The Competition Effects of Industry-wide RPM under Two-Part Tariffs

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Abstract

In this paper, we investigate the competition and welfare effects of resale price maintenance (RPM) in a setting where: (*i*) a monopolist manufacturer sells through two retailers; (*ii*) firms negotiate bilaterally the terms of a two-part tariff contract; and (*iii*) contracts are assumed to be observable. Two different pricing regimes are compared: a regime in which retailers compete in prices in the final output market, and an alternative regime under which the retail price is defined by the manufacturer. We do not find RPM to be dominated by the free pricing equilibrium in terms of welfare. Indeed, when the upstream firm's power is weak, the social effects of RPM are likely to be positive.

JEL Classification: *L13; L41.*

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1 Introduction

According to Rey (2008, p. 135), "[w]hile the legal treatment of vertical restraints has often been subject to more controversy than other areas of competition policy, until recently there was a relative consensus among competition agencies and courts favouring a tougher attitude towards price restraints, such as resale price maintenance (RPM) and its variants (e.g., price floors). In contrast, the economic literature on vertical restraints did not appear to support such a tougher attitude. Theoretical and empirical studies had identified efficiency as well as anticompetitive motives benefits for both price and non-price restrictions and, on the whole, price restrictions did not emerge in a worse light than non-price restrictions."[1] Rey (2008, p. 145) further defends that "where general market conditions leave open the question of whether a vertical restraint will increase or reduce efficiency, economic analysis provides guidance for identifying those specific circumstances in which a particular restraint may reduce competition or increase efficiency".

In this paper, we contribute to this debate by discussing the welfare implications of resale price maintenance (henceforth RPM) in a vertical industry where: (*i*) an upstream monopolist manufacturer supplies two downstream retailers that offer differentiated products; (*ii*) each retailer bargains with the upstream manufacturer over the terms of a two-part tariff contract (i.e. a lump sum fee plus a uniform "wholesale" price); and (*iii*) contracts are assumed to be observable. More specifically, we compare the consumers' surplus and social welfare level under two pricing regimes: the free pricing regime and the RPM regime. In the free-pricing regime, the retailers can freely set the retail price for the product in question. In the RPM regime, it is instead the manufacturer that sets the retail price for its product.

The closest paper to ours is Dobson and Waterson (2007), who use a bilateral oligopoly setting. Except for the type of tariffs involved and the upstream market structure, the proposed model's assumptions follow closely those of Dobson and Waterson (2007). In particular, we assume that the payments between the manufacturer and the retailers take the form of two-part tariffs rather than the form of a linear transfer price. This is in line, for instance, with the contracts usually signed between the producers of Fast Moving Consumer Goods and the large retailers (supermarkets), in which, in addition to a per unit wholesale price, the relationship is characterized by listing fees, slotting allowances and marketing support investments, to name just a few.

[1] Along similar lines, Motta (2004, p. 306), focusing attention on vertical restraints that can raise welfare concerns and which are adopted by firms that enjoy enough market power, concludes that "one cannot simply outlaw certain restraints and permit others. In legal terms, this means that economic analysis suggests a rule of reason rather than a per se rule of prohibition of certain restraints."

Two-part tariffs should help mitigate the so called double marginalization problem, thus making RPM less likely to increase welfare. Indeed, as Dobson and Waterson (2007) point out, two-part tariffs have been "extensively modelled theoretically as a means to avoid vertical externality effects associated with successive market power".

Further, given the opposing signs of many externalities that are eliminated in the RPM regime, the effect of this practice on retail prices and on consumers' welfare is, a priori, ambiguous. While not finding RPM to be universally undesirable, Dobson and Waterson (2007) conclude that whenever retailers are in a strong bargaining position, the social effects of RPM are likely to be adverse, when compared to unrestricted trading, because the practice can help in the process of coordinating final price levels and prevent socially desirable countervailing power arising (in the absence of this practice, retailers seeking to remain competitive are likely to put pressure on manufacturers to cut margins, lowering transfer prices). We, however, show that it is possible that the practice of RPM may be profitable for the upstream firm that embarks on it for parameter values such that RPM leads to lower retail prices than those that would prevail under free pricing competition. Moreover, and in sharp contrast with Dobson and Waterson's (2007) main result, we find that for the social effects of RPM to be positive, it is necessary that the upstream firm's bargaining power is sufficiently low. Hence, our analysis clearly suggests that in circumstances that involve a low bargaining power of the upstream firm when negotiating with its retailers, efficiency arguments resulting from the RPM practice may prevail over the corresponding anti-competitive effects. This our result is therefore in line with Motta (2004, p. 306) who, focusing attention on vertical restraints that can raise welfare concerns and which are adopted by firms that enjoy enough market power, concludes that "one cannot simply outlaw certain restraints and permit others. In legal terms, this means that economic analysis suggests a rule of reason rather than a per se rule of prohibition of certain restraints. ... [Therefore, o]ften, only an elaborate analysis might shed light on whether efficiency considerations or anti-competitive effects prevail."[2]

The intuition behind our main result that the social effects of RPM are likely to be positive when the upstream firm's bargaining power is weak is the following. In a Nash Bargaining solution, the payoff to the upstream firm corresponds to its disagreement payoff plus a percentage of the profits generated by the bilateral relationships. This percentage is directly related to the upstream firm's degree of bargaining power. Hence, contrary to the case of a vertically integrated firm, under RPM the retail price is not set to maximize the industry profit because the manufacturer does not

[2] Along similar lines, Rey (2008) stresses a "tension between the economic literature and the relatively tougher treatment towards price restrictions observed in practice" (p. 159).

capture all those profits. If the degree of bargaining power is low, the upstream firm's payoff is close to the disagreement payoff. Now, by using RPM to set a lower retail price, the upstream firm is able to increase its disagreement payoff, which is especially relevant when the bargaining power of the upstream firm is low. If instead its bargaining power is high, then the upstream firm will be able to capture most of the industry profit and it will, therefore, set the vertically integrated monopolist's optimal retail price. When this is case, and given the assumptions in the model, the retail price unambiguously increases, thereby hurting both consumers and social welfare.

Our paper is also related to the strand of literature that identified the opportunistic behavior as a coordination failure that occurs in vertical markets. As this literature has shown, the supplier might be tempted to embark on opportunistic behavior by privately renegotiating a specific (bilateral) agreement on supply terms with one retailer, leading to higher output or lower prices, thereby free-riding on the other retailers. However, as the risk of this type of rent-shifting opportunistic behavior will be anticipated by other retailers, these other retailers will then be unwilling to accept high wholesale prices and the supplier will be prevented from fully exploiting its market power (see e.g. Mathewson and Winter (1984), O'Brien and Shaffer (1992), and Rey and Vergé (2008), to name a few). Nevertheless, as O'Brien and Shaffer (1992) show, in a setting wherein, like in the present paper, differentiated retailers compete in prices, the efficiency of the vertical structure can be restored by removing retail competition through commitment to an industry-wide price floor, which breaks the link between retail prices and negotiations over the transfer payments. Similarly, in our setting, the inclusion of bilateral bargaining, modelled as a Nash bargaining solution, combined with the two-part tariffs, leads to a well-known result that the unit wholesale price is chosen to maximize the gains to the two negotiating parties (the manufacturer and one of the retailers) and the lump sum fixed fee is then set to divide these gains between them. This means that the unit wholesale price will be set at a lower level when compared to the one that would be chosen by a vertically integrated firm, to increase the profits to the retailer when competing in prices, with obvious benefits to the final consumers. However, when embarking on industry-wide recommended prices (RPM), the manufacturer is able to remove the incentive to cut wholesale prices on a bilateral basis (final sales at the downstream market would not increase as a result) as downstream intra-brand competition is eliminated. Still, and as already mentioned, the resulting final prices when the manufacturer embarks on RPM are shown, under some circumstances, to be lower than the ones regarding the benchmark counterfactual scenario wherein RPM is absent and there is free price competition at the retail market. This result is in line with Heywood et al. (2018) who show that a resale price floor (or ceiling) is profitable for an upstream monopoly and can lead to higher social welfare and consumer surplus when product differentiation is relatively low and downstream retailers engage in spatial price discrimination. Based on these conclusions, Heywood et al. (2018) also argue in favour of a rule of reason approach to RPM.

The remainder of the paper is organized as follows. Section 2 presents the firms' cost structure, the demand model as well as some details about the bargaining stage. Section 3 describes the free pricing regime equilibrium and Section 4 discusses some useful benchmark cases. The RPM regime is analyzed in Section 5 and Section 6 compares the two regimes. All proofs of the formal results presented in the text are relegated to the Appendix.

2 The model

In a vertical industry, there are several externalities that the parties exert on one another, which we discuss in turn.

By horizontal externality between retailers we refer to the externality that is due to the impact of a retail price setting on the profit of the other retailer. When a retailer does not take into consideration the losses it will inflict on its rival, retail prices will be lower (all else constant). This externality may be internalized if collusion between the retailers takes place, i.e. if retail prices are set so as to maximize retailers' aggregate profit. Further, in the RPM regime, this externality simply does not exist as there is no intra-brand competition.

