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MANUFACTURER COLLUSION AND RESALE PRICE MAINTENANCE*

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We provide a novel theory of harm for resale price maintenance (RPM). In a model with two manufacturers and two retailers, we show that RPM facilitates manufacturer collusion when retailers have alternatives to selling a manufacturer's product. Because of the alternatives, manufacturers can only ensure that retailers sell their products by leaving sufficient retail margins. This restricts the wholesale price level even when the manufacturers collude. RPM allows colluding manufacturers to establish higher prices.

I. INTRODUCTION

RESALE PRICE MAINTENANCE (RPM) allows manufacturers to eliminate price competition among retailers, which might therefore lead to higher consumer prices. With the Leegin decision of 2007, the US Supreme Court overturned the long-standing per-se illegality of a minimum RPM in the US and replaced it with a rule of reason approach.¹ With reference to the economic literature, the court based the decision on the pro-competitive service argument whereby the interests of manufacturers and consumers are broadly aligned with respect to retailer profit margins (Marvel and McCafferty [1984]; Mathewson and Winter [1984, 1998]; Telser [1960]; Winter [1993]). Still, the view that RPM can be anti-competitive remains prevalent among competition policy experts and cases against RPM continue to emerge. For instance, minimum and fixed RPM continue to be core restraints of competition in the European Union's

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¹ Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 U.S., 2007.

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new vertical block exemption regulation of 2022.² Against this backdrop, it is surprising that until today the economic literature has provided only few formal theories of harm (Asker and Bar-Isaac [2014]; Hunold and Muthers [2017]; Jullien and Rey [2007]).

Inspired by recent policy cases against RPM, where these theories do not seem to apply, we contribute a new formal theory of how RPM can facilitate manufacturer collusion. RPM has been used by colluding manufacturers of beer, gummi bears, chocolate, and coffee.³ The case reports contain indications that RPM has 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.*⁴

A recent report by an OECD roundtable also describes cases where colluding manufacturers struggled to convince retailers to accept higher wholesale prices without price coordination through RPM.⁵ Holler and Rickert [2022] show empirically that the above-mentioned coffee cartel only became successful in sustaining higher wholesale prices when the coffee producers started using RPM in addition to coordinating their wholesale prices.

It is not straightforward how RPM would facilitate manufacturer collusion in these cases. For an upstream cartel, jointly increasing the wholesale prices should be an option if prices are too low from its 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,⁶ 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

² Minimum and fixed RPM are considered core restrictions of competition in the (EU Vertical Block Exemption, Commission Regulation 2022/720, Article 4a). An efficiency defense according to 101 (3) TFEU is possible in individual cases (par. 197 Vertical Restraints Guidelines of May 2022).

³ The cases concern Anheuser Busch, Haribo, Ritter, and Melitta; (last access 2023/02/04).

⁴ See the Bundeskartellamt's press release "Fine proceedings for vertical price fixing in the German food retail sector concluded" of December 15, 2020 (last access 2023/02/04).

⁵ '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.

⁶ 'Roundtable on Hub-and-Spoke Arrangements – Background Note by the Secretariat 3-4 December 2019'; OECD; (last access 2023/02/04).

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.⁷

The question remains as to why colluding manufacturers would facilitate retail price increases which presumably 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, at a higher wholesale price, the retailers would not sell the product. Intuitively, if a product does not yield enough profit for the retailer, the retailer will not stock, or not push and not advise for and advertise the product which could result in dramatically lower sales. Hence, to have an incentive to sell, manufacturers need to ensure that the retailers make sufficient profits.

We study the link between RPM and manufacturer collusion in a setting where two manufacturers can offer nonlinear contracts to two retailers. We consider a repeated game in which manufacturers may use trigger strategies to collude while retailers are short-lived and thus cannot collude. A key ingredient is that the retailers have outside options, which are valuable alternatives to accepting the manufacturer's contract and selling its product. Similarly, in the static analysis of Hunold and Muthers [2017] the outside option consists of the possibility of a retailer to push products on consumers that are in different markets. One can also interpret the outside options as a degree of bargaining power at the retail level. A motivation for this assumption are, for instance, the cases in the food supply chain where retailers have demonstrated a strong bargaining position, based on their outside options to sell own-branded products, use the shelves for other product categories, and advertise more profitable products more prominently.

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. Our main finding is that collusion may only be effective, that is, yield higher prices than manufacturer competition, if the manufacturers can

⁷ In the case of the coffee roaster cartel, the manufacturers had good visibility of the competitors' wholesale prices, as the retailers would inform them of each others' wholesale conditions. See par. 34 in OLG Düsseldorf, court decision V-4 Kart 5/11 (OWi) of February 10, 2014.

use RPM. RPM tends to increase the manufacturers' profits under collusion but decrease them under competition.

Besides the price levels, we also demonstrate that RPM can increase the stability of collusion by increasing the collusive profits and decreasing the competitive profits. For price levels above those that are sustainable without RPM, the use of RPM enables and, in that sense, stabilizes collusion. However, for a given collusive price level that is achievable both with and without RPM, the effect of RPM on the deviation profits is generally ambiguous. We introduce the notion of renegotiation-proof RPM, meaning that a manufacturer only enforces the retail price prescribed by RPM if that yields a higher manufacturer profit than the retail price which the retailer would want to set in a given situation. Without renegotiation-proof RPM, the retailers need to adhere to the RPM of a non-deviating manufacturer even if this hurts the manufacturer. In this case the deviation profits are larger with RPM. We still find that the use of RPM can result in lower critical discount factors and thereby stabilize collusion.

With renegotiation-proof RPM the result is even stronger as the manufacturers can ensure that the deviation profits with RPM are below the collusive profits, which stabilizes collusion irrespective of the discount factor. Renegotiation-proof RPM is particularly plausible in jurisdictions like the EU where minimum and fixed RPM is typically illegal but nevertheless used. Case decisions of competition authorities and courts reveal that RPM may be implemented through mostly verbal communication, non-binding price recommendations, and the manufacturer's threat to boycott a retailer if the desired retail price is not implemented.⁸ This can be interpreted as a relational contract, like in Buehler and Gärtner [2013], such that it is natural to presume that the agreed retail price is not enforced with a punishment if the deviation was in the common interest (a renegotiation-proof relational contract).

