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Anti-competitive effects of resale-below-cost laws☆

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ABSTRACT

We show that resale-below-cost laws enable producers to impose industrywide price-floors to retailers. This mechanism suppresses downstream competition but also dampens upstream competition, leading to higher prices. Price-floor may be more profitable for producers than resale price maintenance contracts and, while resale price maintenance may have ambiguous effect on welfare, price-floors always harm welfare. Retailers' buyer power appears as a key element for a price-floor to work out.

1. Introduction

In most countries, retailers' pricing practices are ruled by the same general competition laws as those of producers. However, during the 1990s, several countries adopted regulations to prevent retailers from engaging in below-cost pricing, or "loss-leading". These resale-below-cost laws (henceforth "RBC laws") prevent retailers from setting retail prices below a statutorily mandated level of cost, usually based on the unit price invoiced by the supplier.[1] Yet in the last decade, professional and academic studies have denounced the price-raising effects of these laws, thus calling their relevance into question.[2]

Beyond the analysis of the welfare impact of loss-leading, this article studies an unforeseen but major anticompetitive effect of RBC laws.[3] We argue that the ban of below-cost pricing for retailers enables producers to impose industrywide price-floors to their retailers which induce higher prices on the whole range of products sold and not only on those that would have been sold below cost. We claim that this price-floor mechanism may explain most of the price effect of RBC laws.

This article provides a theoretical framework to analyze the anticompetitive effects of the price-floors implemented by RBC laws. We focus on the legislation of countries like France (Galland Act), Ireland (Groceries Orders) or Spain (Law on Unfair Competition), where the conditional or deferred rebates that are not written on the invoice are excluded from the legal minimum price threshold. The Irish Groceries Orders, for instance, stipulate that "a retailer shall not sell grocery goods at a price that is less than the net invoice price of the goods [...]. The net invoice price [...] shall be calculated having regard to an invoice [...] net of any allowance or refund that is allowable on the return of the goods' container, and no account shall be taken of discounts, rebates or other deductions which are not entered on the invoice in cash terms as deductions from the sum due to the supplier" (art. 11).

We consider an industry where two producers sell differentiated products through a duopoly of differentiated retailers. We develop a new setting in order to focus on the real timing of vertical

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[1] RBC laws are widespread in Europe: they exist to some extent in Belgium, France, Hungary, Italy, Luxembourg, Portugal, Spain, Greece and Ireland. In the US, there is no federal RBC law, but many States have RBC laws either applying to all retail products or to specific goods such as gasoline or dairy products. For a detailed review of RBC laws in OECD countries, see the OECD report "Resale Below Cost Laws and Regulations", DAF, 02/23/2006.

[2] See Collins et al. (2001), Canivet (2004), Anderson and Johnson (1999) and Johnson (1999) for empirical evidence of price-raising effects of RBC laws.

[3] For an analysis of the *pros and cons* of loss leading, see Walsh and Whelan (1999).

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negotiations. In our model, producers first set publicly their wholesale prices (*i.e.* their general terms of sales). Afterwards, each producer secretly bargains with each retailer over conditional rebates. These rebates depict the so called "backroom margins", which gather diverse fees such as slotting allowances, conditional price reductions or payment for commercial services. In most countries, they account for a growing part of the transfers between producers and retailers (Shaffer, 1991). The crucial point is that conditional rebates cannot be deducted from the threshold that defines the legal minimum retail price: this threshold will thus be the unit wholesale price. After the negotiations, retailers set final prices: under the law these have to be above the price threshold. In this setting, a producer sets his wholesale price at the price-floor level he wants to implement: The RBC law protects this price-floor that is thus a credible commitment. When the law requires non-discriminatory general terms of sales, as in France or Ireland, this price-floor is *de facto* industrywide. In a previous paper (Allain and Chambolle, 2005), we showed that a monopolist producer may use the law in order to suppress retail competition through an industrywide price-floor, thus profitably raising final prices. This paper goes further and shows that this mechanism also dampens upstream competition. Moreover, this result is robust to different tariff schemes: We show that retail prices increase whether negotiated tariffs are linear or two-part. Besides, we go deeper in the comparison between a price-floor and a resale price maintenance (RPM): We show that when buyer power is large enough, a price-floor works out as a RPM, but otherwise price-floors implement corner solutions which yield higher retail prices and lower welfare than under RPM. In some cases, the price-floor is even more profitable for producers than a RPM.[4]

This article fits in the industrial organization literature on competition policy and vertical restraints. Although there is a large literature on the anticompetitive effects of RPM, few articles have analyzed price-floors.[5] With linear tariffs, if buyer power is strong, retail prices are lower than the joint-profit maximizing level, and producers may use price-floors as a RPM in order to raise retail prices. If producers' power is high, the double margin effect pushes up the retail prices and a price-floor may then appear useless: however we show that producers may still find profitable to adopt corner-pricing strategies in order to set binding price-floors that drive retail prices even higher than a RPM would, because binding the retailers' pricing strategies reduces their bargaining power and their share of total profit. Price-floors in that case harm welfare more than a RPM. With two-part tariffs, we show that price-floors also lead to higher prices than RPM. In all cases, price-floors enable producers to suppress retail competition and to relax upstream competition.

Our work is closely related to two papers: Dobson and Waterson (2007) and Rey and Vergé (2004). Dobson and Waterson (2007) use a similar bilateral oligopoly framework to analyze the effect of industrywide RPM. They show that the welfare effects of RPM are likely to be negative when buyer power is strong, but positive otherwise. With price-floors instead of RPM we show that final prices rise also when the producers are powerful, and that, contrary to a RPM, a price-floor always harms welfare. We also extend our results in a more general tariff setting (two-part tariffs). Rey and Vergé (2004) show that a RPM enables manufacturers to neutralize both downstream and upstream competition and to reach the monopoly profit. They consider differentiated producers offering publicly observable two-part tariff contracts to differentiated retailers, and assume an exogenous market structure. With two-part tariffs, we corroborate their result and endogenize the market structure. In addition we show that a RPM may lead to lower equilibrium prices than a price-floor. Again, if welfare may in some cases be enhanced by a RPM, it is always harmed by a price-floor.

This paper fits also in the literature on buyer power (see Inderst and Mazzarotto, 2006). Most articles in this field analyze the determinants and consequences of buyer power. Our purpose is rather to understand its role on the efficiency and welfare consequences of vertical restraints. We show that buyer power is a key element in the working of a price-floor and facilitates its use by producers. Besides, if competition is not too soft at both levels, the price-raising and welfare-damaging effects of the price-floor are worse when the retailers have all the power.

Finally, our paper is also related to the literature on below-cost pricing and RBC laws. In theory, that RBC laws lead to higher prices is not surprising for several reasons. First, they induce a direct raise in the prices of the former loss-leaders: This price increase may however be compensated by reductions in the prices of other products. Second, when these laws aim at limiting predatory pricing by large retailers, their purpose is to relax short term competition in order to protect long term competition: the short term effect may well increase prices. We put forward the idea that, irrespective of these effects, RBC laws create a price-floor mechanism that enables the producers to relax both upstream and downstream competition and unambiguously harm welfare. Note that, as shown by Von Schlippenbach (2008), there are also potential welfare-enhancing effects of RBC laws. She considers a monopolist retailer selling a "core good" supplied by a monopolist producer and other substitute goods supplied by a competitive fringe of producers. Due to consumers one-stop shopping behavior, the "core good" is a complement to all other goods in the retail assortment. Selling the core good at a loss is thus a profit maximizing strategy for the retailer since it increases store traffic. Under a RBC law, the retailer cannot fully exploit this complementarity effect, therefore the marginal contribution of the core good's supplier to the retailer's profit is reduced. This leads to a lower negotiated wholesale price and improves consumers surplus. The overall welfare effect of a ban may thus be positive. Nevertheless, our argument applies even in a framework where a ban is socially desirable, as we incriminate the definition of the price threshold rather than the ban itself.

Our main contributions to the literature are as follows. First, we highlight differences between a price-floor and a RPM, and show that the former induces corner equilibria that yield higher prices than a RPM. Second, we show how a price-floor may neutralize retail as well as upstream competition, as a RPM, but, although a less restrictive restraint, is more harmful for welfare and may be more profitable for the producers. Third, we underline the role of buyer power in the efficiency of price-floors. Finally, we shed some light on the anticompetitive effects of RBC laws and provide economic policy recommendations on the way to reform them.

The model is presented in Section 2. Section 3 analyzes two benchmark cases: with no legal restriction, and with RPM contracts. Section 4 points out the anticompetitive effects of the law. We derive our analysis with two-part tariffs in Section 5, explore extensions and robustness issues in Section 6 and conclude in Section 7.

2. The model

2.1. Assumptions

Two producers, A and B, produce two horizontally differentiated goods, also branded A and B, at zero marginal cost. Each producer can market his good through two differentiated retailers, 1 and 2, who compete in prices. Apart from the transfer they pay producers, retailers incur zero marginal retailing cost. Consumers differ in their preferences for retailers and products. If each retailer carries both brands, there are four imperfect substitute goods on the market. We denote q_{Ki}

[4] These results illustrate two recent decisions by the French competition authority (Conseil de la Concurrence, 03-D-45, 25/09/2003, on the market for calculators, and 05-D-70, 19/12/2005 on the market for videotapes). Upstream and downstream firms were condemned for having used falsely conditional rebates to set artificially high price-floors relying on RBC law.

[5] With two-part tariffs and secret contracts, O'Brien and Shaffer (1992) show that, as retail competition drives final prices under the monopoly level, a monopolist producer may use either a price-floor or a RPM in order to restore the monopoly price.

the quantity and p_{Ki} the price of good $K\in\{A,B\}$ sold by retailer $i\in\{1,2\}$ (henceforth good Ki). For the sake of simplicity, we use a linear demand specification.[6] The inverse demand for good Ki is:

$$p_{Ki} = 1-q_{Ki}-aq_{Li}-bq_{Kj}-cq_{Lj} \quad \text{with } i \neq j \text{ and } K \neq L. \tag{1}$$

Parameter $a\in[0,1]$ measures the substitutability between the products (interbrand competition): brands A and B become closer substitutes when a increases. Similarly, $b\in[0,1]$ is the degree of substitutability between the retailers (intrabrand competition). Finally, parameter c measures the substitutability between the different brands sold by different retailers. We assume $c=a\cdot b$.[7] Note that when $a=0$ the demands for the two brands are independent, and so are the demands at the two retailers' when $b=0$. We denote by $D_{Ki}(p_{Ki},p_{Kj},p_{Li},p_{Lj})$ the demand for good Ki when the four products are sold. The timing is as follows:

- Stage 1: Producers simultaneously publish non-discriminatory wholesale unit prices w_A and w_B.
- Stage 2: Producer K and retailer i ($K\in\{A,B\}, i\in\{1,2\}$) negotiate backroom margins in the form of a unit rebate, i.e. they negotiate over the effective unit transfer t_{Ki}, (see Section 5 for the case of non-linear rebates). The four bilateral negotiations are secret and simultaneous. The solution concept of the bargaining game is detailed in Section 2.2.
- Stage 3: Retailers simultaneously set final prices p_{A1}, p_{A2}, p_{B1}, and p_{B2}.