By forward vertical externality we refer to the externality that from the impact that a unit wholesale price choice by retailer i will have on retailer j's profit. When a pair manufacturer/retailer, in the process of bargaining over the wholesale price, does not consider the (negative) impact this choice may have on the other retailer's profits, wholesale unit prices will be lower.[3]

By backward vertical externality we refer to the externality that is related to the impact of a retail price increase on the manufacturer's profit. When a retailer does not consider the effects of its pricing strategy on the manufacturer's profit, retail prices will be higher.[4] It is then this

[3] For the same wholesale unit price, this externality is stronger when retailers are colluding on price. Lowering the wholesale cost of retailer i will create a disadvantage for retailer j. Under joint profit maximization, retail prices will be such that firm i will further increase its sales (because firm j will have higher costs). This is similar to the commitment problem, consists in the risk that the supplier might be tempted to renegotiate a specific (bilateral) agreement on supply terms with one retailer, leading to higher output or lower prices. This will then be anticipated by other retailers, who will be unwilling to accept high wholesale prices. This risk of opportunistic behavior is, however, more likely to be a concern in case contracts are not observable by rival retailers or in a context where negotiations occur sequentially (see e.g. O'Brien and Shaffer (1992) and Rey (2008)).

[4] This externality is stronger when retailers are colluding on price, because joint profit maximization will make retailer i set higher prices to create demand for firm j thus lowering further the manufacturer's sales.

externality that creates the double marginalization problem. As Rey (2008, p.137) highlights, "[w]hen a manufacturer and its retailer both enjoy market power, they will exploit this market power by increasing their prices above cost; each mark-up will reflect a trade-off between the impact of a price increase on volume and margin, but will typically ignore the impact of this price increase on the other party's profit. As a result, the addition of mark-ups will lead to retail prices that are not only above costs, but also above the desirable level for the vertical structure as a whole."

The following table summarizes these externalities under alternative market configurations:

		Vertical Int.	Free Pricing	Retail Collusion	RPM
Forward vertical ext.	+	no	yes	yes (stronger)	no
Backward Vertical ext.	-	no	yes	yes (stronger)	no
Horizontal ext.	+	no	yes	no	no

Under vertical integration, all externalities are internalized. The same would happen if the two retailers merged. In this case, one would have that standard double monopoly model and, with two-part wholesale tariffs, industry profit would be maximized. Under retail collusion, the horizontal externality is internalized, but the other externalities remain. In particular, the difference between this case and the case of a merger between the retailers is that the forward vertical externality is still present, as the manufacturer bargains separately with the two retailers, that will afterwards collude on price. In the free-pricing regime, all externalities are present. In contrast, under RPM both the horizontal and the backward vertical externalities are absent. This is for two reasons. First, since the retailers do not set the prices, there is no intra-brand competition. Second, because the wholesale unit prices will not affect the retailers' pricing decisions, the wholesale price set to retailer i does not affect the profit of retailer j. It should be highlighted, however, that RPM does not lead to the vertically integrated outcome because the firm that sets the retails prices has a different objective function.

In the following subsections we present the models' assumptions with respect to upstream and downstream firms, consumers and the bargaining process.

2.1 Firms

We consider a vertically related market, composed of an upstream monopolist, firm U, and a duopolistic downstream market with firms 1 and 2. The upstream monopolist produces, at a constant marginal cost c, an essential input that is supplied to the downstream market. The downstream firms make use of this essential input to produce the differentiated products 1 and 2, where we assume that in order to produce one unit of the product, downstream firms need to buy one unit of the input produced by the upstream monopolist. The downstream retailers are assumed to have no costs other than the input costs.

Let profits (gross of any fixed fees) be denoted by

$$\pi_U = (w_1 - c)q_1 + (w_2 - c)q_2$$

$$\pi_i = (p_i - w_i)q_i$$

where w_i is the wholesale unit price paid by retailer $i = 1, 2$, p_i is the price charged by retailer $i = 1, 2$.

Let $\pi = \pi_U + \pi_1 + \pi_2 = (p_1 - c)q_1 + (p_2 - c)q_2$. Now, each party's total profit includes the corresponding operational profit above plus the fixed fee(s) this party is entitled to or has to pay, that is,

$$\Pi_U = \pi_U + F_1 + F_2$$

$$\Pi_i = \pi_i - F_i$$

$$\Pi = \Pi_U + \Pi_1 + \Pi_2 = \pi$$

where F_i is the fixed fee paid by retailer $i = 1, 2$ to the upstream firm, which is not constrained to be positive.

Following Dobson and Waterson (2007), the two pricing regimes considered differ with respect to the timing of the game. In the free-pricing regime, the two bilateral negotiations take place simultaneously and before the retail competition stage, in which the retail prices are simultaneously set. In the RPM regime, the manufacturer initially sets the retail price, common to the whole industry, and the bilateral negotiations follow.

2.2 Demand

The demand model follows Singh and Vives (1984). Let the representative consumer's utility be given by:

$$U(q_1, q_2) = \frac{\alpha(q_1 + q_2)}{\beta(1-\gamma)} - \frac{(q_1)^2 + (q_2)^2}{2\beta(1-\gamma)(1+\gamma)} - \frac{\gamma q_1 q_2}{\beta(1-\gamma)(1+\gamma)}$$

where q_i represents the quantity sold by retailer i and α, β and $\gamma < 1$ are three positive parameters such that $\alpha - c\beta(1-\gamma) > 0$. The corresponding demands for q_i with $i = 1, 2$, and $j = 1, 2$ with $j \neq i$, is given by

$$q_i = \alpha - \beta p_i + \beta\gamma p_j$$

or

$$p_i = \frac{\alpha}{\beta(1-\gamma)} - \frac{q_i}{\beta - \beta\gamma^2} - \gamma\frac{q_j}{\beta - \beta\gamma^2}$$

In case one of the firms, say firm j, does not sell (for instance, due to a breakdown in the negotiation with the manufacturer regarding the wholesale price), the demand for the monopolist retailer, firm i, will be

$$p_i = \frac{\alpha}{\beta(1-\gamma)} - \frac{q_i}{\beta - \beta\gamma^2} \Leftrightarrow q_i = (1+\gamma)(\alpha - \beta(1-\gamma)p_i).$$

As will be seen below, an important characteristic of the demand structure is that sensitivity of demand with respect to an equal increase in all market prices under duopoly is lower than the one under monopoly. It follows that the former is $\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_j} = -\beta(1-\gamma)$ whereas the latter is $\frac{\partial q_i}{\partial p_i} = -(1+\gamma)\beta(1-\gamma)$. Thus, for $\gamma > 0$ the demand in case of monopoly is more sensitive to increases in the industry price than under duopoly. This follows from the fact that the marginal utility of product 1 negatively depends on the quantity of product 2.

Consumer surplus and social welfare are respectively given by

$$CS = U(q_1, q_2) - p_1 q_1 - p_2 q_2 = \frac{1}{2}\frac{q_1^2 + q_2^2 + 2\gamma q_1 q_2}{\beta(1-\gamma)(\gamma+1)}$$

$$W = \frac{\alpha(q_1 + q_2)}{\beta(1-\gamma)} - \frac{(q_1)^2 + (q_2)^2}{2\beta(1-\gamma)(\gamma+1)} - \frac{\gamma q_1 q_2}{\beta(1-\gamma)(\gamma+1)} - c(q_1 + q_2)$$

with the socially optimal output

$$q_1 = q_2 = q^* = \alpha - c\beta\,(1-\gamma) > 0.$$

In any symmetric equilibrium with $q_1 = q_2 = q$ consumer surplus and welfare simplify, respectively, to

$$CS = \frac{q^2}{\beta\,(1-\gamma)}$$
$$W = \frac{(2q^* - q)\,q}{\beta\,(1-\gamma)}$$

so that consumer surplus increases with output and welfare is higher the closer the output is to q^*.

2.3 Bargaining Stage

In both pricing regimes, we assume that there is bilateral bargaining between the manufacturer and each retailer over the components of the two-part tariff. We further assume that the contracts that arise from these bilateral negotiations are observable, i.e., when competing over price in the free pricing regime, the retailers know each others costs.[5] In addition, negotiations are assumed to be held simultaneously so that, during the bargaining process, the manufacturer's and the retailer's negotiators consider the price that results from the other bilateral negotiation as given. The negotiations are modelled by the two-player generalized Nash bargaining solution and retailers are symmetric with respect to their bargaining power vis-a-vis the manufacturer.

In a negotiation between manufacturer U and retailer i, the unit price w_i and the fixed fee F_i are those that maximize

$$\Phi_i(w_i, w_j, F_i, F_j) = (A_U(w_i, w_j) + F_i - d_{U_i})^{\theta}(A_i(w_i, w_j) - F_i - d_i)^{1-\theta} \tag{1}$$

where $A_U(w_i, w_j)$ and d_{U_i} denote the manufacturer's payoff and disagreement payoff, respectively, $A_i(w_i, w_j)$ and d_i denote the retailer i's payoff and disagreement payoff, respectively, and θ measures the manufacturer's bargaining power.[6] Within each of these bilateral negotiations, the manufac-

[5] See Dobson and Waterson (2007) for a justification of this assumption based on information leakages and insight.
[6] Note that $A_U(w_i, w_j)$ and $A_i(w_i, w_j)$ depend on the pricing regime considered. For simplicity we omit here the

turer's disagreement payoff, d_{U_i}, corresponds to the profit from the expected sales with the outsider retailer acting as a monopolist, whereas the retailers' disagreement payoffs, d_i, are normalized to zero (if the negotiation fails, the retailer does not sell). Note that both payoffs are gross of the fixed fee F_i.