A case in point is a cartel of coffee roasters who coordinated their sales to supermarkets in Germany from 2003 to 2008.⁹ According to the case descriptions, manufacturers had been coordinating wholesale price increases since 2003.¹⁰ Initially, the impact of the wholesale price increases was limited but the cartel became successful once the manufacturers effectively also coordinated retail price increases, which de facto constitutes resale price maintenance.¹¹

⁸ For instance, in the RPM cases on hearing devices (press release "Bundeskartellamt imposes fine on hearing aid manufacturer Phonak GmbH", 2009) and contact lenses (press release: "Bußgeldbescheid B3-123/08", 2009), RPM was enforced through refusals to supply and other incentives when retailers deviated from recommended retail prices.

⁹ OLG Düsseldorf, court decision 4 Kart 3/17 (OWi), February 18, 2018.

¹⁰ Case report "Bußgelder wegen vertikaler Preisabsprachen beim Vertrieb von Röstkaffee" of the Bundeskartellamt, January 18, 2016.

¹¹ See figures 1 and 3 in Holler and Rickert [2022] for a timeline and illustrative price plots.

Holler and Rickert [2022] use a home-scan consumer panel combined with court decisions containing interviews, testimonies, and email exchanges to capture the cartel behavior, such as the amount of wholesale and retail price increases. A central econometric finding of Holler and Rickert [2022] is that RPM increased the cartel overcharge from 3 to 14%. Our theory explains the observation that the manufacturer cartel 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.¹²

Our article is structured as follows. After the related literature in Section II, we set up the model in Section III, derive the competitive outcomes in Section IV and the results for manufacturer collusion in Section V. Finally, we conclude in Section VI with a discussion of competition policy implications.

II. RELATED LITERATURE

Besides the aforementioned article of Jullien and Rey [2007], a strand of literature studies how the retail organization affects manufacturer collusion, though it does not analyze RPM (Liu and Thomes [2021]; Piccolo and Reisinger [2011]; Reisinger and Thomes [2017]). Reisinger and Thomes [2017] compare multi-product retailers with exclusive retailers and Liu and Thomes [2021] study vertical integration versus delegation. Piccolo and Reisinger [2011] show that, compared to a situation of perfect retail price competition, exclusive territories tend to facilitate manufacturer collusion as a deviation becomes less profitable if retail prices react instantaneously when a deviating manufacturer cuts its wholesale price.¹³

Other related articles study different vertical aspects of collusion but do not consider RPM. Nocke and White [2007] study the effects of vertical integration on collusion and Gilo and Yehezkel [2020] demonstrate that collusion involving the monopoly manufacturer can be easier to sustain than collusion only among the retailers. Schlütter [2022] studies the effects of price parity clauses on seller collusion on a sales platform when the sellers also have a direct sales channel. Schinkel *et al.* [2008] show that when cartel damage claims are limited to a cartel's direct purchasers, the manufacturers may benefit from providing rents to retailers to ensure their cooperation and reduce the risk of detection.

Yet another strand of related literature studies the effects of RPM in settings with manufacturer competition and does not consider collusion (Dobson and Waterson [2007]; Rey and Vergé [2010]).

¹² 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.

¹³ The main difference between their model and ours is that we allow the retailers to have outside options to accepting the contract and to the selling of a manufacturer's product.

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. This relates to the literature on retail services which explains how a monopoly manufacturer can benefit in a static setting from RPM when the retail services exert externalities (Mathewson and Winter [1998]; Telser [1960]) whereas competing manufacturers may also suffer from RPM (Hunold and Muthers [2017]).

Colluding manufacturers may face the same type of problems as a single dominant manufacturer. Retailers may have non-contractible choices that exert externalities on the manufacturer. Asker and Bar-Isaac [2014], Dertwinkel-Kalt and Wey [2023], and Inderst and Shaffer [2019] allow the retailer to buy from an alternative source. Inderst and Shaffer [2019] study how a manufacturer coordinates the supply chain when retailers can buy from a competitive fringe. Similar to the case of colluding manufacturers in our setting, they find that a dominant supplier cannot implement profit-maximizing prices as the outside option increases the slotting fee and limits the wholesale price. They do not consider additional vertical restraints. Asker and Bar-Isaac [2014] highlight how vertical restraints can be used to foreclose competing manufacturers. For instance, with RPM the incumbent ensures the retailer a certain profit that vanishes once it stocks the product of a competing manufacturer. In a model with a monopoly retailer and linear contracts, Dertwinkel-Kalt and Wey [2023] focus on the retailer's marginal choices and show that RPM has ambiguous effects on the surplus of consumers and possibly competing brands.

Another problem is that of opportunism. When an upstream monopolist lacks the ability to publicly commit to the vertical contracts, it is tempted to secretly make each retailer an offer with a competitive wholesale price. This limits the manufacturer's ability to realize monopoly profits (Hart *et al.* [1990]; Segal [1999]). Rey and Vergé [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 with a public commitment to industry-wide RPM but not with purely vertical price controls. We abstract from potential opportunism problems of colluding manufacturers in the present article. Opportunism problems and the formation of collusion are the topics of Gieselmann *et al.* [2021] who focus on fully unobservable contract offers and solve for perfect Bayesian Nash equilibria instead of subgame perfect Nash equilibria.

III. MODEL

We study contracting and pricing in a vertically-related market with two symmetric manufacturers and two symmetric retailers. We consider an infinitely repeated stage game with discrete time. We focus on manufacturer collusion and abstract from retailer collusion as well as vertical types

of collusion. The manufacturers live infinitely and share a common discount factor $\delta \in (0, 1)$, whereas the retailers are short-lived and maximize spot profits.

III(i). *Contracting and Pricing in the Stage Game*

Assume that each retailer is an exclusive seller of one of the manufacturer's products.¹⁴ Demand for product i at retailer i is given by a symmetric function $D_i(p_i, p_{-i})$. We assume all costs of production and distribution (except for the payments of the wholesale contract) to be zero, as this simplifies the expressions and does not affect our results. The manufacturer offers contracts with a two-part tariff consisting of a per-unit wholesale price w_i and a fixed transfer F_i . The fixed part of the two-part tariff can be negative, i.e., a payment to the retailer. In some industries like groceries, such payments are commonly referred to as slotting fees.

Timing of the Stage Game and Equilibrium. Within each period, there is a stage game with the following timing:

- 1 Each manufacturer $i \in \{A, B\}$ offers its retailer a two-part tariff contract: a wholesale price $w_i \geq 0$ and franchise fee F_i paid to manufacturer i ; with RPM also a retail price p_i .¹⁵
- 2 Each retailer i observes its contract offer, accepts the offer of its manufacturer i or rejects it.
- 3 Each retailer that has accepted its contract offer pays the transfer F_i and decides whether or not to sell the product. In case the retailer does not sell the product or does not accept the contract, it realizes an outside option of value Ω .¹⁶
- 4 All supply contracts are disclosed to all retailers. Absent RPM, retailers set their prices (p_i) simultaneously.