Some comments are in order. Our main assumption in stage 1 is that of non-discriminatory pricing. This assumption is in line with the French and Irish situations, where the producers must publish general terms of sales (henceforth GTS) for any product. These GTS are non-negotiable and non-discriminatory. They can differ across distribution channels and categories of retailers (hypermarkets, supermarkets, …) according to objective conditions, but by definition, apply to all firms inside a category.

Our model's main novelty is the renegotiation in stage 2: after the producers have set w_K in stage 1, each retailer can bargain with each supplier over secret backroom margins. These renegotiations allow for discriminatory tariffs, and therefore may lead to opportunism problems (McAfee and Schwartz, 1994). This assumption is in line with practice in many cases. The term "backroom margins" refers to the variety of forms such rebates can take.[8] These rebates are generally compatible with the law on discriminatory pricing: most of them are meant to compensate a retailer for a sales effort, which is difficult to verify. Given this opaqueness, there is widespread suspicion that rebates do not reflect actual services provided by the retailer, therefore we assume that no service is provided. Besides, many rebates are paid to a retailer at year end. We model the rebates as deferred reductions in the unit wholesale price and thus they cannot be accounted for in the loss-leading price threshold.[9] That is, under the RBC law, a retailer must not set the price of good K below w_K, even though the actual unit price paid by retailer i is only t_{Ki}.

2.2. Bargaining assumptions and solution concept

In stage 2, simultaneous and secret bilateral negotiations by four producer-retailer pairs yield four unit transfers. Negotiations within each pair is modeled as a Nash bargaining in which the producer's bargaining power is $\alpha\in[0,1]$.[10] Note that both producers have the same bargaining power α, and both retailers $1-\alpha$. Default options correspond to the retailer not distributing the producer's brand.[11] We assume that the outcome of the negotiation between two firms is not observable by others.[12] However, before the beginning of stage 3, each retailer gathers the information from his two negotiations with the two suppliers. Besides, consumers are perfectly informed about the availability and prices of all the products.

We look for symmetric, subgame-perfect *Contract Equilibria* in pure strategies (Crémer and Riordan, 1987; O'Brien and Shaffer, 1992). In a Contract Equilibrium, each set of transfers is immune to profitable bilateral renegotiation by a producer-retailer pair, taking the other three transfers as given, including those defined by a negotiation in which one of them is involved. In particular, this implies that the firms have passive beliefs, *i.e.* if, say, a producer received an unexpected offer from a retailer, his beliefs about the outcome of the three other negotiations, including those in which he or the retailer in question are involved, would not change. Furthermore, this equilibrium concept does not consider multilateral deviations. In other words, we assume that each producer and each retailer send a different agent to each negotiation and that the two agents of a given firm cannot communicate with each other while negotiating.[13]

3. Benchmarks

In this section we present benchmark cases, first assuming no legal restriction on pricing and second assuming that producers can impose RPM contracts.[14]

3.1. No restriction on resale prices

We solve the model assuming there is no constraint on retail prices. We refer to this situation as the *no-restriction* case. We solve the game backward and look only for symmetric equilibria where the four goods are sold.

3.1.1. Stage 3

Consider the stage-3 subgame. Retailer i knows the public values of the wholesale prices w_A and w_B set by producers in stage 1 and the outcome of her two negotiations in stage 2, that is the true values of the unit transfers t_{Ai} and t_{Bi} if both negotiations have succeeded. However, she does not know the outcome of the negotiations of j with both suppliers.

[6] The coexistence of intra- and inter-brands differentiation makes the solving with a general demand function tedious (see Shaffer, 1991). The main results hold in a more general setting and we provide a discussion of their robustness to changes in the demand function in Allain and Chambolle (2010), webappendix.

[7] The underlying assumption is that a representative consumer has a quadratic utility function and a budget of 1 (see Dobson and Waterson, 1996): $U(q) = \sum_{K,i} q_{Ki} - \frac{1}{2}\sum_{K,i} q_{Ki}^2 - a\sum_i q_{Ai}q_{Bi} - b\sum_K q_{K1}q_{K2} - c\sum_K q_{K1}q_{L2}$. Assuming $c=a\cdot b$ is sufficient for the utility to be concave: the substitutability between products Ki and Lj is a combination between intra- and inter-brand substitution. Choosing another value for c such that the utility function is concave would not qualitatively alter our results. Note that a and b are not perfect proxies for the degree of inter- and intra-brand competition: given a system of symmetric prices, the demand for each good decreases with a and b. See Rey and Vergé (2004) for a discussion.

[8] Backroom margins can reach 60% of the unit price invoiced in France (Canivet, 2004).

[9] Section 6.1 shows that this assumption is crucial.

[10] For simplicity, we model the negotiations as one stage, but formally the extensive form of each negotiation is the bargaining game of Binmore et al. (1986). Stage 2 ends when the four negotiations have led to either an agreement or a breakdown. This use of the Nash bargaining game in multilateral negotiations is fairly standard (Cf. de Fontenay and Gans, 2005a).

[11] Section 6.2 considers an alternative assumption where default options correspond to the retailer being able to purchase the good at list price, without rebate, and resell it.

[12] Section 6.3 discusses the role of this assumption.

[13] This assumption is known as "schizophrenia of the negotiator". Contract Equilibrium concept is a refinement of Perfect Bayesian Equilibrium that includes passive beliefs and "schizophrenia of the negotiator". Relaxing the assumption of schizophrenia allows for multilateral deviations which threaten the existence of equilibria (Rey and Vergé, 2004).

[14] Our results in the benchmark cases corroborate those of Dobson and Waterson (2007).

Assume the four negotiations succeeded in stage 2. In stage 3, retailer i's profit is $\Pi_i=(p_{Ai}-t_{Ai})D_{Ai}(p_{Ai},p_{Aj},p_{Bi},p_{Bj})+(p_{Bi}-t_{Bi})D_{Bi}(p_{Bi},p_{Bj},p_{Ai},p_{Aj})$. The two best response final prices of each retailer i are, for $\{K,L\}=\{A,B\},\{i,j\}=\{1,2\}$[15]:

$$p_{Ki}^{BR}\left(t_{Ki},t_{Li},p_{Kj},p_{Lj}\right)=\frac{1+t_{Ki}-b\left(1-p_{Kj}\right)}{2}\tag{2}$$

The intersection of the best responses (assuming correct anticipations) gives the subgame equilibrium prices denoted $p_{Ki}^{e}(t_{Ki},t_{Kj},t_{Li},t_{Lj})$:

$$p_{Ki}^{e}\left(t_{Ki},t_{Kj},t_{Li},t_{Lj}\right)=\frac{2(1+t_{Ki})+bt_{Kj}-b(1+b)}{4-b^2}\tag{3}$$

Final prices p_{Ki}^{e} increase in t_{Ki} and t_{Kj} and are independent of t_{Li} and t_{Lj}.

3.1.2. Stage 2

Consider now the stage-2 negotiations. The Nash program of the negotiation between producer K and retailer i is:

$$\underset{t_{Ki}}{\text{Max}}\left(\Pi_K^a-\Pi_K^{3a}\right)^{\alpha}\left(\Pi_i^a-\Pi_i^{3a}\right)^{1-\alpha}\tag{4}$$

where Π_K^a (resp. Π_i^a) is the anticipated profit of producer K (resp. retailer i) and Π_K^{3a} (resp. Π_i^{3a}) is the anticipated status-quo profit earned by K (resp. i) if the negotiation breaks, *i.e.* if K only deals with j (resp. i only deals with L), all other negotiations being successful. We denote by p_{Kj}^a and p_{Lj}^a the retail price for products Kj and Lj anticipated by retailer i and producer K in stage 2, and t_{Kj}^a their anticipation of the transfer agreed between j and K. Note that, according to our contract equilibrium framework, K and i keep constant anticipations over the three other pairs' negotiations outcome while negotiating in stage 2. More precisely, the anticipated profits are, with $X^a=\left(t_{Ki},t_{Li}^a,p_{Kj}^a,p_{Lj}^a\right)$:

$$\begin{aligned}\Pi_K^a=&\ t_{Ki}D_{Ki}\left(p_{Ki}^{BR}(X^a),p_{Kj}^a,p_{Li}^{BR}(X^a),p_{Lj}^a\right)\\&+t_{Kj}D_{Kj}\left(p_{Kj}^a,p_{Ki}^{BR}(X^a),p_{Lj}^a,p_{Li}^{BR}(X^a)\right)\\\Pi_i^a=&\left(p_{Ki}^{BR}(X^a)-t_{Ki}\right)D_{Ki}\left(p_{Ki}^{BR}(X^a),p_{Kj}^a,p_{Li}^{BR}(X^a),p_{Lj}^a\right)\\&+\left(p_{Li}^{BR}(X^a)-t_{Li}\right)D_{Li}\left(p_{Li}^{BR}(X^a),p_{Lj}^a,p_{Ki}^{BR}(X^a),p_{Kj}^a\right)\end{aligned}$$

To define the status-quo profits (formally given in Appendix A.1.1), assume for instance that the negotiation between A and 1 fails. A and 1 anticipate that this failure does not affect the three other negotiations, even their own negotiations with their other partners which lead to the equilibrium value t_{B2}^*, t_{A2}^* and t_{B1}^*. Besides, as the outcome of the negotiation is not observable ex-post, in stage 3 firms B and 2 will ignore this failure and behave according to their anticipations: 2 will set the equilibrium prices $p_{K2}^a=p_{K2}^*$ for $K=A,B$. However, 1 and A anticipate that, in stage 3, consumers will know that product *A1* is not sold and thus adapt their demand for the other goods. In particular, the demand faced by products *A2* and *B1* will increase: As retailer 1 will be aware of the absence of product A on her shelves, she will thus set the optimal price p_{B1}^3 anticipating this increased demand.