The first-order conditions on F_i are

$$\theta(A_U + F_i - d_{U_i})^{\theta-1}(A_i - F_i - d_i)^{1-\theta} - (1-\theta)(A_U + F_i - d_{U_i})^{\theta}(A_i - F_i - d_i)^{-\theta} = 0 \Leftrightarrow$$

$$\theta(A_i - F_i - d_i) - (1-\theta)\left(A_U + F_i - d_{U_i}\right) = 0$$

from where one obtains:

$$F_i^* = \theta(A_i - d_i) - (1-\theta)\left(A_U - d_{U_i}\right)$$

Replacing F_i^* in the Nash product (1), one obtains:

$$\Phi_i = \theta^{\theta}\left(1-\theta\right)^{1-\theta}\left(A_U(w_i, w_j) + A_i(w_i, w_j) - d_i - d_{U_i}\right)$$

So, w_i is chosen to maximize the incremental gains to the two parties taking w_j as given, $A_U(w_i, w_j) + A_i(w_i, w_j) - d_i - d_{U_i}$, and F_i is set to divide these gains between the two parties, so that the upstream firm's payoff from selling to retailer i is:

$$A_U(w_i^*, w_j^*) - (w_j^* - c)q_j + F_i^* = d_{U_i} - (w_j^* - c)q_j + \theta\left(A_U(w_i^*, w_j^*) + A_i(w_i^*, w_j^*) - d_i - d_{U_i}\right)$$

The payoff for the upstream monopolist resulting from the sales to retailer i alone is composed of two components: the incremental profit in the sales to retailer j that results from disagreement with retailer i and a percentage - equal to its bargaining power - of the incremental profit generated by the bilateral contract bargained between retailer i and the upstream monopolist.

corresponding indices.

It then follows that the manufacturer's payoff from the two negotiations is

$$A_U(w_i^*, w_j^*) + F_j^* + F_i^* =$$

$$= d_{U_i} + d_{U_j} - A_U(w_i^*, w_j^*) + \theta \left(A_U(w_i^*, w_j^*) + A_j(w_i^*, w_j^*) - d_j - d_{U_j} \right)$$

$$+\theta \left(A_U(w_i^*, w_j^*) + A_i(w_i^*, w_j^*) - d_i - d_{U_i} \right)$$

As for retailer i, its payoff is

$$A_i(w_i^*, w_j^*) - F_i^* = d_i + (1-\theta) \left(A_U(w_i^*, w_j^*) + A_i(w_i^*, w_j^*) - d_i - d_{U_i} \right)$$

Each retailer receives its disagreement payoff (normalized to zero) plus a percentage - equal to its bargaining power - of the incremental profit generated by the bilateral contract bargained between the retailer and the upstream monopolist.

3 Wholesale Linear Pricing

As mentioned above, the present paper builds on Dobson and Waterson (2007), but includes two major differences: two-part tariffs and upstream monopoly.[7] To single out the role played by two-part tariffs, which is the main purpose of this paper, and make the results more easily comparable, this short section presents the effects of RPM under linear wholesale pricing. The main result in Dobson and Waterson (2007), that "where retailer power is strong, the social effects of RPM are likely to be adverse" was obtained under a double duopoly industry, but still holds in case there is upstream monopoly, as the next Proposition shows.

Proposition 1: Consumer surplus and welfare are higher with RPM than under free pricing if and only if $\theta > \widehat{\theta}(\gamma)$, with $\widehat{\theta}(0) = 0$, $\widehat{\theta}(1) = 1$ and $\frac{\partial \widehat{\theta}(\gamma)}{\partial \gamma} > 0$.

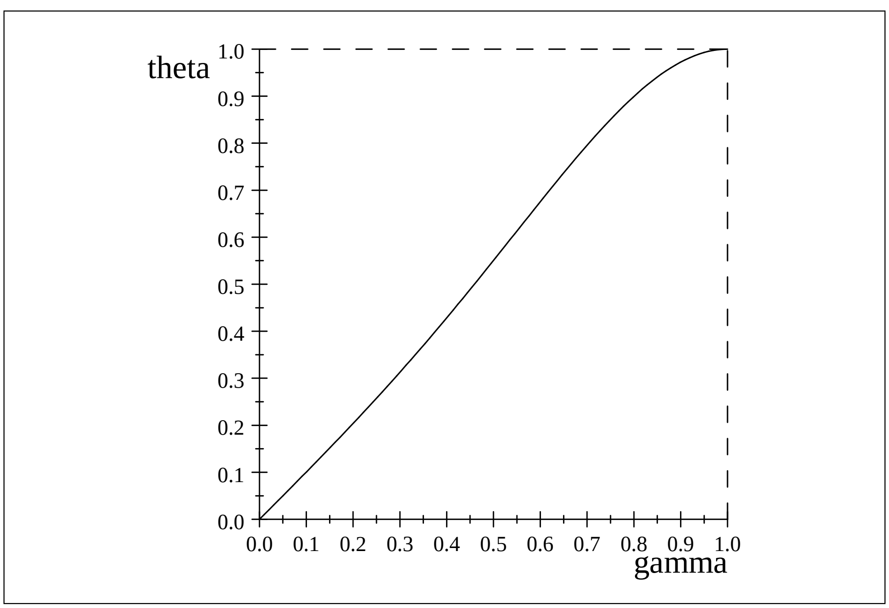
The intuition is as follows. Under free pricing, the final outcome depends on the degree of bargaining power in the following way. When the manufacturer has no bargaining power, the wholesale price will be equal to marginal cost c and the two retailers will compete fiercely (with

[7] Upstream monopolly corresponds to the double duopoly case studied by Dobson and Waterson (2007) when there is no interbrand competition (in their notation, $\beta = 0$).

low costs), yielding high consumer surplus and welfare. In this case, the countervailing power of the two retailers allows them to lower the upstream firm's profit margin and, since they are free to set retail prices and have lower marginal costs, benefit consumers with low prices.

When, instead, the manufacturer has all bargaining power, it is as if this firm sets the wholesale price that maximizes its profit in advance, anticipating the demand from the two downstream retailers. In this case, it will set the monopoly wholesale price, and the final outcome corresponds to duopoly competition between two retailers with high costs, which is worse for consumers.

With RPM, the upstream firm anticipates that it will obtain, in the bargaining stages, a percentage of the industry aggregate profit. This percentage increases with its bargaining power and decreases with the degree of product differentiation. Hence, for any θ and γ, the manufacturer will set p to maximize industry profits. This leads to the outcome of the vertically integrated firm, which has opposing effects on welfare. On the one hand, there is no double marginalization but, on the other hand, there is no intrabrand competition between the two retailers, which are no longer free to compete on price.[8] In our setting, if $\theta = 1$, the first effect dominates and RPM is welfare enhancing, whereas if $\theta = 0$ the second effect dominates and RPM hurts welfare. If θ is sufficiently high, RPM may thus lead to higher welfare. Figure 1 represents $\widehat{\theta}(\gamma)$. The expression is presented in the appendix.



[8] The strength of intrabrand competition depends on parameter γ. If $\gamma = 0$, the two retailers are completely differentiated and there is no such competition. In this case, RPM increases welfare for any θ. If $\gamma = 1$, the two retailers products are perceived as homogeneous, competition between the retailers is fierce and RPM decreses welfare.

4 Wholesale Two-part Tariffs

In this section, we replace the linear wholesale prices by a pair of two-part tariff menus. We will address first the free-pricing regime, followed by the RPM regime.

4.1 Free-pricing equilibrium

In this regime firms are assumed to set prices simultaneously after the two-part tariffs have been negotiated bilaterally. We look for the SPNE following the usual backward induction procedure.

4.1.1 Downstream Price Competition Stage

This stage only exists if the contracts involve two-part wholesale tariffs: under RPM there is no downstream competition. If both retailers have agreed on the contracts, the price setting stage corresponds to a duopoly. If one of the retailers did not reach an agreement with the manufacturer, there will be a monopoly.

Duopoly The equilibrium variables for this case are represented by a superscript D. Retailer i's profits are:

$$\Pi_i = (p_i - w_i)(\alpha - \beta p_i + \beta\gamma p_j) - F_i$$

leading to the following equilibrium prices and outputs:

$$p_i^D(w_i, w_j) = \frac{\alpha\left(2+\gamma\right)+\beta\left(2w_i+\gamma w_j\right)}{\beta\left(2+\gamma\right)\left(2-\gamma\right)} \tag{2}$$

$$q_i^D(w_i, w_j) = \frac{\alpha\left(\gamma+2\right)-\beta\left(2-\gamma^2\right)w_i+\beta\gamma w_j}{\left(2-\gamma\right)\left(\gamma+2\right)} \tag{3}$$

where, as expected, retail prices increase with the retailers' marginal costs, and an increase in own costs lowers the equilibrium output whereas an increase in rival's costs increases it.