Following, for instance, Piccolo and Reisinger [2011], we assume that the wholesale prices only become observable in stage 4 and solve for subgame

¹⁴ In an extension, we endogenize the market structure by allowing manufacturers to compete in contracts for retailers. Competition for retailers reduces the manufacturer profits under competition but does not affect the retail prices. We show that colluding manufacturers need RPM to increase the retail prices. See section 5.1 in Hunold and Muthers [2023] for details.

¹⁵ We 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.

¹⁶ One can think of Ω as the choosing of another product to sell (that is in a different market) but also as a saving on sales effort. For example, the case where a sales effort of zero results in zero sales and an effort of $e > 0$ in sales of D_i yields an identical SPNE. The change from Ω to e is an affine transformation of the retailer profit function that maintains the same preferences of the retailer at lower profit levels and thus results in the same outcome.

perfect Nash equilibria (SPNE).¹⁷ By using subgame perfection we abstract from formulating explicit retailer beliefs about the rival's contract offer. The SPNE we identify are strategically equivalent to perfect Bayesian equilibria where retailers correctly anticipate with their beliefs the equilibrium strategy of manufacturers.

Profits. The profit of retailer i when accepting the contract and selling the product of manufacturer i is

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

If a retailer does not accept the contract offer, it gets the fixed outside option. If a retailer is the only one who accepted a contract, it receives $(p_i - w_i) \cdot D_i(p_i, \infty) - F_i$, where $D_i(p_i, \infty)$ is the “monopoly” demand for product i that is larger than the demand retailer i receives when the other retailer sets the monopoly price.

The profit of manufacturer i is

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

Retailers' Outside Options. A key element of our model is that the retailers have outside options. The manufacturers can use fixed transfers to render the alternatives to contract acceptance unattractive. Our main results are based on the idea that fixed payments do not suffice to incentivize retailers to sell a product. The parameter Ω encompasses these (opportunity) costs of selling the product after contract acceptance. Once a retailer has accepted the contract and paid the fixed fee, it might still have shelf space opportunity costs, marketing costs of selling product i , and other retailing opportunity costs. For example, in Hunold and Muthers [2017] the outside option consists of the possibility for a retailer to push another product on consumers that is in a different market. For the retailer, the incentive to sell and push a product depends on the product's profitability. An important insight is that this creates an incentive problem for the manufacturer where the wholesale price not only affects the profitability of the product for the retailer but also the retail price. Thus, two goals are traded-off with only one instrument.

¹⁷ There are two prime alternative information structures. First, full secrecy of the contracts up to the retailers' pricing decisions necessitates including retailers' beliefs about rival retailers offers (Hart *et al.* [1990]; Rey and Vergé [2004]). This can result in credibility problems of colluding manufacturers which we investigate in Gieselmann *et al.* [2021]. Second, public contracting as in Rey and Vergé [2010] implies that one manufacturer can foreclose its rival by marginally undercutting the candidate equilibrium prices, leading to non-existence problems of equilibria. This occurs because, with non-linear contracting, the participation constraints of the retailers bind in any candidate equilibrium so that a small reductions in a rival's wholesale price can easily violate them.

To capture this trade-off, a fixed and exogenous outside option is sufficient for the analysis of collusion in the present article. The fixed outside option can be interpreted as the value a retailer would obtain from not advertising the product, using the shelf and storage space for other products, or not educating its sales personnel about the product. One may also think of the outside option as being a retailer's possibility to stock a perfect substitute to the manufacturer's product with a marginal cost of $c > 0$, i.e., selling a "private label."¹⁸ In line with this, one can interpret the outside options as a degree of bargaining power at the retail level.

III(ii). *Assumptions on Demand and Profits*

Let us first consider the retailers' price setting without RPM after each retailer 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:

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

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. This leads to

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

Moreover, for the case where both retailers accept the manufacturers' contracts and the wholesale prices are equal ($w_A = w_B = w$), we focus on a symmetric equilibrium in the retailing subgame which results in

Assumption 2. The competitive downstream price level $p_i(w_i, w_{-i})$ increases in the wholesale prices: $\frac{\partial p_i(w_i, w_{-i})}{\partial w_i} > 0$ and $\frac{\partial p_i(w_i, w_{-i})}{\partial w_{-i}} > 0$. The retail profit $\pi_i(w, w)$ decreases in the symmetric wholesale price $w = w_A = w_B$ and $\pi_i(0, 0) > \Omega > \pi_i(w^M, w^M)$ holds, where w^M is the symmetric "monopoly" wholesale price that results in maximal joint industry profits.¹⁹

The last part of the assumption implies that it is always profitable for the industry to sell the product but that the monopoly prices result in too low retail profits. On the upstream profits we make

¹⁸ Annex B of the discussion paper version Hunold and Muthers [2023] contains this extension. In Section V(i), we show that, if each manufacturer can make contract offers to both retailers, exclusive dealing can arise endogenously and RPM still has collusive effects.

¹⁹ The wholesale price w^M is defined as $\arg \max_w \sum_i p_i(w, w) \cdot D_i(p_i(w, w), p_{-i}(w, w))$.

Assumption 3. Absent RPM, a manufacturer's reduced profit function, $\Pi_i(w_i, w_{-i})$, 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 and feature strategic complementarity between wholesale prices (increasing reaction functions).

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.²⁰ For auxiliary computations we use the linear demand function

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

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

We assume that each manufacturer only sells its product if that yields strictly positive profits.

Equilibrium. We solve the game for subgame perfect Nash equilibria (SPNE) and focus on the symmetric equilibria. We compare price competition among the manufacturers with manufacturer collusion, assuming that it is public knowledge whether using RPM is feasible or not.

IV. MANUFACTURER COMPETITION

We start by solving for the stage game SPNE under manufacturers' competition – with and without RPM. Afterwards, we solve the super game and study collusion with and without RPM.