The subgame equilibrium outcome of the negotiations is given by the resolution of the four Nash programs under the condition that the anticipated retail prices are the stage-3 subgame equilibrium prices $p_{Ki}^a=p_{Ki}^e(t_{Ki},t_{Li},t_{Kj},t_{Lj})$. There exists a unique symmetric solution, irrespective of the wholesale prices w_K:

$$t_{Ki}=t^*=\frac{2\alpha(1-a)}{4-2a\alpha-b(2-\alpha)}\tag{5}$$

3.1.3. Equilibrium outcomes

Lemma 1. *In any no-restriction equilibrium, transfers are* $t_{Ki}^*=\frac{2\alpha(1-a)}{4-2a\alpha-b(2-\alpha)}$, *and retail prices* $p_{Ki}=p^*=\frac{2(1-b)+\alpha(1-2a+b)}{4-2a\alpha-(2-\alpha)b}$. *Producers' and retailers' profits are:*

$$\begin{aligned}\Pi_K^*&=\frac{4\alpha(1-a)(2-\alpha)}{(1+a)(1+b)(4-2a\alpha-(2-\alpha)b)^2}\\\Pi_i^*&=\frac{2(1-b)(2-\alpha)^2}{(1+a)(1+b)(4-2a\alpha-(2-\alpha)b)^2}\end{aligned}\tag{6}$$

As the retail prices chosen in stage 3 do not depend on the wholesale prices w_K set in stage 1, but only on the transfers t_{Ki} negotiated in stage 2, wholesale prices are immaterial to the equilibrium outcomes.[16]

A comparative statics analysis highlights the impact of the producers' bargaining power on the equilibrium outcome.

Proposition 1. *The no-restriction equilibrium transfers* t_{Ki}^* *and retail prices* p^* *strictly increase in* α.

The retail price p_{Ki} set in stage 3 increases with the transfer t_{Ki}. Consider the stage-2 negotiation between producer K and retailer i. Given the three other transfers, increasing t_{Ki} has two effects: it increases the producer's margin, *i.e.* his margin per unit of good Ki sold, but, as it also raises p_{Ki}, it reduces demand for that good. In the neighborhood of the equilibrium, the direct effect on the margin dominates, therefore an increase in t_{Ki} raises (resp. decreases) the incremental profit made by K (resp. i) by selling his product to i (resp. K). Yet the larger α, the more weight is applied in the negotiation to the producer's incremental profit, to the detriment of the retailer's. Therefore the equilibrium transfer strictly increases in α. In turn, the double margin effect implies that the final price p^* increases with the transfer, and thus with α.[17]

Note that the sequential timing of the game creates an asymmetry. When $\alpha=0$, retailers have all the bargaining power, and they also enjoy a follower advantage as they set final prices after the negotiations. Thus, producers get zero margin. However, for $\alpha=1$, the producers cannot extract the full surplus as the retailers can still set strictly positive margins in stage 3, and get positive profit. For $\alpha\in(0,1]$, both upstream and downstream firms set positive margins and the double margin inefficiency increases in α.

3.2. RPM contracts

Assume now that the producers can use non-discriminatory RPM, *i.e.* can impose retail prices: Retailers must set retail prices $p_{Ki}=w_K$ in stage 3.[18]

[15] Note that p_{Ki}^{BR} depends only on the final price of the same brand sold by the other retailer, p_{Kj} : all the effect of interbrand competition is in the price p_{Li}^{BR}, set simultaneously by retailer i. This stems from the linearity of demand and the assumption $c=a\cdot b$.

[16] Note that among the continuum of equilibrium, some involve loss-leading, according to the legal definition ($w_K\geq p^*$), and others do not ($w_K\leq p^*$). Here, the practice of loss-leading is neutral with respect to prices, profit sharing and consumers' surplus.

[17] Proposition 1 and all results in the "benchmark" cases hold in a more general setting: Dobson and Waterson (2007) discuss more extensively in their Corollaries 2 and 3 the necessary properties of the demand function for these result to hold. See also Allain and Chambolle (2010) webappendix for a discussion.

[18] Note that all our results would hold if producers could impose in a first stage any resale price rpm_K different from w_K.

Lemma 2. *Under RPM, there is a unique equilibrium: wholesale prices are* $w_K = \tilde{w} = \frac{1-a^2\alpha-b+\alpha b}{2+a\alpha-a^2\alpha-2(1-\alpha)b}$*, the transfers are* $t_{Ki} = \tilde{t} = \frac{\alpha(1-a)(1-a^2\alpha-(1-\alpha)b)}{(\alpha((1-a)a+2b)+2(1-b))(1-b+\alpha(b-a))}$*, and retail prices are* $p_{Ki} = \tilde{w}$*.*

Proof. In stage 3, the retailers have to set prices $p_{Ki} = w_K$. In stage 2, all profits (including the status-quo profits) are modified. The resolution of the four Nash conditions formally exposed in Appendix A.2 yields the following optimal transfers:

$$\tilde{t}_{Ki}(w_K, w_L) = \alpha\frac{\left(1-a^2\alpha-(1-\alpha)b\right)w_K - a(1-\alpha)(1-b)w_L}{(1-(1-\alpha)b)^2 - a^2\alpha^2} \tag{7}$$

Maximizing the producers' profits yields the equilibrium wholesale prices:

$$\underset{w_K}{\text{Max}}\, \tilde{t}_{Ki}(w_K, w_L)\cdot(D_{K1} + D_{K2})(w_K, w_K, w_L, w_L) \quad \square$$

As under *no-restriction*, the transfers $\tilde{t}$ increase with α because the producers' margin increases with their bargaining power. However profit sharing is different. When $\alpha = 0$, retailers negotiate maximum rebates so that producers have zero profit, as in the *no-restriction case*. When α is strictly positive, retailers' share of total profits is less than in the *no-restriction* case. Not being free to choose retail prices in stage 3 reduces their *status-quo* profits in stage 2. Besides, in stage 3 they no longer benefit from a follower advantage, and this further reduces their profits: For $\alpha = 1$, they receive zero margin and profit. The wholesale prices are uniquely defined as there is now a commitment in stage 1: $\tilde{w}$ defines the retail price.

Consider now the retail prices in the RPM equilibrium.

Proposition 2. *Under RPM, the equilibrium retail prices* $p_{Ki} = \tilde{w}$ *decrease with the producers' bargaining power* α*. For* $\alpha = 0$*, equilibrium retail prices are the monopoly price* $p_{Ki} = 1/2$*, and for* $\alpha = 1$*, the equilibrium retail prices equal those chosen by vertically integrated producers each selling two differentiated products:* $p_{Ki} = \frac{1-a}{2-a}$.

Proof. The computation is straightforward from the previous lemma. The intuition is as follows. When $\alpha = 1$, producers have all the bargaining power: $t_{Ki} = w_K$. They behave as two vertically integrated producers, each selling two differentiated products *K1* and *K2*. Retail prices thus account for interbrand competition, but not for intrabrand competition, which is internalized.[19] As α decreases, the retailers claim a higher margin at the expense of the producers', so that the positive effect of raising w_K on the producer's margin becomes relatively more important than the negative effect on demand. Producers thus raise retail prices. □

Corollary 1. *RPM contracts internalize intra-brand competition irrespective of the balance of power. RPM contracts also reduce interbrand competition, and this dampening effect increases with retailers' buyer power.*

Under RPM, the more bargaining power the retailers have, the more they are able to reduce competition between the producers, who increase their prices towards the collusive price in order to maximize the joint profits. Industry profit thus decreases with α. For $\alpha = 0$, the outcomes are those of a perfectly collusive industry: the RPM eliminates retail competition, and buyer power eliminates upstream competition. In that case, retailers extract all the profit. These results confirm the pro-collusive effect of RPM highlighted by Rey and Vergé (2004).

We now compare the RPM equilibrium outcomes to the *no-restriction* case.

Corollary 2. *If retailers have a strong bargaining power, retail prices are higher and welfare lower under RPM contracts that in the no-restriction case. Otherwise retail prices are lower and welfare higher.*

Buyer power reduces double marginalization and pulls down final prices in the *no-restriction* case; by contrast, under RPM, it enables the retailers to reduce upstream competition and raise prices. When the buyer power is large (*i.e.* $\alpha < \alpha_I$: see Appendix A.2), final prices are thus higher and welfare is lower under RPM than in the *no-restriction* case.[20] Dobson and Waterson (2007) show in a similar setting that a RPM may either enhance or harm welfare according to the balance of power.

4. The effects of a RBC law

We turn back here to RBC laws. They prevent the retailers from setting retail prices below, but not above, the unit price ($p_{Ki} \geq w_K$): w_K thus works out as an industrywide price-floor for producer *K*. We determine in Section 4.1 the equilibria of the game when producers may use price-floor contracts, and make the comparison with the *no-restriction* case and the RPM case.

4.1. Price-floor equilibria

We show here that a price-floor implements RPM equilibrium prices when buyer power is high, and leads to corner equilibria with higher retail prices otherwise.

4.1.1. The price-floor implements the RPM equilibrium

When the price-floor is binding, it works out as a RPM: retail prices $p_{Ki} = w_K$ are anticipated in stage 2. However, a price-floor can fail to be binding, and therefore to implement the RPM equilibrium: deviations may be profitable at each stage of the game. Potential deviations are (1) for a retailer to deviate in stage 3 by setting a retail price above the wholesale price, and (2), for a producer to deviate by setting a lower wholesale price in order to enable the retailers to undercut his rival.

Lemma 3. *The RBC law enables the producers to implement the RPM equilibrium for any* α *less than a threshold* $\tilde{\alpha} = \frac{1+a^2-2b^2-\sqrt{1+2a^2+a^4-8a^2b+4a^2b^2}}{2(2a^2-b-b^2)}$.

Proof. See Appendix A.3.1. □

Retailers do not deviate as long as the producers' bargaining power is not too high, but for higher values of α they set retail prices above the price-floor if it is set to the RPM price $\tilde{w}$. The intuition is as follows. Assume that producers set the wholesale price $\tilde{w}$ in stage 1. For a retailer, increasing a retail price involves a trade-off between margin and quantity sold. When $\alpha = 0$, $\tilde{t}_{Ki} = 0$ and the price-floor is at the monopoly level: $\tilde{w} = 1/2$. Therefore, assuming that her competitor

[19] Note that each producer is able to maximize the profit of the vertically integrated structure he would form with his two retailers, but, as the upstream sector remains competitive, he cannot achieve the industrywide monopoly profit that would require $p_{Ki} = \frac{1}{2}$.