The corresponding profits (excluding the fixed transfers) are given by

$$\pi_i^D(w_i, w_j) = \frac{\left(\alpha\left(\gamma+2\right)-\beta w_i\left(2-\gamma^2\right)+\beta\gamma w_j\right)^2}{\left(\gamma-2\right)^2\left(\gamma+2\right)^2\beta} \tag{4}$$

$$\pi_U^D(w_1, w_2) = \sum_{\substack{i=1,2\\ j\neq i}}(w_i - c)\frac{\alpha\left(\gamma+2\right)-\beta\left(2-\gamma^2\right)w_i+\beta\gamma w_j}{\left(2-\gamma\right)\left(\gamma+2\right)} \tag{5}$$

Monopoly Assume now that the negotiation with, say, retailer j breaks down. We then have retailer i acting as a monopolist in the retail pricing stage, with the w_i that results from the bargaining stage. The equilibrium variables for this case are represented by a superscript M.

$$\Pi_i = (p_i - w_i)\, q_i - F_i = (p_i - w_i)\,(\gamma + 1)\,(\alpha - \beta\,(1-\gamma)\,p_i) - F_i$$

The monopoly price and output, as a function of the input price, are:

$$p_i^M(w_i) = \frac{\alpha + \beta w_i\,(1-\gamma)}{2\beta\,(1-\gamma)}$$
$$q_i^M(w_i) = \frac{1}{2}\,(\gamma+1)\,(\alpha - \beta\,(1-\gamma)\,w_i)$$

and the corresponding profits (gross of fixed fees) are

$$\pi_i^M(w_i) = \frac{(1+\gamma)\,(\alpha - \beta\,(1-\gamma)\,w_i)^2}{4\beta\,(1-\gamma)} \tag{6}$$
$$\pi_U^M(w_i) = (w_i - c)\frac{1}{2}\,(\gamma+1)\,(\alpha - \beta\,(1-\gamma)\,w_i) \tag{7}$$

4.1.2 Upstream Negotiation

The manufacturer disagreement payoff when dealing with retailer i is the profit obtained from retailer j, who becomes a monopolist in case of disagreement. This is given by

$$d_{U_i}(w_j) = \pi_U^M(w_j) + F_j$$

The Nash bargaining product is then

$$\Phi_i = (\pi_U^D(w_i, w_j) + F_i + F_j - d_{U_i}(w_j))^\theta(\pi_i^D(w_i, w_j) - F_i)^{1-\theta}$$

which can be simplified to

$$\Phi_i = (\pi_U^D(w_i, w_j) + F_i - \pi_U^M(w_j))^\theta(\pi_i^D(w_i, w_j) - F_i)^{1-\theta}$$

The first-order condition of the fixed fee results in $F_i = \theta\pi_i^D(w_i, w_j) - (1-\theta)\left(\pi_U^D(w_i, w_j) - \pi_U^M(w_j)\right)$ and replacing this into the Nash product, the Nash product can be simplified to:

$$\Phi_i(w_i, w_j) = \pi_i^D(w_i, w_j) + \pi_U^D(w_i, w_j) - \pi_U^M(w_j) \tag{8}$$

The FOC result in

$$w_1^F = w_2^F = \frac{c\beta\,(1-\gamma)\,(2-\gamma)\,(\gamma+2) + \alpha\gamma^2}{4\beta\,(1-\gamma)} > c$$

where the superscript F denotes the free-pricing Nash retail prices regime.

The wholesale price w_1 is set to maximize the incremental joint profits of retailer 1 and of the manufacturer, for a given w_2 and likewise for w_2. So, w_1 is lower than the wholesale price that would be obtained under joint profit maximization (only at this stage and assuming competition afterwards). This is because the negative impact of a lower w_1 on retailer 2 is not considered. However, w_1^F is still higher than the one obtained for the vertically integrated firm, c. The intuition is simple. By setting w_1 above marginal cost, the competition between the two retailers (that takes place afterwards) is mitigated, making them both set higher retail prices.

The corresponding prices and outputs are:

$$p_i^F = \frac{\alpha\,(2-\gamma) + c\beta\,(\gamma+2)\,(1-\gamma)}{4\beta\,(1-\gamma)} = c + \frac{2-\gamma}{4\,(1-\gamma)}\frac{\alpha - c\beta\,(1-\gamma)}{\beta} \tag{9}$$

$$q_i^F = \frac{\gamma+2}{4}\left(\alpha - c\beta\,(1-\gamma)\right) \tag{10}$$

Note that

$$\frac{\partial p_i^F}{\partial\gamma} = \frac{\alpha + c\beta\,(1-\gamma)^2}{4\beta\,(\gamma-1)^2} > 0$$

A more homogeneous product (higher γ) leads in this case to higher equilibrium prices because a high γ also means a larger demand.

In what follows we present the equilibrium profits, fixed fees, consumer surplus and welfare in equilibrium, denote by superscript F. All expressions are normalized by dividing them by $\frac{(\alpha - c\beta(1-\gamma))^2}{\beta}$

The profits, gross of fixed fees, are:

$$\pi_i^F = \frac{(\gamma+2)^2}{16}$$
$$\pi_U^F = \frac{\gamma^2(\gamma+2)}{8(1-\gamma)}$$

and the equilibrium fixed fees are:

$$F_i^F = \frac{(\gamma+2)\left(\theta\left(-2\gamma-\gamma^3+\gamma^4+4\right)+\gamma^2\left(\gamma-\gamma^2-2\right)\right)}{32(1-\gamma)}$$

Thus, welfare, consumer surplus, the manufacturer's profits and industry profits are, in the free price regime:

$$W^F = \frac{(\gamma+2)(6-\gamma)}{16(1-\gamma)}$$
$$CS^F = \frac{(\gamma+2)^2}{16(1-\gamma)}$$
$$\Pi_U^F = \frac{(\gamma+2)\left(\theta\left(-2\gamma-\gamma^3+\gamma^4+4\right)+\gamma^3(1-\gamma)\right)}{16(1-\gamma)}$$
$$\Pi^F = \frac{2(\gamma+2)(2-\gamma)}{16(1-\gamma)}$$

4.2 Benchmark cases

In this section we present some important benchmark scenarios, starting with the case of a vertically integrated firm. These cases will be useful when explaining the effects of RPM.

4.2.1 Vertically integrated firm

Consider first the case of a vertically integrated firm. The equilibrium variables in this case are denoted by a superscript I. The retail prices are set to maximize the industry profit and, in this case, there is no wholesale price. The first-order conditions for profit maximization yield

$$p_i^I = \frac{\beta c\,(1-\gamma)+\alpha}{2\beta\,(1-\gamma)} > c$$

$$q_i^I = \frac{1}{2}\left(\alpha - \beta c\,(1-\gamma)\right)$$

with the corresponding normalized profit, consumer surplus and welfare:

$$\Pi^I = \frac{1}{2\,(1-\gamma)};\, CS^I = \frac{1}{4\,(1-\gamma)};\, W^I = \frac{3}{4\,(1-\gamma)}$$

The retail prices can be compared with those in the equilibrium of the free pricing regime:

$$p_i^I - p_i^F = \frac{\gamma}{4\,(1-\gamma)}\frac{\alpha - c\beta\,(1-\gamma)}{\beta} > 0$$

In theory, the vertically integrated firm may set prices that are higher or lower than those in the free pricing regime. On the one hand, there is no double marginalization. On the other hand, the competition between the two retailers is removed. In this setting, the vertically integrated firm sets higher prices and the price difference increases when γ is large, that is, when the competition between the two retailers is stronger. When $\gamma = 0$, the two products belong to independent markets and the two bargaining games are also independent: one would have two double monopolies. In that case, due to the two-part tariffs, we obtain exactly the same outcome with a vertically integrated firm or in the free pricing regime.

4.2.2 Downstream Collusion

Consider now that instead of competing on price, the two downstream retailers collude. However, they still bargain independently with the upstream monopolist regarding the two-part tariff. The equilibrium variables in this case are denoted by a superscript C. In order to avoid negative equilibrium quantities, we assume that $2 - 3\gamma > 0$.

In case there is collusion at the retail stage, the retail prices are set to maximize the retailers' aggregate profit:

$$\pi_1(w_1, w_2) + \pi_2(w_1, w_2) = (p_1 - w_1)(\alpha - \beta p_1 + \beta\gamma p_2) + (p_2 - w_2)(\alpha - \beta p_2 + \beta\gamma p_1)$$

yielding

$$p_i = \frac{\alpha + \beta w_i (1-\gamma)}{2\beta (1-\gamma)}$$

$$q_i = \frac{1}{2} (\alpha - \beta w_i + \beta \gamma w_j)$$

Despite the fact that the two retailers collude on price, they are independent firms that bargain with the manufacturer over the wholesale prices. As before, the bargaining stage maximizes (8) with the same disagreement payoffs as in the free-pricing case. This leads to

$$w_i^C = \frac{2c\beta (1-\gamma)^2 - \alpha\gamma}{\beta (2-3\gamma)(1-\gamma)}$$

Note that this input price is below marginal cost:

$$w_i^C - c = -\gamma \frac{\alpha - c\beta (1-\gamma)}{\beta (2-3\gamma)(1-\gamma)} < 0$$

With collusion at the retail level, the w that maximizes the industry joint profit is c. However, the bargaining results in a wholesale price below c because the profit of retailer 2 is not considered in the bargaining between retailer 1 and the manufacturer and vice-versa. Recall that with retail price competition, the w that maximizes the joint profit is above marginal cost (to lead to higher retail prices in the ensuing retail competition stage). In that case, the bargained w_1 that maximizes the profits of retailer 1 and the manufacturer is below that level for the same reasons, but still above c.