IV(i). *Retailer Strategy (Contract Acceptance and Pricing)*

Let us first consider that the retailers set the retail prices. As the retailers are short-lived, their equilibrium strategy can be derived by solving for the stage game SPNE using backward induction. We start with stage 4, assuming that both retailers stock their manufacturer's product. In stage 4, retailers observe both wholesale prices and compete in retail prices. This results in a flow profit denoted by $\pi_i(w_i, w_{-i})$. These profits decrease in w_i and increase in w_{-i} as described in Assumption 1.

²⁰ Please see Annex C of our discussion paper version (Hunold and Muthers [2023]) where we confirm the assumptions using the linear demand specification.

Anticipating these flow profits, each retailer decides in stage 3 whether to accept the contract and sell the product. Retailer i sells its product if the following sales condition holds:

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

At this stage, each retailer only observes its own wholesale contract. In the subgame perfect Nash equilibrium, each retailer bases its sales decision on the correctly anticipated equilibrium wholesale price w^* of the other retailer.

The fixed transfer F_i is sunk at this stage. Hence, the sales decision depends only on the flow profits and thus the marginal wholesale prices of the manufacturers' contracts. Each manufacturer will have to take the sales constraint (2) into account to ensure that the retailer actually sells the product.

In stage 2, each retailer receives its manufacturer's contract offer. Simultaneously, each of the retailers either accepts or rejects its contract offer. Each retailer accepts its contract if its expected profit exceeds the value of the outside option Ω . Thus, in stage 2, each retailer accepts the contract if the following contract acceptance constraint holds:

$$(3) \quad \max(\pi_i(w_i, w^*), \Omega) \geq F_i.$$

Note that the contract acceptance condition must hold with equality in equilibrium as it is the only condition that limits F_i . We simplify the contract acceptance constraint (3) using the sales constraint (2) and summarize in

Lemma 1. Without RPM each retailer accepts the contract and stocks the product if both the sales condition

$$(4) \quad \pi_i(w_i, w^*) \geq \Omega$$

and the contract acceptance condition

$$(5) \quad F_i = \pi_i(w_i, w^*) - \Omega$$

hold.

Note that if the sales constraint (4) binds, the fixed transfer is zero, otherwise it is positive. We replace F_i with its definition (5) in the following manufacturer problems.

IV(ii). *Manufacturer Competition without RPM*

Consider the case where manufacturers offer contracts competitively and cannot use RPM, which is known by the retailers.

In stage 1 of the game, the manufacturers offer contracts simultaneously, anticipating the retailers' reactions. Suppose each manufacturer wants to ensure that its product is sold at its retailer. Each manufacturer solves

$$\max_{w_i, F_i} \Pi_i = w_i \cdot D_i(p_i(w_i, w_{-i}), p_{-i}(w_{-i}, w_i)) + (\pi_i(w_i, w^*) - \Omega),$$

subject to the sales condition

$$(6) \quad \pi_i(w_i, w^*) \geq \Omega.$$

Whether the sales constraint is binding depends on the level of the outside option Ω . We analyze in turn the cases of a non-binding and a binding sales constraint.

Unconstrained Marginal Wholesale Prices. For Ω sufficiently small, the sales constraint does not bind as $\pi_i(w^*, w^*) > 0$. The unconstrained case is equivalent to disregarding condition (6). This unconstrained case corresponds to a competitive equilibrium in the spirit of Bonanno and Vickers [1988] with positive wholesale margins. The symmetric equilibrium wholesale prices are defined by the system of first order conditions of the wholesale prices. This results in

$$(7) \quad \frac{\partial p_i(\cdot)}{\partial w_i} \cdot \left[\frac{\partial D_i(\cdot)}{\partial p_i} + D_i(\cdot) \right] + \frac{\partial D_i(\cdot)}{\partial p_{-i}} \frac{\partial p_{-i}(\cdot)}{\partial w_i} p_i(\cdot) = 0.$$

Denote by $w^U = w^* = w_i$ the symmetric wholesale price that solves equation (7). Equation (7) corresponds to the equilibrium condition in Bonanno and Vickers [1988], where the second, positive term captures the strategic delegation effect. The strategic delegation effect implies that wholesale prices are above marginal costs, such that prices are larger than they would be for an integrated supplier consisting of a manufacturer-retailer pair. We define the unrestricted competitive retail price absent RPM as

$$p^U = p(w^U, w^U)$$

and the corresponding manufacturer profit as

$$\Pi^U = p^U D_i(p^U, p^U) - \Omega.$$

Constrained Marginal Wholesale Prices. For sufficiently large values of Ω , the sales constraint binds and defines the equilibrium wholesale prices. While the unconstrained price w^U is defined by a first order condition, the sales constraint puts an upper limit on w_i as the retail profits decrease in w_i . The constrained equilibrium wholesale price $w^*(\Omega)$ is defined by the

largest symmetric combination of wholesale prices w that satisfies the sales constraint

$$(8) \quad \pi_i(w, w) = \Omega.$$

It follows from Assumption 2 and equation (8) that $w^*(\Omega)$ decreases in Ω . In equilibrium, the retailers observe and correctly anticipate the wholesale prices of w^* and non-cooperatively set retail prices of

$$(9) \quad p^*(\Omega) = p(w^*(\Omega), w^*(\Omega)).$$

Thus, the retail prices decrease in the level of the outside option. The corresponding manufacturer profit is

$$\Pi^*(\Omega) = p^*(\Omega) \cdot D_i(p^*(\Omega), p^*(\Omega)) - \Omega.$$

The sales constraint binds if $w^U > w^*(\Omega)$ or, equivalently, if $p^U > p^*(\Omega)$. Hence, the equilibrium price is the minimum of p^U and $p^*(\Omega)$.

Manufacturers only offer contracts if they anticipate making profits on the equilibrium path. This implies that the outside options must not be too valuable, such that $w^*(\Omega) > 0$ holds. Otherwise the profit of the retailers would not suffice to recover Ω and selling would result in a loss for the manufacturers.

Note that both products are sold in any equilibrium. By contradiction, suppose that there is a candidate equilibrium where only the contract of manufacturer i is accepted: the accepted contract must have $w_i = 0$ as this maximizes the joint profits of the manufacturer and its retailer and w_i has no marginal effect on the contract acceptance of the other retailer (due to the information structure). However, if $w_i = 0$ is offered, manufacturer $-i$'s best response is to offer an acceptable contract with $w_{-i} \geq 0$ as $w_{-i} = 0$ yields profits for retailer $-i$ that strictly exceed the outside option according with Assumption 2: $\pi_{-i}(0, 0) > \Omega$.