[20] As the costs are normalized to zero, total welfare is $W = U(q) = \sum_{K,i} q_{Ki} - \frac{1}{2}\sum_{K,i} q_{Ki}^2 - a\sum_i q_{Ai}q_{Bi} - b\sum_K q_{K1}q_{K2} - c\sum_K q_{K1}q_{L2}$: when the four prices are equal, it increases in the total quantity. As we consider symmetric equilibria, comparing welfare boils down to comparing retail prices.

respects the constrained retail prices, without the law a retailer would reduce her retail prices in order to increase her demand and profit: her best response price defined by Eq. (2) would be less than $\tilde{w}$. The price-floor is thus binding. In contrast, when α goes to 1, $\tilde{t}_{Ki}$ is high and $\tilde{w}$ low: Each retailer prefers to raise retail prices above $\tilde{w}$, in order to increase margin and profit, even at the expense of a reduction in demand. The price-floor set at the RPM level is no longer binding. There exists a threshold $\tilde{\alpha}$ such that retail prices are constrained by a price-floor set to $\tilde{w}$ if and only if $\alpha \leq \tilde{\alpha}$. There is no profitable deviation in stage 1 for a producer.

Note that $\tilde{\alpha}$ increases in b. When $b=0$, the price-floor never implements the RPM equilibrium: for $\alpha=0$, $\tilde{w}=1/2$ irrespective of b, and a retailer's best response price also equals 1/2, so that $\tilde{\alpha}=0$. When b increases, the best response price decreases and the RPM level becomes binding for low values of α. Besides, $\tilde{\alpha}$ decreases in a, as both the retailer's best response price and $\tilde{w}$ decrease with a, but the latter is steeper than the former: Under the ban, the strength of upstream competition a impacts retail prices more than in the *no-restriction* case, where retailers' positive margins dampen upstream competition (cf. Rey and Stiglitz, 1995).

When $\alpha \geq \tilde{\alpha}$, retailers may still be constrained in stage 3 either if producers increase the price-floor in stage 1, or if firms negotiate lower transfers in stage 2.

4.1.2. The corner price-floor equilibrium

When $\alpha > \tilde{\alpha}$, producers may implement a corner solution by increasing the wholesale prices w_K in stage 1 to a level such that retailers remain constrained in stage 3. Negotiations in stage 2 lead to the transfers defined by Eq. (7) and the stage-3 constraint is binding.

Lemma 4. *For $\tilde{\alpha} \leq \alpha \leq \overline{\alpha} = \frac{2-b}{3-b}$, there exists a price-floor equilibrium where $w_A = w_B = \overline{w} = \frac{1-a\alpha-b(1-\alpha)}{2-\alpha(1+a-b)-b}$ and transfers are defined by Eq. (7).*

Proof. See Appendix A.3.2. □

Note that $\overline{w}$ increases with α: as t_{Ki} increases in α, retailers' best response prices increase and it becomes more difficult to constrain retailers' pricing decision. As a consequence, when α is very large ($\alpha \geq \overline{\alpha}$), the price $\overline{w}$ becomes too high and each producer has unilateral incentives to deviate towards a lower wholesale price: this deviation leads to a corner solution in stage-2 negotiations such that retail prices are still constrained, and the deviating producer benefits from a higher market share.[21]

4.1.3. The corner transfer equilibrium

When $\alpha \geq \overline{\alpha}$, there exists a price-floor equilibrium where the producers keep the wholesale price constant, equal to $\hat{w}=\overline{w}(\overline{\alpha})$, and stage 2 negotiations lead to a corner solution such that transfers are low enough to constrain the retail prices in stage 3. Prices are independent of α.

Lemma 5. *For $\overline{\alpha} \leq \alpha \leq \hat{\alpha} = \frac{4-2b}{4-b}$, there exists a price-floor equilibrium where $w_A = w_B = \hat{w} = \frac{3-2a-2b+ab}{(2-a)(2-b)}$ and corner-solution transfers are $\hat{t} = \hat{w}(2-b)-1+b$.*

Proof. See Appendix A.3.3. □

The corner transfer equilibrium exists in the interval $[\overline{\alpha}, \hat{\alpha}]$: for smaller α, each pair would deviate in stage 2 towards a lower unit transfer, and for $\alpha \geq \hat{\alpha}$, it would deviate towards a higher unit transfer that releases the stage-3 constraint. Note that $\hat{\alpha}$ does not depend on a by construction, but it decreases in b. The interval of α where price-floor equilibria exist shrinks when retail competition becomes tougher: if $b=0$, $\hat{\alpha}=1$ and a price-floor equilibrium exists for all α, whereas if $b=1$ there is no price-floor equilibrium for $\alpha > \frac{2}{3}$. Indeed, the higher b, the more profitable it is for the producers to deviate towards the *no-restriction* equilibrium.

4.1.4. All price-floor equilibria

Proposition 3. *Under the RBC law, a price-floor equilibrium exists if the buyer power is strong enough, i.e. for any $\alpha \leq \hat{\alpha} = \frac{4-2b}{4-b}$.*

Proof. Straightforward from Lemmas 3–5. □

The bold line in Fig. 1 below represents the retail price in the price-floor equilibria $\begin{cases} \tilde{w} \text{ if } \alpha \leq \tilde{\alpha} \\ \overline{w} \text{ if } \tilde{\alpha} < \alpha \leq \overline{\alpha} \\ \hat{w} \text{ if } \overline{\alpha} < \alpha \leq \hat{\alpha} \end{cases}$ for $\alpha \in [0,1]$ when $a=b=0.5$.

4.2. Properties of the price-floor equilibria

In this section we compare the price-floor equilibrium outcomes to the equilibrium outcomes with *no restriction* and with RPM contracts. Consider first retail prices.

Proposition 4. *Under a RBC law, equilibrium retail prices are strictly higher than in the no-restriction case for $\alpha < \hat{\alpha}$, and weakly higher than under RPM for any α.*

Proof. From Corollary 2, $\tilde{w} \geqslant p^*$ for $\alpha \leq \alpha_l$ with $\tilde{\alpha} < \alpha_l$. Furthermore, $\overline{w} \geqslant p^*$. Note that, for a given retail price, the producers get higher margins when the retailers are constrained, because the retailers' status-quo profits are lower then: this implies that, for the same retail price, the transfer $\overline{t}$ is higher than t^*. Yet by construction $\overline{w}$ is the price chosen without constraint by the retailers with a unit cost $\overline{t}$: $\overline{w}=p^e(\overline{t})$, as p^* is the price chosen without constraint and with a unit cost of $t^*: p^*=p^e(t^*)$. As $p^e(t)$ increases with t, $\overline{w} \geq p^*$ (for $\alpha=0$, $\overline{w}=p^*$). Besides, $\hat{w}$ is constant and above p^* as long as $\alpha \leq \hat{\alpha}$ since p^* increases in α and $p^*=\hat{w}$ for $\alpha=\hat{\alpha}$. Finally, retail prices are higher in the corner price-floor equilibria than in the RPM equilibrium: For $\alpha=\tilde{\alpha}$, $\overline{w}=\tilde{w}$, and $\overline{w}$ increases whereas $\tilde{w}$ decreases in α. □

The maximum retail price increase induced by the RBC law is either in $\alpha=0$ or in $\alpha=\overline{\alpha}$. When retail competition is low, especially if producers' competition is low too, the global maximum is in $\alpha=\overline{\alpha}$: the RBC law induces a higher retail price increase than the RPM. The

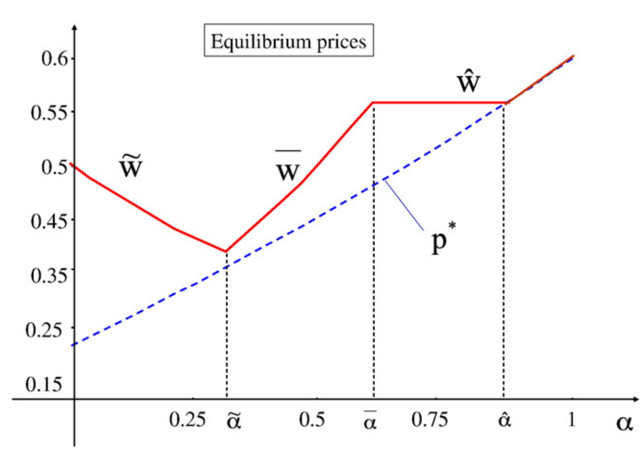

Fig. 1. Retail prices.

[21] Note that if $b=0$ and $a=1$, the price-floor is $\frac{1}{2}$ and retailers get the monopoly profit for all α while a RPM would go to zero when α goes to 1, and all firms would get zero profits. This example highlights fundamental differences between the price-floor mechanism and the RPM.

gap between a price-floor and a RPM widens when producers have more bargaining power.

Corollary 3. *In the price-floor equilibria, intrabrand competition is internalized and interbrand competition reduced. The reduction of upstream competition is stronger with a price-floor than with a RPM: Although a RPM may sometimes be welfare-enhancing, a price-floor is always welfare-damaging.*

Proof. Straightforward from Proposition 4. □

As shown in Corollary 1, a RPM internalizes retail competition and dampens upstream competition. A RBC law yields the same effect for $\alpha \le \tilde{\alpha}$. For $\alpha \ge \tilde{\alpha}$, the corner solutions are such that retail prices are constrained, thus suppressing retail competition. Besides, upstream competition is also reduced since producers have to raise wholesale prices in order to constrain retail prices. Finally, contrary to a RPM, a price-floor always harms welfare: Whenever a RPM may enhance welfare (*i.e.* when α is large), a price-floor leads to higher prices and damages welfare.

Consider now the effect of the law on profits.

Proposition 5. *Producers are better off under the RBC law than in the no-restriction case, whereas retailers' profits are higher under the law only when buyer power is high. Producers' share of profit is weakly larger with a RPM than with a price-floor, but upstream profits may be higher with a price-floor than with a RPM.*

Proof. Straightforward from the comparison of profits. □

First, the effect of the law on industry profits depends on the balance of power between producers and retailers. When $\alpha \leqslant \tilde{\alpha}$, the industry profit is larger than in the *no restriction* case, as $p^* \le \tilde{w} \le \frac{1}{2}$ where 1/2 is the price that maximizes industry profits. When $\alpha \geqslant \tilde{\alpha}$, under RPM producers' competition gradually drives the prices and the industry profit down with α, whereas under price-floors, final prices and industry profit keep increasing with α as long as $\alpha \le \frac{b}{1-a+b}$: Then the industry profit is higher with a price-floor than with a RPM. Note however that industry profit decreases when α goes to 1 and may become lower than under RPM and even than in the *no-restriction* case.

Second, the law also influences the profit sharing. When retail prices are constrained, producers extract a larger share of profit: This positive effect dominates the potential loss of total profit, and producers always benefit from a RBC law: their profit under RBC laws increases with α (it is constant for $\alpha \in (\overline{\alpha}, \hat{\alpha})$). In contrast, retailers may benefit from the law only if their buyer power is high. Note that in the corner price-floor equilibrium, the share of profit captured by producers is the same than under RPM, but it is lower in the corner transfer equilibrium, as transfers are reduced in order to keep the stage-3 constraint binding.