Given the wholesale prices, equilibrium retail prices and quantities are

$$p_i^C = \frac{\alpha (1-2\gamma) + c\beta (1-\gamma)^2}{\beta (1-\gamma)(2-3\gamma)}$$

$$q_i^C = \frac{1-\gamma}{2-3\gamma} (\alpha - c\beta (1-\gamma))$$

resulting in the following normalized profits:

$$\pi_1^C = \pi_2^C = \frac{(1-\gamma)}{(3\gamma-2)^2}$$
$$\pi_U^C = \frac{-2\gamma}{(3\gamma-2)^2}$$
$$\Pi^C = \frac{2(1-2\gamma)}{(3\gamma-2)^2}$$
$$\pi_U^M = \frac{(\gamma+1)(1-\gamma)}{(3\gamma-2)^2}$$

The fixed fees are

$$F_i = \theta\pi_i^C - (1-\theta)\left(\pi_U^C - \pi_U^M\right) = \frac{\gamma(2-\gamma-\theta(3-\gamma))+1}{(3\gamma-2)^2}$$

Consumer surplus and welfare are given by

$$CS^C = \frac{(1-\gamma)}{(3\gamma-2)^2}$$
$$W^C = \frac{3-5\gamma}{(3\gamma-2)^2}$$

4.2.3 Single Retailer

In case there is just one retailer, firm $1+2$, the market structure corresponds to a double monopoly vertical industry. The downstream stage would be just like in the case in which retailers collude, resulting in

$$\pi_{1+2}^D(w_1, w_2) = \sum_{\substack{i=1,2 \\ j\neq i}} \left(\frac{\alpha+\beta w_i(1-\gamma)}{2\beta(1-\gamma)} - w_i\right)\frac{1}{2}(\alpha-\beta w_i+\beta\gamma w_j)$$
$$\pi_U^D(w_1, w_2) = \sum_{\substack{i=1,2 \\ j\neq i}} (w_i - c)\frac{1}{2}(\alpha-\beta w_i+\beta\gamma w_j)$$

The bargaining stage is now different because there is just one bargaining process going on that aims at maximizing

$$\Phi_{1+2}(w_1, w_2) = \pi_{1+2}^D(w_1, w_2) + \pi_U^D(w_1, w_2)$$

with respect to w_1 and w_2 that results in $w_1 = w_2 = c$. This results in the prices and quantities of the vertically integrated firm.

4.3 RPM equilibrium

We assume that under "common" RPM the retail prices are set to p: the manufacturer can "impose" a common retail price p at the outset. Again, firms bargain over the w_i's and the fixed fees F_i's, but *after* knowing which p is imposed by the manufacturer. The equilibrium variables in this case are denoted by a superscript R.

4.3.1 Retail Payoffs

Then, if both retailers reach an agreement with the upstream monopolist, the quantities sold are:

$$q_i^D(p) = \alpha - \beta\,(1-\gamma)\,p$$

with profits (gross of the fixed fees)

$$\pi_i^D(p, w_i) = (p - w_i)\,(\alpha - \beta\,(1-\gamma)\,p) \tag{11}$$

$$\pi_U^D(p, w_1, w_2) = (w_1 - c)\,(\alpha - \beta\,(1-\gamma)\,p) + (w_2 - c)\,(\alpha - \beta\,(1-\gamma)\,p) \tag{12}$$

If one retailer does not close a deal, the other one, say retailer i, will be a monopolist (but forced to set the same price p) and

$$q_i^M(p) = (1+\gamma)\,(\alpha - \beta\,(1-\gamma)\,p)$$

$$\pi_i^M(p, w_i) = (p - w_i)\,(1+\gamma)\,(\alpha - \beta\,(1-\gamma)\,p) \tag{13}$$

$$\pi_U^M(p, w_i) = (w_i - c)\,(1+\gamma)\,(\alpha - \beta\,(1-\gamma)\,p) \tag{14}$$

This is different from the free-pricing regime, as the surviving retailer would be free to set the monopoly price. Now, it is constrained to set p.

Note that $q_i^M(p) - 2q_i^D(p) = -(1-\gamma)(\alpha - p\beta(1-\gamma)) < 0$. For the same retail price level, total sales are lower when a single product is sold than under duopoly.

4.3.2 Upstream Negotiation

As seen above, the F_i's are given by

$$F_i^* = \theta\pi_i^D(p, w_i) - (1-\theta)\left(\pi_U^D(p, w_1, w_2) - \pi_U^M(p, w_j)\right)$$

Replacing F_i^* in the Nash product, one obtains:

$$\Phi_i = \theta^\theta (1-\theta)^{1-\theta}\left(\pi_U^D(p, w_1, w_2) + \pi_i^D(p, w_i) - 0 - \pi_U^M(p, w_j)\right)$$

which simplify to:

$$\Phi_i = \theta^\theta (1-\theta)^{1-\theta}(\alpha - \beta(1-\gamma)p)(p - c + \gamma(c - w_j))$$

Recall that when bargaining over two-part tariffs, the unit price w_i is set to maximize the incremental profits from the relationship between the upstream firm and retailer i, and the fixed fee F_i is used to share the profits between the two parties. In this case, however, the incremental profits do not depend on w_i for two reasons. On the one hand, the retail price p and retail revenues do not depend on w_i because p is set in advance by the upstream firm. On the other hand, when retailer i's profits are aggregated with the upstream firm's profit the terms $w_i q_i$ cancel out: the cost of retailer i is part of the revenue of the upstream firm. Therefore, regardless of the price set in advance by the upstream firm, any w_i maximizes Φ_i. There is a multiplicity of Nash bargaining solutions for any p.

Without loss of generality, we write $w_i = c + \rho_i(w_i^F - c)$ that is

$$w_i = c + \rho_i\left(\frac{c\beta(1-\gamma)(2-\gamma)(\gamma+2) + \alpha\gamma^2}{4\beta(1-\gamma)} - c\right) \tag{15}$$

If $\rho_i = 1$, we have the same input prices as in the free-pricing regime case. If $\rho_i = 0$, the manufacturer sells at marginal cost.

4.3.3 Retail price

In the first stage, the manufacturer sets the retail price p, to maximize its own profit, anticipating the results of the negotiations that will follow. In general, one would expect that the Nash bargaining solution was a function of p. But in this case, as seen above, only the fixed fees depend on p. However, the unit wholesale prices, as measured by ρ_i, are relevant when choosing the optimal p. This is because although ρ_i is irrelevant for the bargaining between retailer i and the manufacturer, it does play a role in the determination of the manufacturer disagreement payoff at the other bargain. Now, since the Nash bargaining solution involves a multiplicity of possible ρ_i's, we assume that the upstream manufacturer must form some expectation about which ρ_i's will be the outcome of the Nash bargaining solutions that occur subsequently. In particular, we assume that when setting the retail price, the upstream manufacturer correctly anticipates the outcomes of the subsequent bilateral negotiations over the wholesale prices, just as any retailer, when negotiating with the common manufacturer over the wholesale price, correctly anticipates the outcome that will result from the other simultaneous bargain involving the common manufacturer and its rival retailer.

The upstream manufacturer's payoff, as a function of ρ_i, can be expressed as

$$
\begin{aligned}
\Pi_U(p,\rho_1,\rho_2) &= \pi_U^D(p,\rho_1,\rho_2) + F_1^* + F_2^* = \\
&= \pi_U^M(p,\rho_2) + \pi_U^M(p,\rho_1) - \pi_U^D(p,\rho_1,\rho_2) \\
&+ \theta\left(\pi_U^D(p,\rho_1,\rho_2) + \pi_1^D(p,\rho_1,\rho_2) - \pi_U^M(p,\rho_2)\right) \\
&+ \theta\left(\pi_U^D(p,\rho_1,\rho_2) + \pi_2^D(p,\rho_1,\rho_2) - \pi_U^M(p,\rho_1)\right)
\end{aligned}
$$

Maximizing Π_U with respect to p is the same as maximizing

$$
\pi_1^D + \pi_2^D + \pi_U^D + \frac{1-\theta}{\theta}\left(\pi_U^M + \pi_U^M - \pi_U^D\right) = \Pi(p) + \frac{1-\theta}{\theta}\left(\pi_U^M + \pi_U^M - \pi_U^D\right)
$$

Hence, whether the optimal price p is larger or smaller than the price that maximizes industry profits, $\Pi(p)$, depends on how $\pi_U^M(p,\rho_1)+\pi_U^M(p,\rho_2)-\pi_U^D(p,\rho_1,\rho_2)$ changes with p.[9] This expression