Proposition 1. For Ω sufficiently large, such that $p^U > p^*(\Omega)$: The equilibrium retail prices as well as the wholesale prices decrease in the value Ω of the outside option. Manufacturer and industry profits decrease in Ω , whereas retailer profits increase.

For Ω sufficiently low, such that $p^U \leq p^*(\Omega)$: The equilibrium prices are independent of Ω and defined by equation (7).

In both cases the marginal wholesale prices are strictly positive.

Proof. See derivation above. ■

Whenever the outside options of the retailers are sufficiently attractive, the prices are pinned down by the retailers' contract acceptance conditions and not by the level of manufacturer competition. With linear demand

as in (1), the critical Ω is below 0.25 and decreases in the intensity of competition (parameter γ). For instance, values of $\gamma = 3$ and $\Omega = 0.1$ yield $p^U = 0.26 < p^*(0.1) = 0.37$, so that the manufacturers are not constrained by the retailers' outside options. Given $\gamma = 3$, the critical value of Ω where $p^U = p^*(\Omega)$ is at about 0.14.

IV(iii). *RPM and Manufacturer Competition*

Suppose that both manufacturers use RPM and the retailers are aware of this. Confronted with manufacturer i 's contract offer (w_i, F_i, p) , retailer i chooses whether to accept and sell the manufacturer's product. We solve for the sub-game perfect Nash equilibrium where each retailer correctly anticipates the contract terms offered to the rival retailer. Each retailer only has to decide whether to accept the contract and sell the product in light of the outside option of value Ω .

With RPM, each manufacturer can choose the retail price at a level that maximizes the joint profits with its retailer. As the outside options are fixed amounts, each manufacturer effectively maximizes the product line profit $p_i \cdot D_i(p_i, p_{-i})$ with respect to p_i . Recall that, without RPM, the retailers set the retail prices based on positive input costs of $w_i > 0$.

Proposition 2. Under manufacturers competition, the symmetric equilibrium retail prices are lower with RPM than without RPM: $p^{RPM} < \min(p^*(\Omega), p^U)$. The manufacturers' profits are lower with RPM.

Proof. See the annex. ■

Our linear demand in equation (1) implies $p^{RPM} = 1/(2 + \gamma)$; again, for a competition intensity of $\gamma = 3$ and $\Omega = 0.1$, we get $p^{RPM} = 0.2 < \min(p^*(\Omega) = 0.37, p^U = 0.26)$.

The intuition behind the result is that, with RPM, each manufacturer directly controls the retail prices and competes more directly with the other manufacturer than absent RPM. Without RPM there is a strategic delegation effect as each retailer faces a wholesale price above marginal costs and adds a margin to that. This dampens competition relative to direct price competition between manufacturers at the true and thus lower marginal costs.

The price-reducing effect of RPM is based on the effects identified in Bonanno and Vickers [1988] for the issue of vertical integration versus separation. Note that RPM can have price-increasing effects in a static setting and also lead to too much retail services (Hunold and Muthers [2017]; Rey and Vergé [2010]). We abstract from these static effects to focus on the collusive effects of RPM.

V. MANUFACTURER COLLUSION

The underlying idea for collusion is that the manufacturers can sustain higher wholesale prices by employing a dynamic strategy that punishes deviations to lower wholesale prices. We assume that the manufacturers collude on the wholesale prices (and, with RPM, also on the retail prices) using grim-trigger strategies to support an outcome that maximizes their joint profits. We focus on the case of symmetric collusion where the symmetric manufacturers collude on the same price level. In equilibrium, both manufacturers' contracts will be accepted and both products will be sold. Recall that we assume short-lived retailers and thus exclude retailer collusion.

With grim-trigger strategies, each manufacturer starts in period 0 to offer the collusive contract. This results in profits of Π^C for each manufacturer. If one manufacturer deviates from offering the collusive contract, both manufacturers revert to offering the competitive contract in all future periods, which results in non-cooperative Nash profits of Π^N in each future period. In the deviation period, the deviating manufacturer can possibly earn higher profits, which we denote by Π^D . The reduced form incentive constraint for a manufacturer to stick to the collusive agreement is

$$(10) \quad \frac{\Pi^C}{1-\delta} \geq \Pi^D + \frac{\delta \Pi^N}{1-\delta}.$$

We refer to manufacturers as being patient enough when the discount factor δ with $\delta \in (0, 1)$ is high enough for the stability condition to hold. The previous two Sections IV(ii) and IV(iii) characterize the competitive Nash equilibria with the profits Π^N for the cases with and without RPM. Proposition 2 implies that the competitive profit without RPM is strictly higher than the competitive profit with RPM.

For reference, the industry profit-maximizing retail price level is

$$p^M \equiv \arg \max_p p \cdot D_i(p, p)$$

and the condition

$$(11) \quad p_i(w^M, w^M) = p^M$$

defines the wholesale price level w^M that yields p^M absent RPM. Condition (11) has a unique solution for w^M under Assumption 2.

The highest profit that each manufacturer can obtain in a collusive period is $\Pi^M \equiv p^M \cdot D_i(p^M, p^M) - \Omega$, which equals the industry profit per product minus the retailer's outside option value.

V(i). *No RPM*

In stage 1 of the game, the manufacturers offer a collusive contract, denoted by (w^C, F^C) , that maximizes their joint stage game profits. The retailers know that the manufacturers cannot use RPM. To assess the stability condition (10), we derive the profit of the deviating manufacturer in a deviation period (Π^D) and the period profit on the collusive path (Π^C). In case of punishment, the manufacturers revert to the competitive supply contracts as characterized in Proposition 1, yielding a manufacturer profit of Π^N .

Outside Options Define Competitive Prices ($p^U \geq p^*(\Omega)$). Recall that the competitive manufacturer profit depends on whether the sales constraint, which is caused by the outside option Ω , binds. A similar case distinction arises under collusion. Let us first focus on the case in which Ω limits the competitive price: $p^U \geq p^*(\Omega)$. For this case without RPM, we show that even a perfectly working manufacturer cartel cannot implement a price that is higher than the competitive equilibrium price and cannot extract larger profits than under competition. Formally, this means that $\Pi^C = \Pi^D = \Pi^N$, which implies that collusion cannot increase profits without RPM.