5. Two-part tariff

So far we have assumed that rebates were linear, and that negotiations determined unit transfers. We extend here our analysis to two-part transfers.[22] Stages 1 and 3 of the game are unchanged, but the stage-2 negotiations now define for each pair (K, i) a unit transfer t_{Ki} and a fixed fee F_{Ki}: the total transfer retailer i pays producer K for the quantity q_{Ki} is thus $t_{Ki} q_{Ki} + F_{Ki}$. Profits are, with P the vector of retail prices:

$$\Pi_K = t_{Ki} D_{Ki}(P) + F_{Ki} + t_{Kj} D_{Kj}(P) + F_{Kj}$$
$$\Pi_i = (p_{Ki} - t_{Ki}) D_{Ki}(P) - F_{Ki} + (p_{Li} - t_{Li}) D_{Li}(P) - F_{Li}$$

We derive the equilibria without restriction, with RPM and under a price-floor.[23]

5.1. No restriction

Suppose first that there is no restriction on retail prices.

Proposition 6. *When producers and retailers bargain over two-part transfers, in the no-restriction equilibrium, the unit transfer is set to the marginal cost of production and the retail price to the level that would be set by two competing vertically integrated multi-product retailers.*

Proof. Two-part transfers do not modify the last stage of the game: retailer i's best response prices $(p_{Ai}^{BR}, p_{Bi}^{BR})(t_{Ai}, t_{Bi}, p_{Aj}, p_{Bj})$ are defined by 2. In the second stage, each of the four pairwise negotiations yields two outcomes, t_{Ki} and F_{Ki}, determined by the two first order conditions:

$$\alpha \frac{\partial\left(\Pi_K - \Pi_K^3\right)}{\partial t_{Ki}} \left(\Pi_i - \Pi_i^3\right) + (1-\alpha)\left(\Pi_K - \Pi_K^3\right) \frac{\partial\left(\Pi_i - \Pi_i^3\right)}{\partial t_{Ki}} = 0 \qquad (8)$$

$$\alpha \frac{\partial\left(\Pi_K - \Pi_K^3\right)}{\partial t_{Ki}} \left(\Pi_i - \Pi_i^3\right) + (1-\alpha)\left(\Pi_K - \Pi_K^3\right) \frac{\partial\left(\Pi_i - \Pi_i^3\right)}{\partial t_{Ki}} = 0 \qquad (9)$$

The system of eight first-order conditions yields a unique symmetric subgame equilibrium: $t_{Ki} = 0$ and $F_{Ki}^{TP} = \frac{\alpha(1-a)(1-b)}{(1+a)(1+b)(2-b)^2}$. As with linear tariffs, there is no commitment in stage 1. The symmetric equilibrium retail prices are $p_{Ki}^{TP} = \frac{1-b}{2-b}$ and profits are $\Pi_K = 2F_{Ki}$ and $\Pi_i = \frac{2(1-b)(1-\alpha(1-a))}{(1+a)(1+b)(2-b)^2}$. □

Note that, unlike Rey and Vergé (2004), we obtain equilibria under two-part tariffs where the four goods are sold.[24] Besides, the equilibrium transfers are uniquely defined. Two-part tariffs suppress double margin: the unit transfer is zero, so that each retailer behaves as a vertically integrated firm selling the two differentiated products. Retail prices are then independent of α, and are equal to the equilibrium retail price for $\alpha = 0$ with linear tariffs. Without restraint, retail prices are thus lower with two-part transfer than with linear transfer. Two-part tariffs internalize interbrand competition, but retail prices still account for intrabrand competition (p_{Ki}^{TP} only depends on b): final prices are lower than the full collusion price (1/2).

Industry profit is lower with two-part tariffs than with linear tariffs, unless competition is low at both levels and producers have a high bargaining power[25]: When α is not too high, equilibrium final prices with linear tariffs are lower than the joint-profit maximizing price 1/2. The suppression of double margin through two-part tariffs drives prices further away from this joint-profit maximizing price.

[22] Bonnet and Dubois (2010) or Villas-Boas (2007) assess the prevalence of non-linear or linear pricing.

[23] All the results presented here are in the linear demand framework. See Allain and Chambolle (2010) for a discussion of the robustness.

[24] In Rey and Vergé (2004), there may exist no equilibrium where the four goods are sold, unless they assume that producers can bypass established retailers and find alternative outlets, or that producers are excluded from the market if one offer is rejected by a retailer. Our assumption of delegated agents ("schizophrenia of the negotiator") prevents firms from deviating simultaneously with two vertical partners and allows the existence of equilibria: this framework offers a convenient building block that avoids non-existence of equilibrium when studying interlocking relationships.

[25] *I.e.* $\alpha \in \left[\frac{2b(2-b)}{2-b^2-2a(1-b)}, 1\right]$. Note that this interval exists only for low values of a and b.

Producers' share of total profit is $\alpha(1-a)$: it increases in α and decreases in a.

5.2. Two part tariffs under RPM

Assume now that the producers can use RPM contracts.

Lemma 6. *With two-part tariffs and RPM, there exists a continuum of symmetric subgame equilibria characterized by:*

$$F_K^{\circ}(w_K,w_L,t_K,t_L)=\frac{(1-a-w_K+aw_L)(\alpha(w_K-a(w_L-t_L)-bt_K)-(1-b)t_K)}{(1-a^2)(1+b)} \tag{10}$$

Proof. In stage 3, all final prices are set to the RPM level, even in case of a negotiation breakdown. Final demands are thus fixed too. When they negotiate, K and i anticipate the outcome of the three other negotiations, and the two first order conditions (8) and (9) reduce to:

$$D_{Ki}(W)\Big[\alpha\Big[\big(w_K-t_{Ki}\big)D_{Ki}\big(W\big)+\big(w_L-t_{Li}\big)\Big(D_{Li}\big(W\big)-D_{Li}^3\big(.\big)\Big)\Big]$$
$$-\big(1-\alpha\big)\Big[t_{Ki}D_{Ki}\big(W\big)+t_{Kj}\Big(D_{Kj}\big(W\big)-D_{Kj}^3\big(.\big)\Big)\Big]-F_{Ki}\Big]=0$$
$$\alpha\Big[\big(w_K-t_{Ki}\big)D_{Ki}\big(W\big)+\big(w_L-t_{Li}\big)\Big(D_{Li}\big(W\big)-D_{Li}^3\big(.\big)\Big)\Big]$$
$$-\big(1-\alpha\big)\Big[t_{Ki}D_{Ki}\big(W\big)+t_{Kj}\Big(D_{Kj}\big(W\big)-D_{Kj}^3\big(.\big)\Big)\Big]-F_{Ki}=0$$

With W the vector of constrained final prices. This degenerate system of eight Nash conditions yields a system of solutions (F_{A1},F_{B1}, F_{A2},F_{B2}) as a function of four parameters (t_{A1},t_{B1},t_{A2},t_{B2}):

$$F_{Ki}=\frac{(1-a-w_K+aw_L)\big(\alpha(w_K-a(w_L-t_{Li}))-t_{Ki}+b(1-\alpha)t_{Kj}\big)}{(1-a^2)(1+b)} \tag{11}$$

Among this continuum of subgame equilibria, Eq. (10) gives the solution satisfying symmetry across the retailers ($t_{K1}=t_{K2}=t_K$, $F_{K1}=F_{K2}=F_K$). The transfers vary in an interval defined by the participation constraints of all players.[26] □

All subgame equilibria are not equivalent in terms of profits. Consider the negotiation between K and i. First, given the outcome of the three other negotiations, all equilibrium tariffs (t_{Ki},F_{Ki}) yield the same profit for K and i: for instance, for K, Eq. (11) ensures that $F_{Ki}+t_{Ki}D_{Ki}(W)$ does not depend on t_{Ki}. Consider now the joint profit of the distribution of product K by the two retailers: $J\Pi_K\equiv\Pi_K+(\Pi_1-\Pi_1^3)+(\Pi_2-\Pi_2^3)=w_K(D_{K1}+D_{K2})(W)+(p_{L1}-t_{L1})(D_{L1}-D_{L1}^3)+(p_{L2}-t_{L2})(D_{L2}-D_{L2}^3)$. As final prices and quantities are fixed by RPM, $J\Pi_K$ is independent of t_{Ki} negotiated inside the structure; However it increases in t_{Li} because the opportunity cost for i to sell product K (*i.e.* the reduction in its sales of product L, compared to its status-quo profit) increases with its margin on product L. As a consequence, among the symmetric subgame equilibria, $J\Pi_K$ is independent of t_K and increases in t_L. Consider finally the sharing of the profit $J\Pi_K$ inside the structure. Given the outcome of the three other negotiations, we know by Eq. (11) that K's total profit $\Pi_K=F_{Ki}+t_{Ki}D_{Ki}(W)+t_{Kj}D_{Kj}(W)+F_{Kj}$ does not depend on t_{Ki}, but it increases in t_{Kj} (because the status-quo profit of K increases in the tariff he negotiates with j[27]) and increases in t_{Li} (because the status-quo profit of i decreases in the tariff he negotiates with L). As a consequence, among the symmetric subgame equilibria, the share of profits earned by K (resp. i) increases (resp. decreases) in t_K through the effect of t_{Kj} on the producer's status-quo profit when he negotiates with i.

Consider now the choice of the RPM level in the first stage.

Proposition 7. *With two-part tariffs and RPM, there exists a continuum of symmetric equilibria where retail prices are* $w^{\circ}(t)=\frac{1}{2}\left(1-t\frac{b+\alpha(a-b)}{\alpha(1-a)}\right)$, *with* $0\le t\le t_{RPM}=\frac{\alpha(1-a)}{b+\alpha(2-a-b)}$.