[9] If $\pi_U^M(p,\rho_1)+\pi_U^M(p,\rho_2)-\pi_U^D(p,\rho_1,\rho_2)$ does not depend on p then the optimal p corresponds to p^I, the price set

is

$$\pi_U^M + \pi_U^M - \pi_U^D = (w_2 - c)(1+\gamma)(\alpha - \beta(1-\gamma)p) + (w_1 - c)(1+\gamma)(\alpha - \beta(1-\gamma)p) -$$

$$- (w_1 - c)(\alpha - \beta(1-\gamma)p) - (w_2 - c)(\alpha - \beta(1-\gamma)p)$$

$$= \gamma\left(\rho_1(w_1^F - c) + \rho_2(w_2^F - c)\right)(\alpha - p\beta(1-\gamma))$$

and, therefore, $\pi_U^M + \pi_U^M - \pi_U^D$ decreases with the retail price if $\rho_1 > 0$, $\rho_2 > 0$ and $\gamma > 0$. In this case, the manufacturer will choose a price below the one that maximizes the industry profit. As mentioned above, the reason is that demand in $\pi_U^M(p, \rho_1)$ is $(\gamma+1)(\alpha - \beta(1-\gamma)p)$ which, if $\gamma > 0$, is more sensitive to the common price than the demand for the same product under duopoly (in π_U^D), which is $\alpha - \beta(1-\gamma)p$. Thus, for a given positive wholesaler average margin, a lower p increases $\pi_U^M + \pi_U^M - \pi_U^D$. It may then happen that RPM yields prices lower than the vertically integrated structure and, eventually, lower than those in the free-pricing equilibrium.

If θ is equal to 1, we have the retail price under RPM is the one that the vertically integrated firm would set because the term $\frac{1-\theta}{\theta}\left(\pi_U^M + \pi_U^M - \pi_U^D\right)$ is equal to zero. This is easy to understand. If the manufacturer has all the bargaining power, it will be able to capture all the industry profit in the bilateral negotiations over the fixed fees. Hence, the optimal p is the one that the vertically integrated firm would choose.

If $\theta \to 0$, p will be set to maximize $\pi_U^M(p, \rho_1) + \pi_U^M(p, \rho_2) - \pi_U^D(p, \rho_1, \rho_2)$ The solution is then the lowest admissible price.[10]

Note also that if $\rho = 0$ then $\pi_U^M = \pi_U^D = 0$. As the wholesale price is equal to marginal cost c, maximizing Π_U would be equivalent to maximizing the industry profit Π.

Finally, if γ is equal to zero the two retailers operate in independent markets. In that case, $\pi_U^M(p, \rho_1) + \pi_U^M(p, \rho_2) - \pi_U^D(p, \rho_1, \rho_2)$ is equal to zero and, again, the manufacturer chooses the retail price to maximize the joint industry profits Π.

We now present the optimal price that, as explained above, is below p_i^I. Without loss of gener-

by the vertically integrated firm.

[10] In this model, products are substitutes if γ is positive. For the same unit price, the demand for each product if the other one is not sold is larger than when the other is placed in the market. This happens because $U(q_1, q_2) < U(q_1, 0) + U(0, q_2)$.

ality, and in order to simplify the expressions, we write

$$p = c + \lambda \left(p_i^I - c\right) = c + \lambda \left(\frac{\beta c (1-\gamma) + \alpha}{2\beta (1-\gamma)} - c \right) \tag{16}$$

If $\lambda = 0$, we have the socially optimal price. If $\lambda = 1$, we have the price that maximizes industry profit (vertically integrated firm). If $\lambda = 1 - \frac{1}{2}\gamma$, we have the price of the free-pricing regime. If $\lambda = 1 + \frac{1}{4}\gamma^2$, we have the monopoly price in the free-pricing regime when only one firm sells.

Plugging (16) and (15) into the corresponding profit functions, the upstream manufacturer's normalized profits are

$$\Pi_U (\lambda, \rho_1, \rho_2) = (2 - \lambda) \frac{4\theta\lambda + \gamma^3(\rho_1 + \rho_2)(1-\theta)}{8(1-\gamma)}$$

In the first stage, the manufacturer sets the retail price, or the value of λ. The price that maximizes the manufacturer's expected payoff follows from:

$$\begin{aligned} \frac{\partial \Pi_U (\lambda, \rho_1, \rho_2)}{\partial \lambda} &= \frac{8\theta (1-\lambda) - \gamma^3(\rho_1 + \rho_2)(1-\theta)}{8(1-\gamma)} = 0 \Leftrightarrow \\ \lambda^* &= \left(1 - \frac{\rho_1 + \rho_2}{2} \frac{1-\theta}{4\theta} \gamma^3 \right) \end{aligned}$$

where we need that $\lambda^* > 0 \Leftrightarrow \theta > \frac{\gamma^3 \frac{\rho_1+\rho_2}{2}}{\gamma^3 \frac{\rho_1+\rho_2}{2} + 4}$ so that the retail price is above the manufacturer's marginal cost and the negotiation increases the parties' profits.

Note that

$$\begin{aligned} \frac{\partial \lambda^*}{\partial \theta} &= \frac{\gamma^3}{4\theta^2} \frac{\rho_1 + \rho_2}{2} > 0 \\ \frac{\partial \lambda^*}{\partial \gamma} &= -\frac{3}{4}\gamma^2 \frac{1-\theta}{\theta} \frac{\rho_1 + \rho_2}{2} < 0 \end{aligned}$$

When the manufacturer has a higher bargaining power, the retail price (under RPM) will be higher and when the products are more homogeneous, the retail price (under RPM) will be lower. The corresponding expressions for the imposed equilibrium retail price and corresponding quantities are:

$$p_i^R = \left(\frac{\alpha + c\beta (1-\gamma)}{2\beta (1-\gamma)} - \frac{\rho_1+\rho_2}{2} \frac{1-\theta}{\theta} \frac{\gamma^3 (\alpha - c\beta (1-\gamma))}{8\beta (1-\gamma)} \right)$$
$$q_i^R = \frac{1}{2} (\alpha - c\beta (1-\gamma)) + \frac{\rho_1+\rho_2}{2} \frac{1-\theta}{\theta} \frac{\gamma^3 (\alpha - c\beta (1-\gamma))}{8}$$

The maximum expected normalized profit is then

$$\Pi_U^R(\lambda^*) = \frac{\left(4\theta + \gamma^3 \frac{\rho_1+\rho_2}{2} (1-\theta)\right)^2}{32\theta (1-\gamma)}$$

which is decomposed in $\pi_U^D(\lambda^*) + F_1(\lambda^*) + F_2(\lambda^*)$ with

$$F_i(\lambda^*) = \frac{1}{128} \left(4 + \gamma^3 \rho \frac{1-\theta}{\theta} \right) \frac{8\theta + \gamma^2 (-\rho_i (4 + \gamma (1-\theta)) + 3\gamma\rho_j (1-\theta))}{(1-\gamma)}$$
$$\pi_U^D(\lambda^*) = \gamma^2 \frac{4\theta + \gamma^3 (1-\theta) \rho}{16\theta (1-\gamma)} \rho$$

Finally, the retailers profits (normalized and excluding the fixed fees) are:

$$\pi_i^D(\lambda^*) = \left(8\theta + \gamma^3 2\rho (1-\theta)\right) \frac{2\theta \left(2 - \gamma^2 \rho_i\right) - \gamma^3 \rho (1-\theta)}{128\theta^2 (1-\gamma)}$$

Consumer surplus and welfare are:

$$CS^R(\lambda^*) = \frac{\left(4\theta + \gamma^3 \rho (1-\theta)\right)^2}{64 (1-\gamma) \theta^2}$$
$$W^R(\lambda^*) = \frac{\left(4\theta + \gamma^3 \rho (1-\theta)\right)\left(12\theta - \gamma^3 \rho (1-\theta)\right)}{64 (1-\gamma) \theta^2}$$

5 Results

In this section we compare the manufacturer's equilibrium profit, equilibrium consumer surplus and equilibrium welfare with and without RPM.

The following Proposition establishes under which conditions RPM is profitable for the manufacturer.

Proposition 2:

i) If

$$\theta > \frac{\gamma(\gamma+2)(1-\gamma)}{(\gamma+1)(2-\gamma^2)}$$

RPM at the manufacturer's optimal retail price λ^* increases the manufacturer's profit for any $\rho \geq 0$.

ii) If

$$\theta < \frac{\gamma(\gamma+2)(1-\gamma)}{(\gamma+1)(2-\gamma^2)}$$

RPM at the manufacturer's optimal retail price λ^* increases the manufacturer's profit if and only if

$$\rho > \rho^*(\theta,\gamma) := \frac{\sqrt{2\theta(\gamma+2)(2\theta(2-\gamma)+\gamma^3(1-\gamma)(1-\theta))}-4\theta}{\gamma^3(1-\theta)}$$

with $\rho^*(\theta,\gamma) < 1$.[11]

For any θ there is a value for ρ above which the manufacturer's profits increase when imposing RPM. The intuition is the following: if the manufacturer has a sufficiently high degree of bargaining power (either because θ is high or because ρ is high) it will capture almost all the profit. By setting the retail price in advance, the manufacturer is able to avoid the competition between the two retailers and is thus able to generate the vertically integrated profit.