As the manufacturers want to sell both products, they solve:

$$\max_{w_A, w_B} \Pi_A + \Pi_B = \sum_{i=A, B} w_i \cdot D_i(p_i(w_i, w_{-i}), p_{-i}(w_{-i}, w_i)) + (\pi_i(w_i, w_{-i}) - \Omega),$$

subject to

$$(12) \quad \pi_i(w_i, w_{-i}) \geq \Omega, \quad \forall i.$$

This simplifies to

$$(13) \quad \max_{w_A, w_B} \Pi_A + \Pi_B = \sum_{i=A, B} p_i(w_i, w_{-i}) \cdot D_i(p_i(w_i, w_{-i}), p_{-i}(w_{-i}, w_i)) - \Omega,$$

subject to

$$(14) \quad \pi_i(w_i, w_{-i}) \geq \Omega, \quad \forall i.$$

When neglecting condition (14), the unconstrained maximizer of (13) is w^M . The constraint (14) binds if $w^M \geq w(\Omega)$ (equivalently, if $p^M \geq p^*(\Omega)$), which holds as stated in Assumption 2. Under manufacturer collusion, the sales constraint binds for lower values of Ω than under competition as $p^M \geq p^U$. Thus, in case $p^U \geq p^*(\Omega)$, the colluding manufacturers cannot raise prices, so that the competitive price level $p^*(\Omega)$ results, which implies that the profit of a colluding manufacturer is

$$\Pi(\Omega) = p^*(\Omega) \cdot D_i(p^*(\Omega), p^*(\Omega)) - \Omega,$$

which is the same as under competition. This implies that collusion is ineffective at increasing prices and profits, such that $\Pi^C = \Pi^D = \Pi^N = \Pi(\Omega)$.

Competitive Prices not Defined by Outside Options ($p^U < p^*(\Omega)$). In this case there is scope for the collusive price to be larger than the competitive price.

The period profits on the collusive path are limited by the outside option such that $\Pi^C = \Pi(\Omega)$ results. We denote \bar{w}^D as the maximizer of the deviation profits, which yields deviation profits of

$$\Pi^D = p(\bar{w}^D, w(\Omega)) \cdot D_i(p(\bar{w}^D, w(\Omega)), p(w(\Omega), \bar{w}^D)) - \Omega.$$

This yields a profit order of $\Pi^D > \Pi^C > \Pi^N$, where now $\Pi^C = \Pi(\Omega)$. These profits imply a critical discount factor as defined in equation (10).

We summarize in

Proposition 3. Absent RPM, suppose the manufacturers collude using symmetric grim-trigger strategies.

- If the retailers' outside option is sufficiently large, such that $p^*(\Omega) \leq p^U$ holds, the collusive wholesale prices equal the competitive prices of $w^*(\Omega)$ and the retail prices equal the competitive prices of $p^*(\Omega)$.
- If the outside option is sufficiently small such that $p^U < p^*(\Omega)$ holds and the manufacturers are sufficiently patient, there is a collusive equilibrium with a wholesale price of $w^*(\Omega)$ and a retail price $p^*(\Omega)$, where both are larger than the competitive level (w^U, p^U) .
- There is no collusive equilibrium at industry profit-maximizing prices; the maximal obtainable retail price is $p^*(\Omega)$.

The case distinction is the same as in Proposition 1. In the parametric example with linear demand, critical Ω , below which the unconstrained case results, is below 0.25 (the monopoly profit with a single product) and decreases in the intensity of competition (parameter γ). Hence, when product competition is more intense, collusion cannot increase prices absent RPM even if the retailers only have worse outside options.

The main insight is that the manufacturers, when colluding, may not be able to implement higher wholesale prices than under competition. They are not able to implement monopoly prices. The underlying intuition is that manufacturers do not have sufficient instruments to ensure simultaneously that the retailers have the right incentives to stock and promote the products of manufacturers A and B and set the retail prices that maximize industry profits. The collusive prices are limited by the sales' outside option. Whenever the retailers' outside option binds under competition absent RPM, the resulting price level under collusion and competition is identical.

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. This kind of coordination may be difficult in certain types of markets, such as food retailing. Moreover, because of product differentiation there is a profit loss from not offering both products in the same period.²¹

V(ii). *RPM*

Suppose manufacturers also set the retail prices (RPM) and collude on symmetric wholesale and retail prices.

Collusive Profit Π^C . On the collusive equilibrium path the manufacturers solve:

$$\max_{w_A, w_B, p_A, p_B} \Pi_A + \Pi_B = \sum_{i=A, B} p_i \cdot D_i(p_i, p_{-i}) - \Omega$$

subject to

$$(15) \quad (p_i - w_i)D_i(p_i, p_{-i}) \geq \Omega, \quad \forall i.$$

The wholesale price w_i is free to satisfy the sales condition, while $p_i = p_{-i} = p^M$ maximizes $\sum_i p_i \cdot D_i(p_i, p_{-i})$. Consequently, the collusive manufacturer profit equals $\Pi^C = \Pi^M = p^M \cdot D_i(p^M, p^M) - \Omega$. The sales condition (15), which restricts the collusive wholesale price w^C , becomes

$$(16) \quad w^C \leq p^M - \frac{\Omega}{D_i(p^M, p^M)}.$$

Condition (16) implies that the wholesale price must not be too large to ensure that the retailers have incentives to sell the products post contract acceptance. There is a degree of freedom as the manufacturers can compensate a lower wholesale price with a higher fixed fee.

Deviation Profit Π^D . Under the assumption that the non-deviating retailer has to set the collusive RPM price, a deviating manufacturer solves:

$$\max_{p_i, w_i} \Pi_i = p_i \cdot D_i(p_i, p^M) - \Omega,$$

subject to

$$(17) \quad (p_i - w_i)D_i(p_i, p^M) \geq \Omega.$$

²¹ The profitability of asymmetric collusion depends on the level of demand a product receives if the other retailer chooses the outside option. For instance, if $D(p^M, \infty) < 2D(p^M, p^M)$, there is demand lost under asymmetric collusion, such that it results in lower manufacturer profits than symmetric collusion.

This results in an optimal deviation price of

$$p^D = \arg \max_{p_i} p_i \cdot D_i(p_i, p^M)$$

and a deviation profit for the manufacturer of

$$\Pi^D = p^D \cdot D_i(p^D, p^M) - \Omega.$$

As the deviation profit results from a best-response to the monopoly price, $\Pi^D > \Pi^C = \Pi^M$ holds. Again, due to the fixed fee, there is a degree of freedom in the wholesale price, which must satisfy

$$w^D \leq p^D - \frac{\Omega}{D_i(p^D, p^M)}.$$

The punishment profits equal those under manufacturer competition with RPM: Π^{RPM} . From Proposition 2 we know that these profits are lower than the profits under competition without RPM. Thus punishment with RPM is more severe.