Proof. In stage 1, the producers anticipate one of the symmetric subgame equilibria, say (t_A,t_B). Producer A's best response to w_B is then

$$w_A^{BR}(w_B,t_A,t_B)=aw_B+\frac{\alpha(1-a)-a\alpha t_B-b(1-\alpha)t_A}{2\alpha} \tag{12}$$

For each (t_A,t_B), there exists a unique (w_A,w_B) such that if the producers anticipate the subgame equilibrium outcomes (t_A,t_B,F_A°,F_B°), then setting the RPM prices (w_A,w_B) in stage 1 is an equilibrium strategy. Finally, there is a continuum of symmetric equilibria such that $t_A=t_B=t$ and:

$$w_A=w_B=w^{\circ}(t)=\frac{1}{2}\left(1-t\frac{b+\alpha(a-b)}{\alpha(1-a)}\right) \tag{13}$$

with t such that $0\le t\le w^{\circ}$, *i.e.* for $0\le t\le t_{RPM}$, with $t_{RPM}=\frac{\alpha(1-a)}{b+\alpha(2-a-b)}$.[28] □

Note that the retail price $w^{\circ}(t)$ decreases in t. As t_{RPM} decreases with α, the set of equilibrium retail prices $[w(t_{RPM}),1/2]$, with $w(t_{RPM})=\frac{(1-a)\alpha}{(2-a-b)\alpha+b}$, shrinks with α. If $\alpha=0$, all prices from 0 to the monopoly price are sustainable in equilibrium, but when $\alpha=1$, the minimum RPM price is $\frac{1-a}{2-a}$, the price that would be chosen by vertically integrated producers.[29]

Given α, producers' profit $\Pi_K^{\circ}=\left(\frac{\alpha(1-a)+t(a\alpha+b(1-\alpha))^2}{2\alpha(1-a^2)(1+b)}\right)$ increases in t, whereas retailers' profit decreases in t. Joint profit is maximum when $t=0$ and retail prices are at the monopoly level $w^{\circ}(0)=1/2$, and decreases in t: this original result stems from the existence of a continuum of subgame equilibria in the negotiation stage where profit sharing is influenced by the unit transfers (t_K and t_L) through their effect on status-quo profits. The intuition is as follows. If in stage 1 the producers anticipate that the stage-2 negotiations will lead to $t=0$ and the matching fixed fees, they are going to be paid through the fixed fee only and the best they can do is to maximise the joint profit by setting $w=1/2$. Yet if they anticipate a positive unit transfer t, then each producer's (resp. retailer's) status-quo profit decreases (resp. increases) with the RPM price[30]: Producers thus set RPM prices that do not maximize industry profit in order to get a larger share of a smaller pie. Even with an upstream monopoly ($a=0$) there exists a continuum of equilibrium RPM prices that do not necessarily maximise the joint profit.

[26] The participation constraints impose $t_K\le\frac{at_L+w_K-aw_L}{b}$, assuming that $w_K\ge aw_L$ which will be satisfied in a symmetric equilibrium. Transfers are nonnegative and less than the RPM price, as negative rebates are not allowed (we discuss this assumption further). However t_K can be large enough for F_K to be negative.

[27] In case of a breach in negotiation between K and i, the higher t_{Kj}, the more K benefits from the increase in demand for product Kj.

[28] t_{RPM} is defined by the constraint $t\le w$. Relaxing this constraint enlarges the set of subgame equilibria: first, the set of equilibria defined by Eq. (13) extends to any t such that $w\le t\le t^{sq}$ where $t^{sq}=\frac{w(1+a-\alpha(1-a))}{b+a+\alpha(a-b)}$; second, new subgame equilibria with $t>t^{sq}$ appear where the retailers' status-quo profit are zero. Finally, these yield lower equilibrium final prices.

[29] The RPM equilibrium with linear tariffs $\tilde{w}$ is still an equilibrium under RPM with two-part tariffs. Joint profit is the same than with linear tariffs, but retailers get more and producers less.

[30] Totally differentiating producer A's status-quo profit given (t_A,t_B) and w_B yields $\frac{d\Pi_A^{sq}}{dw_A}\Big|_{w_A=w_B}\le0$ for $w_A=w_B$ and $t_A=t_B=t$ satisfying Eq. (13).

5.3. Two part tariffs under the ban

Consider now that w is only a price-floor.

Proposition 8. *With two-part tariffs and price-floors, there exists a continuum of equilibria where retail prices are* $w^{\circ}(t) = \frac{1}{2}\left(1 - t\frac{b+\alpha(a-b)}{\alpha(1-a)}\right)$, *with* $0 \le t \le t_{PF} = \frac{\alpha b(1-a)}{b(2-b)+\alpha(2-b(2+a-b))}$ *and* $t_{PF} \le t_{RPM}$.

Proof. In stage 3, retailer i's best response prices $p_{Ki} = \frac{1-b+t_K+bp_{Kj}}{2}$ are below the price-floor, which will be binding if and only if $t \le t_{PF}$. We check in Appendix A.4 that there is no deviation in the first stage. □

As with RPM, for any α, there exists an equilibrium where competition is neutralized at both level: $t=0$ and the monopoly price 1/2 is achieved. Among the continuum of equilibria, the retail price $w^{\circ}(t)$ and the joint profit decrease in the unit transfer t. The minimum price sustainable with price-floors is $w^{\circ}(t_{PF}) = \frac{1}{2}\left(1 - \frac{b(b+\alpha(a-b))}{(2-b)b+\alpha(2-b(2+a-b))}\right)$. The interval of equilibrium retail prices $[w^{\circ}(t_{PF}), 1/2]$ is smaller than under RPM and shrinks when α increases. For $\alpha=0$, the lowest price in equilibrium is $w^{\circ}(t_{PF}) = \frac{1-b}{2-b}$, that is the *no-restriction* equilibrium final prices, whereas it is $\frac{1-ab}{2-ab}$ for $\alpha=1$. Retail prices are thus always higher than in the *no-restriction* equilibrium. Fig. 2 represents the range of equilibria with two-part tariffs for $a=0.4$ and $b=0.5$.

Note that, as with linear transfers, producers are better off with price-floors, which suppress retail competition and partially relax upstream competition.[31] Retailers' situation is ambiguous: their profit with price-floor is higher than without restriction when $t_K=0$, but lower when $t_K=t_{PF}$.

Consider now the welfare effects of the price-floor mechanism.

Proposition 9. *With two-part tariffs, all price-floors equilibria harm welfare, whereas RPM may be welfare-enhancing in equilibrium.*

Proof. In any price-floor equilibrium, retail prices are higher than in the *no-restriction* equilibrium $\left(w_{PF} \ge \frac{1-b}{2-b}\right)$. By contrast, under RPM, among the continuum of existing equilibria, there are equilibria with final prices lower than the *no-restriction* equilibrium price: for instance $w(t_{RPM}) \le \frac{1-b}{2-b}$ when α is not too high.[32] □

The price-raising effect of price-floors allowed by RBC laws is thus robust to the introduction of two-part tariffs. These results are in line with Rey and Vergé (2004), who show that a RPM may sustain the collusive outcome in an interlocking relationship with two-part tariffs. We confirm that a price-floor, as well as a RPM, may foster collusion on the upstream as well as downstream markets. We go further by differentiating these two vertical restraints and showing that price-floors are always welfare-damaging while the welfare effect of RPM is ambiguous.

6. Robustness and extensions

6.1. Individual price-floors

Here we relax the assumption that producers impose industry-wide price-floors and study the case of discriminatory price-floors.

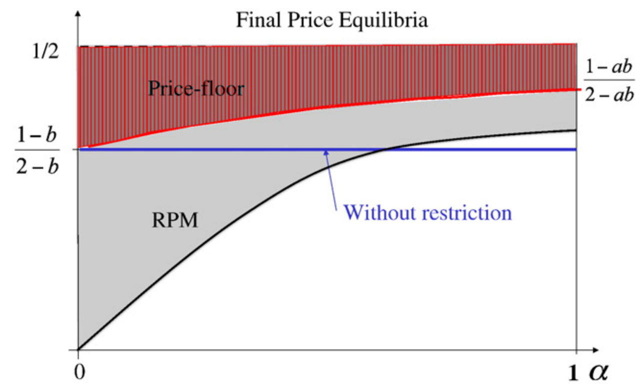

Fig. 2. Retail prices with two-part tariffs.

Assume that in stage 2 firms are allowed to bargain over two linear rebates, one included in the definition of the price-floor and the other not: stage 1 becomes "passive" and contracts are fully determined in stage 2 where each pair negotiates over a price-floor w_{Ki} and a unit transfer $w_{Ki} - f_{Ki}$.

Proposition 10. *Pairwise-negotiated price-floors are not binding in equilibrium.*

Proof. In stage 2, anticipating constrained retail prices, the equilibrium outcomes are: $w_{Ki}^{\diamond} = 1 - \frac{1}{2-\alpha a-(1-\alpha)b}$ and $f_{Ki}^{\diamond} = \frac{(1-\alpha)(1-b)}{2-\alpha a-(1-\alpha)b}$. These rebates however yield unconstrained final prices in stage 3: $p_{Ki}^{BR}(w_{Ki}^{\diamond} - f_{Ki}^{\diamond}) \geqslant w_{Ki}^{\diamond}$. Besides, the minimum symmetric binding price-floor is $\overline{w_{Ki}^{\diamond}} = \frac{1-a\alpha-b(1-\alpha)}{2-\alpha(1+a-b)-b}$, such that $p_{Ki}^{BR} = \overline{w_{Ki}^{\diamond}}$ for both retailers. It is straightforward that any price-floor above this level will also fail to sustain an equilibrium as there is always a unilateral incentive for a pair (K,i) to deviate towards a lower price-floor in stage-2 renegotiations. □

Pairwise renegotiation of the price-floor thus suppresses the price-raising mechanism. This result suggests a way to reform RBC laws. Without waiving the very principle of the law, changing the definition of the price threshold would be sufficient to eliminate the price-floor mechanism, and thus most of the price effect of the law. The example of Spain, where inflationary effects have been rather limited (see Canivet, 2004, p68), gives a good illustration. There, deferred rebates cannot be included in the threshold, but the law does not require the GTS to be published, allowing producers and retailers to negotiate over the price threshold.

6.2. Incomplete breakdown

So far we assumed that after a breakdown in the negotiation between K and i, product Ki was not sold ("complete breakdown", henceforth CB). Assume instead that i may still purchase product K at the unit wholesale price w_K ("incomplete breakdown"). With two-part tariffs and sufficient interbrand competition, our main results hold.

Consider the *no restriction* case. In case of breakdown between K and i, w_K will now influence the status-quo profits as i may still purchase a positive quantity of good K at that price. There is now a commitment in stage 1 that gives producers a new tool to increase their power in the negotiation stage. We show in Appendix A.5.1 that this suppresses some of the equilibria of the CB case and creates a new symmetric equilibrium (w^{*s}, t^{*s}, F^{*s}) with the same final price than the CB equilibria ($t^{*s}=0$ and $p^{*s} = \frac{1-b}{2-b}$) and an increased

[31] However, under RBC laws, producers are better off with linear than with two-part transfers.

[32] When $\alpha \le \frac{b(1-b)}{b(2-b)-a}$ if $b \ge a$ and for any α else. Note that the highest welfare (minimum retail price) is attained for $\alpha=0$: in the linear tariff case welfare was minimum for $\alpha=0$.

share of profit for the producers. Note that w^{*s} increases in α: When α goes to 1, demand for good *Ki* after a breakdown goes to zero and for $\alpha = 1$ equilibria are those of the *CB* case.