The next result presents the conditions under which RPM results in higher consumer surplus and social welfare than the one obtained in the free-pricing equilibrium.

Proposition 3: RPM increases social welfare and consumer surplus if and only if

$$\theta_{\min} < \theta < \overline{\theta} := \frac{\gamma^2\rho}{\gamma^2\rho+2}$$

or, in terms of ρ, if and only if

$$\underline{\rho}(\theta,\gamma) := \frac{\theta}{1-\theta}\frac{2}{\gamma^2} < \rho < \overline{\rho}(\theta,\gamma) := \frac{\theta}{1-\theta}\frac{4}{\gamma^3}$$

with $\frac{\partial\overline{\theta}}{\partial\rho} = \frac{2\gamma^2}{(\gamma^2\rho+2)^2} > 0$ and $\frac{\partial\overline{\theta}}{\partial\gamma} = \frac{4\gamma\rho}{(\gamma^2\rho+2)^2} > 0$.

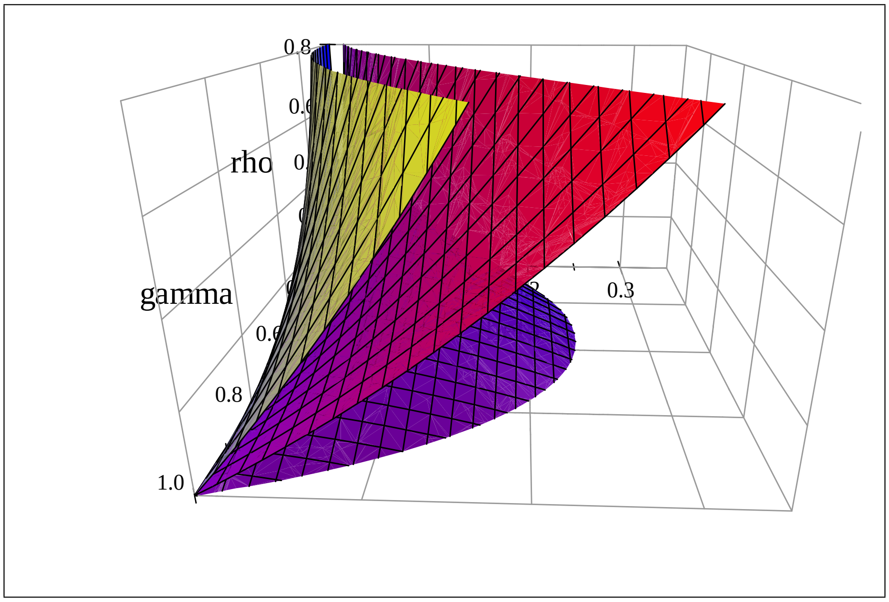
A larger ρ and a larger γ make this more likely. The reason is as explained above. If θ is large,

[11] Visual inspection of this function reveals that $\rho^*(\theta,\gamma) < .4$

the upstream firm will set a price closer to the one that maximizes the industry profits because it anticipates its profits will put a large weight on industry profits.

Corollary 1: RPM is both profitable and increases social welfare if ρ is sufficiently high and θ is sufficiently low.

The following figure illustrates the two thresholds.



The blue surface depicts $\rho^*(\theta, \gamma)$. In order for RPM to be profitable one needs to be above it. The red and yellow surfaces depict $\underline{\rho}(\theta, \gamma)$ and $\overline{\rho}(\theta, \gamma)$, respectively. Between the two surfaces, RPM increases social welfare and consumer surplus.

6 Conclusions

In this paper, we compare the market equilibrium in the presence of RPM with the counterfactual scenario in which RPM is absent (and there is free retail price competition). In a setting where: (*i*) a monopolist manufacturer sells through two retailers; (*ii*) firms negotiate bilaterally the terms of a two-part tariff contract; and (*iii*) contracts are assumed to be observable, we identify the circumstances under which the use of RPM brings efficiency: it induces a final outcome which is not only more favorable to the upstream producer that embarks on it, but also enhances (consumers' and total) welfare.

In the absence of RPM, both the manufacturer and the retailers enjoy a positive mark-up, implying that due to the addition of mark-ups, the resulting final market (retail) price ends up being too high. If instead RPM is used, this double marginalization problem is avoided, prices may be lower than under free retail competition and, for sufficiently low levels of bargaining power by the upstream firm, both consumers and total welfare are shown to increase as a result.

The intuition behind this result is as follows. Contrary to what happens in the case of a vertically integrated firm, under RPM the re-sale price is not set to maximize the industry profit because the manufacturer does not capture all profit generated in the industry. In fact, the profit is divided in the bilateral bargaining stages in such a way that the retailers will retain part of the incremental profit which is generated by this negotiation. Now, by using RPM to set a lower retail price, the manufacturer is able to increase its disagreement payoff which allows it to capture a larger part of the industry profit. If the manufacturer's bargaining power was high, then it would be able to capture most of the industry profit and it would then set the vertically integrated monopolist's optimal retail price. In that case, and given the assumptions in the model, the retail price would unambiguously increase, thereby hurting both consumers and social welfare.

Our framework, therefore, suggests that in order to understand whether the impact of RPM on social welfare is adverse or not, competition authorities should study in detail the relative strength of all players involved in negotiations over the terms of two-part tariff contracts, which typically characterize the relationship between manufacturers and retailers in vertical industries.

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Appendix

Proof of Proposition 1: In general, the Nash bargaining products are

$$\Phi_1 = (\pi_U^D(w_1, w_2) - d_{U_1}(w_2))^\theta (\pi_1^D(w_1, w_2))^{1-\theta}$$

$$\Phi_2 = (\pi_U^D(w_1, w_2) - d_{U_2}(w_1))^\theta (\pi_2^D(w_1, w_2))^{1-\theta}$$

The first-order conditions with respect to w_1 are

$$\theta(\frac{\pi_U^D(w_1, w_2) - d_{U_1}(w_2)}{\pi_1^D(w_1, w_2)})^{-1} \frac{\partial \pi_U^D(w_1, w_2)}{\partial w_1} + (1-\theta) \frac{\partial \pi_1^D(w_1, w_2)}{\partial w_1} = 0$$

Assume initially the free pricing regime. In this particular case, the expressions for profits are given by equations 4, 5, and 7. Inserting these expressions in the previous first-order conditions and assuming symmetry ($w_1 = w_2$) one obtains:

$$(w_1 - c)\, \beta \left(2\gamma - \gamma^3 + \gamma^4 + 2\theta\gamma^2 + \theta\gamma^3 - \theta\gamma^4 - 4\right) + \theta\,(\gamma + 2)\,(\alpha - c\beta + c\beta\gamma) = 0$$

which yields:

$$w_1 = w_2 = c + \frac{\theta\,(\gamma + 2)\,(\alpha - c\beta\,(1 - \gamma))}{\beta\,((\gamma^2 - 2)\,(\gamma - \gamma^2 - 2) - \theta\gamma^2\,(\gamma + 1)\,(2 - \gamma))}$$

Replacing these into 2 and 3 one obtains

$$p_1 = p_2 = c + \frac{\left(2\theta - 2\gamma + \gamma^3 - \gamma^4 + \theta\gamma - 2\theta\gamma^2 - \theta\gamma^3 + \theta\gamma^4 + 4\right)(\alpha - c\beta + c\beta\gamma)}{\beta\,(\gamma - 2)\,(2\gamma - \gamma^3 + \gamma^4 + 2\theta\gamma^2 + \theta\gamma^3 - \theta\gamma^4 - 4)}$$

$$q_1^D = q_2^D = \frac{\left(-\theta\left(\gamma - \gamma^2 - \gamma^3 + \gamma^4 - 2\right) + 2\gamma - \gamma^3 + \gamma^4 - 4\right)(\alpha - c\beta + c\beta\gamma)}{(\gamma - 2)\,((\gamma^2 - 2)\,(\gamma - \gamma^2 - 2) + \theta\gamma^2\,(\gamma + 1)\,(\gamma - 2))}$$

The corresponding profits are

$$\pi_1^D = \pi_2^D = \frac{\left(\theta\left(\gamma - \gamma^2 - \gamma^3 + \gamma^4 - 2\right) + \left(\gamma - \gamma^2 - 2\right)\left(\gamma^2 - 2\right)\right)^2}{\left(\gamma - 2\right)^2\left(-2\gamma + \gamma^3 - \gamma^4 - 2\theta\gamma^2 - \theta\gamma^3 + \theta\gamma^4 + 4\right)^2}\frac{\left(\alpha - c\beta + c\beta\gamma\right)^2}{\beta}$$

$$\pi_U^D = 2\theta\left(\gamma + 2\right)\frac{\theta\left(\gamma - \gamma^2 - \gamma^3 + \gamma^4 - 2\right) + \left(\gamma - \gamma^2 - 2\right)\left(\gamma^2 - 2\right)}{\left(2 - \gamma\right)\left(-2\gamma + \gamma^3 - \gamma^4 - 2\theta\gamma^2 - \theta\gamma^3 + \theta\gamma^4 + 4\right)^2}\frac{\left(\alpha - c\beta + c\beta\gamma\right)^2}{\beta}$$