This yields the usual order of the profits of the colluding manufacturers: $\Pi^D > \Pi^C (= \Pi^M) > \Pi^N (= \Pi^{RPM})$. Hence, collusion at monopoly prices is stable for some sufficiently large discount factor δ that satisfies the stability condition (10). Recall from Proposition 3 that the maximal price that can be implemented by colluding manufacturers without RPM is the price at which the outside option binds: $p^*(\Omega)$. Thus, prices above that price level can only be implemented with RPM. This yields a maximum profit without RPM of $\Pi(\Omega)$. Comparing the outcome to the case without RPM (Proposition 3) yields that RPM increases the collusive prices and profits if the manufacturers are sufficiently patient for this collusive equilibrium to exist.

We summarize in

Proposition 4. Suppose the manufacturers use RPM and, in addition, coordinate both the wholesale prices and the retail prices. There is a collusive equilibrium with retail prices at p^M and wholesale prices at w^C , defined by condition (16), if the manufacturers are sufficiently patient. In that equilibrium, each manufacturer makes a profit of Π^M , such that RPM increases the collusive manufacturer profits. Any price above $p^*(\Omega)$ can only be implemented with RPM.

RPM is necessary for any collusion with prices above $p^*(\Omega)$. For the case that the outside option is binding under competition, RPM is thus necessary for any collusive price increase. If the outside option does not bind under competition, there is scope for price-increasing collusion up to $p^*(\Omega)$ without RPM. To implement these prices, RPM may be used to increase the stability of

collusion, i.e., increase the range of discount factors that support collusion. RPM in that case affects the punishment profits which it reduces, because of the vanishing strategic delegation effect. RPM may increase the deviation profits. Without RPM, the retailer of the non-deviating manufacturer would react to the deviation by decreasing the price, but this price reduction is not possible if RPM is enforced. Hence, RPM has ambiguous effects on stability at a given collusive price level.

Returning to the linear demand example with $\gamma = 3$ and $\Omega = 0.1$, with RPM the critical discount factor at the monopoly price level of $p^M = 0.5$ is $\delta_{\text{RPM}} = 0.61$. By the same logic as above, one can also construct collusive equilibria with RPM at collusive prices below the monopoly level. This can be useful to compare the critical discount factors with and without RPM at the same price level. At the highest achievable price level without RPM, $p^*(0.1) = 0.37$, the critical discount factor with RPM is 0.23; the critical discount factor without RPM at the level p^* equals 0.28, making collusion at this price level more stable with RPM.

Importantly, if RPM is not enforced by the non-deviating manufacturer, it still lowers the punishment profits but does not increase the deviation profits and thus stabilizes collusion.

V(ii)(a). *Renegotiation-proof RPM*

We consider the case in which RPM may be enforced selectively by manufacturers in more detail. In jurisdictions like the EU where RPM is generally illegal, one can think of RPM as being implemented not with a legal contract but rather a self-enforcing, relational contract. As in Buehler and Gärtner [2013], such vertical price agreements can be represented as renegotiation-proof relational contracts. Renegotiation-proofness ensures that a clause is only enforced if it is in the contract parties' mutual interest. In particular, a certain retail price can be maintained if and only if there is no Pareto improvement for the manufacturer-retailer pair.

Consider that collusion at monopoly prices is implemented with trigger strategies between manufacturers and a self-enforcing vertical contract. On the collusive path there is no Pareto improvement for the manufacturer and retailer, as any price deviation is punished by the other manufacturer. Similarly, in punishment periods there is no Pareto improvement, as the RPM price is already a joint best response to the price of the competing product. However, in deviation periods, the non-deviating manufacturer should not enforce the monopoly price as this is not the best response to a price reduction. The non-deviating manufacturer weakly prefers the retailer to lower the retail price and thereby increase demand. For a sufficiently low wholesale price (below w^M is sufficient), the retailer also prefers to set a lower retail price than the monopoly price. Thus, it is not optimal for the

non-deviating manufacturer (and its retailer) to enforce the prescribed RPM price as it is Pareto dominated by a lower price.

The retail price level in deviation periods depends on the level of the wholesale price on the equilibrium path. With RPM and two-part tariffs, there is a degree of freedom as the level of wholesale prices is chosen, together with the fixed fee, to ensure that the retailer does not prefer the outside option and that it does not directly affect the retail prices. Hence, wholesale prices of zero are consistent with an equilibrium and ensure tough retailer responses in cases of deviation. The profits for the deviating manufacturer are then lower than the collusive profits, implying that collusion is stable for any discount factor. Hence, RPM not only allows for higher collusive prices but also unambiguously stabilizes collusion if it is renegotiation-proof.

See the discussion paper version Hunold and Muthers [2023] for the formal proof.

V(iii). *Endogenous Resale Price Maintenance*

Consider that each manufacturer decides individually and simultaneously whether to include RPM in its contract offer in stage 1. In stage 4, the revelation of the contracts makes the prescribed retail price, and thereby the use of RPM, common knowledge.²²

By using RPM in this modified game, a manufacturer can always replicate the same outcome as without RPM by imposing the same price as without RPM, resulting in identical profits. Thus, under competition, the unilateral introduction of RPM cannot be worse for the manufacturer. RPM is strictly preferred by the manufacturer whenever the outside option constrains the wholesale price, as the manufacturer would prefer a higher retail price than the one the retailer sets without RPM. A manufacturer can profitably implement the higher retail price with RPM and simultaneously increase the wholesale price and/or the fixed fee.

Under collusion, RPM increases the collusive profits on the equilibrium path and thus can be implemented with trigger strategies whenever collusion with RPM satisfies the usual stability condition. By the same logic as above for the case of competition, using RPM is also an optimal strategy in deviation periods.

Hence, there is always an equilibrium in which both manufacturers use RPM, even though under competition this results in lower manufacturer profits. The reason is that the retailers setting the retail prices causes strategic delegation effects, which dampens manufacturer competition absent RPM.

²² For the alternative timing that manufacturers pre-commit to RPM see section 5.2 of the discussion paper Hunold and Muthers [2023]. The only difference in outcomes is that RPM may then not always be adopted under competition when the outside option is not binding.