Under price-floors, equilibria are unchanged as long as $a > \frac{1}{2}$. The insight is as follows. First, status-quo profits are modified only if, after a breakdown between *A* and 1, it is still profitable for 1 to buy and resell *A1* at a price $p_{A1} > w_A$. This will be the case if the consumers' taste for variety compensates the higher cost of *A1*, that is if the transfer t_{B1} negotiated with the rival supplier is high enough: $t_{B1} \geqslant \underline{t}^s$, where $\underline{t}^s$ increases with *a*. Second, the price-floor is indeed binding if the transfers are lower than a threshold $\overline{t^s}$ that decreases in *a* (because the equilibrium wholesale prices decrease in *a*). Finally, for $a > \frac{1}{2}$ the two conditions are incompatible $\left(\overline{t^s} < \underline{t}^s\right)$ and our results hold in this new setting as equilibrium prices are the same than in the *CB* case: RBC laws increase final prices.[33] Note finally that the price-floor equilibria yield higher profits for the producers than the *no restriction* equilibria only when α is large (*i.e.* when w^{s} is high).[34]

6.3. Secret vs. public contracts

Irrespective of the upstream industry structure, secret contracts have different effects with linear or two-part tariffs. We discuss the role of secrecy in a framework of take-it-or-leave-it contracts. The insight would be the same with bargaining.

With linear tariffs, the difference between public and secret contracts boils down to the ex-post observability of contracts (henceforth EPO) or, in our model, observability of the outcome of stage 2 before the beginning of stage 3. The producers cannot capture the whole industry profit. Yet they capture an even lower share of joint profits if contracts are observable ex-post. Consider the case of an upstream monopoly ($a = 0$). In stage 3, the outcomes of the contracting stage are public, so that each retailer knows which products are sold by her competitors and at which cost. This reduces the producer's status-quo profit: in case of a breakdown between, say, *A* and 1, 2 is aware of being a monopoly on the market for *A* and increases her price in stage 3, which reduces the demand for *A2* and the producer's status-quo profit. With no restriction, EPO leads to lower equilibrium transfers and retail prices. In contrast, the price-floor is higher with EPO: as the outcome of the contracting stage is less favorable to the producer, his margin is lower and he thus has an incentive to increase the final price. Furthermore, the price-floor strategy is chosen by the producer for a wider interval of α than without EPO. The price-raising effect of the price-floor mechanism is thus even worse with EPO (see Appendix A.5.2).

Although two-part tariffs enable a monopolist producer dealing with competing retailers to capture the whole industry profit with public contracts, Hart and Tirole (1990) have shown that secret contracts raise a commitment problem that prevents him from getting the monopoly profit. As long as the fixed fee is not optional (*i.e.* it is paid before the retailers' orders, cf. de Fontenay and Gans, 2005b), each retailer only accepts a contract that is immune to bilateral renegotiation between the producer and the rival retailer, *i.e.* such that the unit transfer is set to the marginal cost of production and the fixed fee equivalent to the downstream competition equilibrium profit. Secrecy of contracts thus has two effects: (1) the commitment problem and (2) the non ex-post observability of contracts. With upstream competition, the comparison between public and secret contracts is still missing in the literature.[35]

7. Conclusion

The main result of this article is that industrywide price-floors not only suppress retail competition, but also dampen producers' competition. Moreover, as price-floors reduce retailers' latitude, they enable producers to extract a larger share of joint profits. Producers thus always benefit from price-floors, and retailers may also be better off with a price floor when buyer power is high enough. Furthermore, the comparison of price-floor and RPM shows that if both restraints have similar anticompetitive effects, a price-floor may be more profitable for producers, lead to higher retail prices and be worse for total welfare than a RPM. These results hold with linear as well as two-part tariff contracts. Finally, we show that the difference between a price-floor and a RPM tends to increase when buyer power is weak.

Our results contribute to the debate on the price effects of RBC laws. We show how, paradoxically, RBC laws combined to anti-discrimination rules provide roundabout means for producers to impose industrywide price-floors, a vertical restraint that is banned *per se* in the EU competition laws. We thus provide a theoretical explanation for some price-raising effects of RBC laws where no predatory pricing is involved, and which is independent from loss-leading practices. Moreover, we prove that this effect relies on the definition of the cost threshold adopted in RBC laws. In a broader setting the RBC laws may have two types of effects: First, the price-floor effect, which always harms welfare, raises producers profit, and may raise retailers profits if their buyer power is large; Second, the effect of the ban on loss leading, usually viewed as positive for the producers but negative for the retailers, and possibly welfare enhancing. Although empirical assessment of profit sharing in the vertical chain is scarce, qualitative observations in Canivet (2004) point out that, after ten years of enforcement of the Galland Act, all actors of the French sector seem to have benefited from the law, retailers as well as producers.[36] These observations support our interpretation that the law was not only prohibiting loss-leaders (which would be likely to reduce retailers' profits), but also enabled a price-raising mechanism that benefited all firms in the vertical channel.

Empirical evidence supports our results. For instance, food prices in France increased significantly after the enactment of the Galland law in 1997: the average prices of food products increased faster than the overall consumer price index after the Galland law, whereas it was slower before. Biscourp et al. (2008) provide evidence that, after ten years under the Galland law, retail prices are no longer significatively correlated to retail competition at the local level which may be interpreted as a lack of retail competition. These findings are consistent with our price-floor interpretation. Note that we do not claim that the RBC law should be lifted, but that the definition of the price threshold must be modified: integrating backroom margins in the threshold definition is sufficient to prevent most of the inflationary effects of the law. This result has been the basis of the 2006 reform of the French RBC law (see Canivet, 2004).

Finally, this article brings some new elements to the debate on the RPM. Indeed, both RPM and price-floor were banned *per se* in the US until the recent Supreme Court Leegin decision,[37] which went back on the jurisprudence and replaced the *per se* ban with a rule of reason.[38] The economic literature about the pros and cons of RPM

[33] The case $a < 1/2$ is less tractable because of the multiplicity of equilibria: new price-floor equilibria may coexist with the *CB* price-floor equilibria.

[34] Price-floor equilibria profits are unchanged while the no restriction producers' profits increase. Moreover, in the *no restriction* case, the double-margin effect is stronger in case of breakdown than in case of success in the bargaining: this tends to reduce the transfers. When α is large, producers are thus more willing to succeed in their negotiations to limit the double-margin effect and reduce the retailers' outside option by setting a wholesale price so high that there would be no demand left for the product in case of a breakdown: producer's profit thus decreases towards the profit obtained in the CB case when α goes to 1.

[35] In most cases, there is no equilibrium with public contract and interlocking relationships (see Rey and Vergé, 2004).

[36] However, Canivet (2004) describes how the retailers started to complain when prices raised too high levels: they seemed less reluctant than producers to change the law.

[37] US Supreme Court, Leegin Creative Leather Products Inc, vs. PSKS inc, 06-480, 2007/06/28.

[38] The court already lifted the *per se* ban on price ceilings in State Oil v. Khan, 1997.

does not conclude clearly about the dominant effect. Many papers, including ours, support the view that RPM may on occasion have a beneficial impact on competition and welfare. However, we show that, since price-floors always damage welfare, a clear distinction should be made between price-floors and RPM.

Appendix A[39]

A.1. The no-restriction case

A.1.1. Status-quo profits in stage-2 negotiation

Consider the stage-3 subgame after a breakdown in negotiation between A and 1. Consumers are aware that only three goods are available on the market: Deriving the demand function with $q_{A1}=0$ from Eq. (1) yields the new demands $D^3_{B1}(p_{A2},p_{B1},p_{B2}) = \frac{1-b-p_{B1}+bp_{B2}}{1-b^2}$ and $D^3_{A2}(p_{A2},p_{B1},p_{B2}) = \frac{1-a-p_{A2}+ap_{B2}}{1-a^2}$.

The optimal price for good $B1$ is thus $p^3_{B1} = \frac{1-b(1-p^a_{B2})+t^a_{B1}}{2}$.[40] The status-quo profits anticipated by the negotiating firms are:

$$\Pi^3_A = t^a_{A2} D^3_{A2}\left(p^3_{B1},p^a_{A2},p^a_{B2}\right) = t^a_{A2}\frac{1-a-p^a_{A2}+ap^a_{B2}}{1-a^2}$$

$$\Pi^3_1 = \left(p^3_{B1}-t^a_{B1}\right) D^3_{B1}\left(p^3_{B1},p^a_{A2},p^a_{B2}\right) = \frac{\left(1-b+bp^a_{B2}-t^a_{B1}\right)^2}{4(1-b^2)}.$$

A.2. The RPM equilibrium

The retailers have to set $p_{Ki}=w_K$ in stage 3 irrespective of the market structure, even in case of a breach in stage-2 negotiations. In case of a failure in the negotiation between A and 1, the negotiators anticipate that the price of product $B1$ will be $p_{B1}=w_B$. The status-quo profits are thus:

$$\Pi^3_A = t_{A2} D^3_{A2}(p_{A2}=w_A, p_{B1}=w_B, p_{B2}=w_B) = \frac{t_{A2}(1-a-w_A+aw_B)}{(1-a^2)}$$

$$\Pi^3_1 = (w_B-t_{B1}) D^3_{B1}(p_{A2}=w_A, p_{B1}=w_B, p_{B2}=w_B) = \frac{(1-w_B)(w_B-t_{B1})}{(1+b)}$$

Similarly, A and 1 anticipate the following third-stage profits in case of success of the negotiation, with $W=(w_A,w_A,w_B,w_B)$ and $D_{Ki}(W) = \frac{(1-a-w_K+aw_L)}{(1-a^2)(1+b)}$:

$$\Pi_A(t_{A1}) = t_{A1}D_{A1}(W) + t_{A2}D_{A2}(W)$$
$$\Pi_1(t_{A1}) = (p_{A1}-t_{A1})D_{A1}(W) + (p_{A2}-t_{A2})D_{A2}(W)$$

The Nash condition for the negotiation between A and 1 is $\underset{t_{A1}}{\mathrm{Max}}\left(\Pi_A(t_{A1})-\Pi^3_A\right)^{\alpha}\left(\Pi_1(t_{A1})-\Pi^3_1\right)^{1-\alpha}$. The resolution of the four Nash conditions gives the optimal transfers[41] $\tilde{t}_{Ki}(w_K,w_L) = \alpha\frac{(1-a^2\alpha-(1-\alpha)b)w_K - a(1-\alpha)(1-b)w_L}{(1-(1-\alpha)b)^2-a^2\alpha^2}$. Given w_L, $\frac{\partial\tilde{t}_{Ki}}{\partial w_K} = \alpha\frac{(1-a^2\alpha-(1-\alpha)b)}{(1-(1-\alpha)b)^2-a^2\alpha^2} \geq 0$.