Consumer Surplus and welfare are, respectively,

$$CS = \frac{\left(\frac{\left(2\theta + 2\gamma - \gamma^3 + \gamma^4 - \theta\gamma + \theta\gamma^2 + \theta\gamma^3 - \theta\gamma^4 - 4\right)}{\left(\gamma - 2\right)\left(-2\gamma + \gamma^3 - \gamma^4 - 2\theta\gamma^2 - \theta\gamma^3 + \theta\gamma^4 + 4\right)}\right)^2}{\left(1 - \gamma\right)}\frac{\left(\alpha - c\beta + c\beta\gamma\right)^2}{\beta}$$

$$W = \frac{\left(\theta\left(\gamma + 7\gamma^2 - \gamma^3 - 5\gamma^4 + 2\gamma^5 - 2\right) + \left(2\gamma - 3\right)\left(\gamma^2 - 2\right)\left(\gamma - \gamma^2 - 2\right)\right)}{\left(\gamma - 1\right)\left(\gamma - 2\right)^2\left(-2\theta\gamma^2 - \theta\gamma^3 + \theta\gamma^4 + 4 - 2\gamma + \gamma^3 - \gamma^4\right)^2} \times \left(\theta\left(\gamma - \gamma^2 - \gamma^3 + \gamma^4 - 2\right) + \left(\gamma - \gamma^2 - 2\right)\left(\gamma^2 - 2\right)\right)\frac{\left(\alpha - c\beta + c\beta\gamma\right)^2}{\beta}$$

Assume now that the upstream firm can engage in RPM and let p be such that $\alpha - p\beta\left(1 - \gamma\right) > 0$. Then profits are given by equations 11, 12 and 14. In this case, the Nash first-order condition is for w_1:

$$\left(\alpha - p\beta + p\beta\gamma\right)\frac{c - w_1 - c\theta - c\gamma + p\theta + \gamma w_2 + c\theta\gamma - \theta\gamma w_2}{-c + w_1 + c\gamma - \gamma w_2} = 0$$

which, given symmetry implies

$$w_1 = w_2 = c + \theta\frac{p - c}{1 - \gamma\left(1 - \theta\right)}$$

So, profits are

$$\pi_1^D(p) = \pi_2^D(p) = \frac{\left(1 - \gamma\right)\left(1 - \theta\right)}{1 - \gamma\left(1 - \theta\right)}\left(p - c\right)\left(\alpha - p\beta + p\beta\gamma\right)$$

$$\pi_U^D(p) = \frac{\theta}{1 - \gamma\left(1 - \theta\right)}2\left(p - c\right)\left(\alpha - p\beta + p\beta\gamma\right)$$

The upstream firms sets p to maximize its profit:

$$\frac{\partial\pi_U^D}{\partial p} = -2\theta\frac{-\alpha - c\beta + 2p\beta + c\beta\gamma - 2p\beta\gamma}{-\gamma + \theta\gamma + 1} = 0$$

yielding, for $\theta \neq 0$

$$p = \frac{1}{2}\frac{\alpha + c\beta(1-\gamma)}{\beta(1-\gamma)} > c$$

$$q = \frac{1}{2}(\alpha - c\beta + c\beta\gamma)$$

$$w_1 = w_2 = c + \frac{1}{2}\theta\frac{\alpha - c\beta(1-\gamma)}{\beta(1-\gamma)(1-\gamma(1-\theta))}$$

Equilibrium profits are

$$\pi_1^D = \pi_2^D = \frac{1-\theta}{4(1-\gamma(1-\theta))}\frac{(\alpha - c\beta + c\beta\gamma)^2}{\beta}$$

$$\pi_U^D = \frac{\theta}{2(1-\gamma)(1-\gamma(1-\theta))}\frac{(\alpha - c\beta + c\beta\gamma)^2}{\beta}$$

As for consumer surplus and welfare

$$CS = \frac{1}{4(1-\gamma)}\frac{(\alpha - c\beta + c\beta\gamma)^2}{\beta}$$

$$W = \frac{3}{4(1-\gamma)}\frac{(\alpha - c\beta + c\beta\gamma)^2}{\beta}$$

Consumer surplus is higher with RPM if and only if

$$\frac{\gamma\left(\gamma^2-2\right)\left(\gamma-\gamma^2-2\right)+\theta\left(2\gamma+2\gamma^2-2\gamma^3-\gamma^4+\gamma^5-4\right)}{\left(\gamma^2-2\right)\left(\gamma-\gamma^2-2\right)-\theta\gamma^2(\gamma+1)(2-\gamma)} < 0$$

It can be shown that for $\theta \leq 1$ the denominator is always positive. The numerator is negative, and consumer surplus increases with RPM if and only if

$$\theta > \widehat{\theta}(\gamma) := \frac{\gamma\left(\gamma^2-2\right)\left(\gamma-\gamma^2-2\right)}{-\gamma^5+\gamma^4+2\gamma^3-2\gamma^2-2\gamma+4}$$

As the individual retailer equilibrium output under RPM or under free pricing are lower than the socially optimal output, $\alpha - c\beta(1-\gamma)$, then welfare and consumer surplus move in the same direction: they both increase with output.

Proof of Proposition 2:

RPM is profitable if and only if $\Pi_U^{RPM}(\lambda^*) > \Pi_U^{FN}$ which is equivalent to:

$$\frac{\left(4\theta + \gamma^3 \left(\frac{\rho_1+\rho_2}{2}\right)(1-\theta)\right)^2}{32\theta(1-\gamma)} > \frac{(\gamma+2)\left(\theta\left(-2\gamma - \gamma^3 + \gamma^4 + 4\right) + \gamma^3(1-\gamma)\right)}{16(1-\gamma)}$$

which is equivalent to

$$\rho^2\gamma^4(\theta-1)^2 + \rho 8\theta\gamma(1-\theta) + 2\theta\left(\theta(\gamma+1)\left(2-\gamma^2\right) - \gamma(\gamma+2)(1-\gamma)\right) > 0$$

We have that, for $\rho \geq 0$

$$\frac{\partial\left(\rho^2\gamma^4(\theta-1)^2 + \rho 8\theta\gamma(1-\theta) + 2\theta\left(\theta(\gamma+1)\left(2-\gamma^2\right) - \gamma(\gamma+2)(1-\gamma)\right)\right)}{\partial\rho} = 2\gamma(1-\theta)\left(4\theta + \gamma^3\rho(1-\theta)\right) > 0$$

So, if $\theta(\gamma+1)\left(2-\gamma^2\right) - \gamma(\gamma+2)(1-\gamma) > 0$, RPM is always profitable for any $\rho \geq 0$. Otherwise, it is profitable if

$$\rho > \rho^*(\theta,\gamma) := \frac{\sqrt{2\theta(\gamma+2)(2\theta(2-\gamma) + \gamma^3(1-\gamma)(1-\theta))} - 4\theta}{\gamma^3(1-\theta)}$$

with $\rho^*(\theta,\gamma) \in (0,1)$.[12]

Proof of Proposition 3:

RPM increases welfare if and only if

$$W^{RPM}(\lambda) - W^{FN} > 0 \Leftrightarrow$$

$$\frac{(2-\lambda)(\lambda+2)}{4(1-\gamma)} - \frac{(\gamma+2)(6-\gamma)}{16(1-\gamma)} > 0 \Leftrightarrow$$

$$\lambda < 1 - \frac{1}{2}\gamma$$

[12] The condition for $\rho^* < 1$ is equivalent to $\left(\theta^2\left(-4\gamma - 2\gamma^2 - 2\gamma^3 + \gamma^4 + 4\right) + 2\theta\gamma(2-\gamma)\left(\gamma + \gamma^2 + 1\right) + \gamma^4\right) > 0$ which always holds: If $\left(-4\gamma - 2\gamma^2 - 2\gamma^3 + \gamma^4 + 4\right) > 0$ this is always true.

If $\left(-4\gamma - 2\gamma^2 - 2\gamma^3 + \gamma^4 + 4\right) < 0$ it is an inverted parabola with minimum when $\theta = 0$ or $\theta = 1$: The corresponding value is, respectively, $\gamma^4 > 0$ and $4 > 0$.

RPM increases consumer surplus if and only if

$$CS^{RPM}(\lambda) - CS^{FN} > 0 \Leftrightarrow$$
$$\frac{(2-\lambda)^2}{4(1-\gamma)} - \frac{(\gamma+2)^2}{16(1-\gamma)} > 0 \Leftrightarrow$$
$$\lambda < 1 - \frac{1}{2}\gamma$$

Note that if $\lambda = 1$ (the retail price maximizes industry profits), then consumer surplus and welfare always decrease. If $\lambda^* < 1 - \frac{1}{2}\gamma$ RPM increases both consumer surplus and total welfare when the manufacturer sets the retail price that maximizes its own profit. This happens when

$$\frac{1}{4}\gamma\frac{\theta\left(\gamma^2\rho+2\right)-\gamma^2\rho}{\theta} < 0 \Leftrightarrow \theta < \overline{\theta} := \frac{\gamma^2\rho}{\gamma^2\rho+2}$$

Or, in terms of $\rho : \theta\left(\gamma^2\rho+2\right) - \gamma^2\rho \Leftrightarrow \rho > \frac{\theta}{1-\theta}\frac{2}{\gamma^2}$.