 0) = p(0, 0) \cdot D_i(0, 0) - \pi(c, 0)$
RPM and collusion	$p^C \cdot D_i(p^C, p^C)$	$\pi(c, 0)$	$p^C \cdot D_i(p^C, p^C) - \pi(c, 0)$

Table 5: Summary of prices and profits for the case of two-part tariffs

strategic delegation as the pricing is not delegated to the retailers. Thus, the prices are below those under manufacturer competition without RPM.

Summary. Compared to linear tariffs, two-part tariffs can increase the manufacturer profits in the cases without RPM as the renegotiations are more aggressive to the detriment of the retailer that purchases the fringe product. Moreover, collusion may also raise the prices to some degree even without RPM. Nevertheless, RPM still facilitates collusion by further increasing the prices up to the monopoly level.

The market outcome is identical between an optimally organized cartel and competition when there is no RPM. Hence, there is no scope for a cartel without RPM. With RPM and competition, profits cannot be larger. The cartel with RPM can increase prices and wholesale prices if the RPM is sufficiently flexible such that industry-wide RPM collapses or is adapted in case store brands are introduced. This makes the introduction of store brands less attractive.

Annex C: Computations for the parametric example

Competition absent RPM. Each retailer seeks to

$$\max_{p_i} (p_i - w_i) [1 - p_i + \gamma (p_{-i} - p_i)],$$

which yields the FOC

$$1 - 2p_i + \gamma (p_{-i} - 2p_i) + w_i \cdot (1 + \gamma) = 0.$$

Solving for the retail equilibrium prices as a function of w_i and w_{-i} and plugging these

prices in the manufacturer problem allows us to derive the reaction function

$$w_i^R(w_{-i}) = \frac{\gamma^2 w_{-i} + \gamma w_{-i} + 3\gamma + 2}{2\gamma^2 + 8\gamma + 4}, \quad (15)$$

which has a slope of $\frac{\gamma^2 + \gamma}{2\gamma^2 + 8\gamma + 4}$, which is in-between 0 and 1 because $\gamma > 0$.

When both retailers sell the respective product, and absent RPM, a retailer's reduced profit decreases both in the own input price as well as the uniform input price level w (for $w_1 = w_2 = w$). A retailer's reduced profit at symmetric input prices at a level of w equals

$$\pi_i(w_i = w, w_{-i} = w) = \frac{(1 + \gamma)(1 - w)^2}{(2 + \gamma)^2}.$$

Note that retail profits decline in w . Setting this profit equal to Ω defines the highest feasible input price level at which both retailers source the respective products absent RPM:

$$w^*(\Omega) = 1 - (2 + \gamma)\sqrt{\frac{\Omega}{1 + \gamma}}$$

under the natural restriction $w^* \leq 1$. Note that $\Omega = 0$ implies $w^* = 1$ and higher levels of Ω imply lower levels of w^* (up to $w^* = 0$). The resulting symmetric retail prices equal

$$p^* = \frac{1 + w^*(1 + \gamma)}{2 + \gamma} \quad (16)$$

$$= \frac{1 + \left(1 - (2 + \gamma)\sqrt{\frac{\Omega}{1 + \gamma}}\right)(1 + \gamma)}{2 + \gamma} = 1 - \sqrt{\Omega(1 + \gamma)}.$$

When the manufacturers compete absent RPM and without any restriction from the retailers' outside options (as in the case $\Omega = 0$), the resulting *unconstrained* price levels equal

$$w^U = \frac{2 + 3\gamma}{4 + 7\gamma + \gamma^2},$$

$$p^U = \frac{4\gamma^2 + 12\gamma + 6}{\gamma^3 + 9\gamma^2 + 18\gamma + 8}.$$

The retailer's outside options (Ω) restrict the manufacturers' competitive wholesale pricing if $w^U > w^*$, which implies

$$\Omega > \frac{(\gamma + 1)(\gamma^2 + 4\gamma + 2)^2}{(\gamma^3 + 9\gamma^2 + 18\gamma + 8)^2} \equiv \hat{\Omega}(\gamma).$$

Note that $\hat{\Omega}(\gamma = 0) = 0.0625$ and that $\sup_{\gamma > 0} \hat{\Omega}(\gamma) \approx 0.076$ at $\gamma \approx 1.51$. Note also that $\hat{\Omega}$ approaches 0 as γ , which corresponds to the intensity of price competition, increasing beyond 1.51.

Competition with RPM. The competitive retail prices with RPM equal

$$p^{RPM} = 1/(2 + \gamma).$$

Each manufacturer sets the wholesale price such that the retailer's profit equals Ω , which yields

$$w^{RPM} = p^{RPM} - \Omega/(1 - p^{RPM}) = 1/(2 + \gamma) - \Omega \frac{2 + \gamma}{1 + \gamma}.$$

The retail price p^{RPM} is smaller than p^U . Moreover, p^{RPM} must also be smaller than the restricted retail price absent RPM if the manufacturers make positive profits (which corresponds to $w^* > 0$).

Collusion absent RPM. In line with the above theory, absent RPM the same prices result under manufacturer competition and collusion when the outside options constrain the upstream pricing ($\Omega > \hat{\Omega}(\gamma)$). Otherwise, for $\Omega < \hat{\Omega}(\gamma)$, the upstream prices may increase up to $w^*(\Omega)$ under collusion and the retail prices rise accordingly. This price rise (and thus the increase in the upstream profits) may be small as the difference between w^U and w^* can be small.

Collusion with RPM. The manufacturers optimally agree on retail prices of $p^C = 1/2 = \arg \max_p 2 \cdot p \cdot (1 - p + \gamma(p - p))$ and wholesale prices which satisfy each retailer's participation constraint of

$$(1/2 - w) \cdot (1 - 1/2) = \Omega \implies w^C = 1/2 - 2\Omega.$$