VI. CONCLUSION

We started from the empirical observation that resale price maintenance (RPM) has been used by colluding manufacturers in various competition policy cases and 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 as it relies on information asymmetries about demand, which we could not identify as a driving force. In light of the case material, we developed a new theory of how RPM can facilitate upstream collusion absent any information asymmetries. For policy, our insights are relevant as they allow us to rationalize the use of RPM by colluding manufacturers in actual cases, as referred to in the introduction.

Our key assumption is that retailers have an alternative to selling the manufacturers' products, such that manufacturers can only ensure that the retailers sell their products by leaving a sufficient margin to the retailers. This restricts the wholesale price level even when manufacturers collude. Our model features two competing manufacturers, of which each sells through an exclusive retailer. Each retailer has an outside option and manufacturers make secret but interim observable two-part tariff offers. Using a repeated game framework, we study manufacturer competition as well as collusion, both with and without RPM.

We show that collusion may only be effective, that is, yield higher prices than competition, if the manufacturers can use RPM. The reason is that RPM allows the manufacturers to ensure sufficiently high retail margins 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.

Besides the price levels, we also demonstrate that RPM can increase the stability of collusion by increasing the collusive profits and decreasing the competitive profits. For price levels above those that are sustainable without RPM, the use of RPM enables and, in that sense, stabilizes collusion. However, for a given collusive price level that is achievable both with and without RPM, the effect of RPM on the deviation profits is generally ambiguous. We introduce the notion of renegotiation-proof RPM, meaning that a manufacturer only enforces the retail price prescribed by RPM if that yields a higher manufacturer profit than the retail price which the retailer would want to set in a given situation. In this case, the manufacturers can ensure that deviation profits with RPM are below the collusive profits, which stabilizes collusion irrespective of the discount factor. If, instead, the retailers need to adhere to the RPM of a non-deviating manufacturer even if this hurts the manufacturer, the deviation profits are larger with RPM. We still find in our parametric example with linear demand that the use of RPM can result in lower critical discount factors and thereby stabilizes collusion.

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 more general insight is that an upstream cartel still suffers from various fundamental problems regarding the coordination of competing downstream firms that also an upstream monopolist suffers from. RPM is capable of solving some 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. In light of this reasoning, competition authorities may thus take the prevalence of RPM as an indication of market power and, possibly, even collusion.

APPENDIX

ANNEX WITH PROOFS

Proof of Proposition 2. The logic of the proof that $p^{RPM} < \min(p^*(\Omega), p^U)$ has two steps: (a) We show that $p^{RPM} = p(w = 0)$. (b) We show that $p^{RPM} < p^U$ and that $p^*(\Omega) > p(w = 0)$ by demonstrating that $p^*(\Omega) = p(\tilde{w})$ for some $\tilde{w} > 0$.

Given points (a) and (b) together, condition $p'(w) > 0$ (Assumption 2) implies $p^{RPM} < \min(p^*(\Omega), p^U)$.

Step (a): The problem for manufacturer i is to

$$\begin{aligned} & \max_{w_i, p_i, F_i} w_i \cdot D_i(p_i, p_{-i}) + F_i \\ \text{(A1)} \quad & \text{s.t. } (p_i - w_i)D_i(p_i, p_{-i}) - F_i \geq \Omega \end{aligned}$$

$$\text{(A2)} \quad \text{and } (p_i - w_i)D_i(p_i, p_{-i}) \geq \Omega,$$

where p_{-i} is the correctly anticipated retail price of the other product.

Both constraints have to bind in an optimum as the unconstrained manufacturer profits strictly increase in w_i and F_i , for a given retail price p_i . Both conditions (A1) and (A2) holding with equality implies $F_i = 0$ and reduces the problem to:

$$\text{(A3)} \quad \max_{p_i, F_i} (p_i \cdot D_i(p_i, p_{-i}) - \Omega)$$

$$\text{(A4)} \quad \text{s.t. } w_i = p_i - \Omega/D_i(p_i, p_{-i}).$$

The maximization problem with respect to p_i now corresponds to the one of a retailer without RPM for a wholesale price of $w_i = 0$. The equilibrium retail price of each manufacturer under competition with RPM is thus $p^{RPM} = p(w_i = 0, w_{-i} = 0)$. Step

(b): To show that $p^{RPM} < \min(p^*(\Omega), p^U)$, we show that both $p^*(\Omega)$ and p^U are prices resulting from $p(\tilde{w}, \tilde{w})$ for some $\tilde{w} > 0$.

For p^U , $\tilde{w} > 0$ follows from the logic of strategic delegation (Bonanno and Vickers [1988]). The first order condition for w^U is given by equation (7), that is,

$$(A5) \quad \frac{\partial p_i(\cdot)}{\partial w_i} \cdot \left[\frac{\partial D_i(\cdot)}{\partial p_i} + D_i(\cdot) \right] + \frac{\partial D_i(\cdot)}{\partial p_{-i}} \frac{\partial p_{-i}(\cdot)}{\partial w_i} p_i(\cdot) = 0.$$

We evaluate (A5) at $p_i = p_{-i} = p^{RPM}$. The first term is zero, as the term in brackets is equivalent to the first order condition (FOC) under RPM. That is, equation (A5) implies that the second term $\frac{\partial D_i(\cdot)}{\partial p_i} + D_i(\cdot)$ equals zero at p^{RPM} . However, the second term is positive for any positive price. In order for the FOC to hold, the price p^U that solves (A5) must thus be larger than p^{RPM} , such that, by concavity, $\frac{\partial D_i(\cdot)}{\partial p_i} + D_i(\cdot) < 0$ holds. This implies $p^U > p^{RPM}$.

For $p^*(\Omega)$, $\tilde{w} > 0$ follows from the assumption that manufacturers only sell products if it is strictly profitable. Recall from equation (9) that $p^*(\Omega) = p(w^*(\Omega))$. Suppose that $w^*(\Omega) = 0$. The left-hand side of equation (A2) reduces to the industry profit: $p(w^*(\Omega)) \cdot D_i(p(w^*(\Omega)), p(w^*(\Omega))) = \Omega$. The contract acceptance constraint of a retailer becomes $F_i = 0$. Hence, the manufacturers cannot make a positive profit when $w^*(\Omega) = 0$. Hence, $w^*(\Omega) > 0$ holds whenever the product is sold.

Retailers get a profit of Ω both with and without RPM. Introducing RPM thus affects both the industry and the manufacturer profits equally. As the price level absent RPM is below the monopoly level (that means $\min(p^*(\Omega), p^U) < p^M$), the manufacturers make less profit when they both use RPM compared to a situation without RPM as the retail prices are lower with RPM. ■

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