In stage 1, A sets the wholesale price that maximizes his profit $\sum_{i=1,2}\tilde{t}_{Ai}(W)D_{Ai}(W)$.

The optimal wholesale prices and transfers are then $w_K=\tilde{w}=\frac{1-a^2\alpha-b+\alpha b}{2+a\alpha-a^2\alpha-2(1-\alpha)b}$, and $\tilde{t}_{Ki}=\tilde{t}=\frac{\alpha(1-a)(1-a^2\alpha-(1-\alpha)b)}{(\alpha((1-a)a+2b)+2(1-b))(1-b+\alpha(b-a))}$.

The producers' profits are $\tilde{\Pi}_K=\frac{2\alpha(1-a)(1+a\alpha-(1-\alpha)b)(1-a^2\alpha-(1-\alpha)b)}{(1+a)(1+b)[2+a\alpha(1-a)-2(1-\alpha)b]^2(1-b+\alpha(b-a))}$.

Moreover $\tilde{w}\geq p^* \Leftrightarrow \alpha\leq\alpha_I$ where

$$\alpha_I = \frac{2(1+a^2)-b-3b^2-\sqrt{4a^2+8a(1-b)^2b+(2-b+b^2)^2+4a^2(2-7b+3b^2)}}{6a^2-2a(1-b)-2b(2+b)}.$$

A.3. Price-floor equilibria

A.3.1. The price-floor implements the RPM equilibrium

A.3.1.1. No deviation by a retailer in stage 3. Assume that the producers set the price-floor $\tilde{w}$ in stage 1, and that the stage-2 negotiations yield the RPM equilibrium transfers $\tilde{t}$. In stage 3, if retailer i anticipates that her rival sets price $p_{Kj}=\tilde{w}$, she can still set p_{Ki} above the price-floor $\tilde{w}$. The best response prices of retailer i is given by Eq. (2): $p^{BR}_{Ki}(\tilde{t},\tilde{w}) = \frac{1+\tilde{t}-b(1-\tilde{w})}{2}$. No deviation occurs in stage 3 if $p^{BR}_{Ki}(\tilde{t},\tilde{w})\leq\tilde{w}$, or:

$$\tilde{t}\leq\tilde{w}(2-b)-1+b \tag{14}$$

This condition is monotone in α, therefore this defines a threshold $\tilde{\alpha}\leq\alpha_I$ such that retail prices will indeed be constrained by a price-floor if and only if:

$$\alpha\leq\tilde{\alpha} = \frac{1+a^2-2b^2-\sqrt{1+2a^2+a^4-8a^2b+4a^2b^2}}{2(2a^2-b-b^2)} \tag{15}$$

A.3.1.2. No deviation in stage 2. Assume that the producers have set the price-floor $\tilde{w}$ in stage 1, and that $\alpha\leq\tilde{\alpha}$. Consider the stage-2 negotiation between A and 1, given the transfer $\tilde{t}$ agreed by the three other pairs.

First, if the negotiation fails, p^3_{B1} may not remain constrained by the price-floor. Retailer 1's optimal price $p^{BR}_{B1} = \frac{1-b(1-\tilde{w})+t_{B1}}{2}\leq\tilde{w}$ if and only if $t_{B1}\leq\tilde{w}(2-b)-1+b$: yet $t_{B1}=\tilde{t}$ satisfies this condition by Eq. (14). So even if a negotiation fails, all final prices remain constrained, and the status-quo profits are those of the RPM case.

Second, A and 1 may deviate by negotiating a higher transfer t^d_{A1} such that the retail price p_{A1} will be unconstrained in stage 3. Given that the three other retail prices are $\tilde{w}$, 1 maximizes his profit by setting $p^d_{A1}=\frac{1}{2}\left((1-a)(1-b(1-\tilde{w}))+t^d_{A1}-a\left(2w-\tilde{t}\right)\right)$, and $p^d_{A1}\geq\tilde{w}\Leftrightarrow t^d_{A1}\geq t_c = a\tilde{t}-(1-a)(1-b(1-\tilde{w})-2\tilde{w})$. Under price-floors, the Nash condition is defined by segments: for $t^d_{A1}\geq t_c$, prices are unconstrained (p^d_{A1}), and for $t^d_{A1}\leq t_c$ prices are constrained ($p_{A1}=\tilde{w}$). If $\alpha\leq\tilde{\alpha}$, the maximum of the Nash condition is $\tilde{t}\leq t_c$ and yields constrained retail prices.

A.3.1.3. No deviation in stage 1. Assume that B sets the wholesale price $\tilde{w}$. First, it is obvious that A would not deviate by increasing his wholesale price: as p_{A1} and p_{A2} would remain constrained the deviation would not be profitable, whether retail prices for B were constrained or not. But it could be profitable for A to deviate by setting in stage 1 a w_A sufficiently low to relax the stage-3 constraint and allow the retailers to set p_{Ai} above w_A but below $\tilde{w}$. We show in

[39] A more detailed version of the proofs is available in Allain and Chambolle (2010), webappendix.

[40] Note that $p^3_{Ki}=p^{BR}_{B1}$: given the prices chosen by retailer j, the optimal price for product Ki is the same whether i sells L or not. This property holds for any linear demand function with symmetric cross-price derivatives, and for any demand functions if cross-price derivatives are symmetric and $\varepsilon^3_{AA}=\varepsilon_{AA}+\varepsilon_{AB}$ where ε^3_{AA} is the direct-price elasticity of the demand for product A when only A is sold, and ε_{AA} and ε_{AB} respectively the direct-price and cross-price elasticities of the demand when both products are sold. A change in the demand function could raise a difference between p^3_{B1} and p^{BR}_{B1} without altering qualitatively our results.

[41] Defined by continuity, for $\alpha=1$ and $a=1$: $t_{Ki}(w_K,w_L)=w_K$; and for $\alpha=0$ and $b=1$, $t_{Ki}(w_K,w_L)=0$.

Allain and Chambolle (2010), webappendix that if $\alpha<\tilde{\alpha}$, such a deviation is not profitable.

A.3.2. The corner price-floor equilibrium

For $\alpha \geq \tilde{\alpha}$, the producers have to increase the price-floors above $\tilde{w}$ in order to saturate the constraint (14). As long as this leads to the optimal negotiated transfers (7), the minimum symmetric wholesale price which satisfies this constraint is $\overline{w} = \frac{1-a\alpha-b(1-\alpha)}{2-\alpha(1+a-b)-b}$. Setting this price in stage 1 sustains an equilibrium for $\tilde{\alpha} \leq \alpha \leq \overline{\alpha} = \frac{2-b}{3-b}$, with producers' equilibrium profits $\overline{\Pi_K} = \frac{2(1-a)\alpha(1-\alpha)}{(1+a)(1+b)(2-\alpha(1+a-b)-b)^2}$.

Assume that B sets $w_B = \overline{w}$ and A deviates by setting $w_A \leq \overline{w}$. If $t_{Ki} \leq (2-b)w_K - 1 + b$, all retail prices are constrained in stage 3, even in case of a failure in a negotiation, and producer A anticipates the profit $\Pi_A^d = \frac{2(1-a(1-\overline{w})-w_A)((2-b)w_A-1+b)}{(1-a^2)(1+b)}$, which is maximum for $w_A^d = 1-\frac{1}{2(2-b)}-\frac{a(1-\alpha)}{2(2-\alpha(1+a-b)-b)}$. If $\alpha \leq \overline{\alpha}$, $w_A^d \geq \overline{w}$ and no deviation of this type is profitable for A. We show in Allain and Chambolle (2010) that α defines the threshold below which there is no profitable deviation in the first two stages.

A.3.3. The corner transfer equilibrium

The unit price $w_A = w_B = \hat{w}$ sustains an equilibrium for $\overline{\alpha} \leq \alpha \leq \hat{\alpha} = \frac{2(2-b)}{4-b}$ where each pair negotiates limit transfers $\hat{t} = (2-b)\hat{w} - 1 + b$. First, if both producers have set the unit price $\hat{w}$ in stage 1, and all other pairs' negotiations outcomes in stage 2 are the optimal transfer $\hat{t}$, the unique solution of the Nash condition of the negotiation for the last pair is the corner solution $\hat{t}$ as long as $\alpha \leq \hat{\alpha}$. Second, if B chooses $\hat{w}$ in stage 1, the best response of A is to set the same unit price.

A.4. Two-part tariffs: deviations in stage 1

A producer, say A, does not deviate from the price-floor strategy by setting a lower price-floor (*e.g.* $w_A = 0$) such that retail prices are unconstrained in stage 3: In that case, prices remain constrained at w_B for B in stage 3 but not for product A; Solving the corresponding Nash conditions gives the optimal tariffs in stage 2: $t_{Ki} = 0$. The maximum deviation profit for A is thus $\Pi_A^d = \frac{2\alpha(1-b)(1-a)}{(1+a)(1+b)(2-b)^2}$ which is less than $\Pi_K^{PF}(t=0)$, the minimum profit A gets in the price-floor equilibrium: the deviation is not profitable.

A.5. Robustness and extensions

A.5.1. Incomplete breakdown

A.5.1.1. No restriction case. In case of a breach between K and i, i may still sell product K at a cost w_K. The optimal final prices are then: $p_{Ki}^{BR} = \frac{(1-b(1-p_{Kj})+w_K)}{2}$ and $p_{Li}^{BR} = \frac{(1-b(1-p_{Lj})+t_{Li})}{2}$. Demand for product Ki is positive if and only if, with $P = (p_{Ki}^{BR}, p_{Kj}, p_{Li}^{BR}, p_{Lj})$:

$$D_{Ki}(P) \geq 0 \Leftrightarrow w_K \leq \widehat{w_{Ki}}\left(p_{Kj}^a, p_{Lj}^a, t_{Li}^a\right) \equiv 1-b\left(1-p_{Kj}\right) + ab\left(1-p_{Lj}\right) - a(1-t_{Li}) \qquad (16)$$

- If $w_K \leq \widehat{w_{Ki}}(p_{Kj}, p_{Lj}, t_{Li})$, i thus sells both products. The status-quo profits are then, with $P = (p_{Ki}^{BR}, p_{Kj}, p_{Li}^{BR}, p_{Lj})$: $\Pi_i^{SQ} = (p_{Ki}^{BR} - w_K)D_{Ki}(P) + (p_{Li}^{BR} - t_{Li})D_{Li}(P) - F_{Li}$ and $\Pi_K^{SQ} = w_K D_{Ki}(P) + t_{Kj}D_{Kj}(P) + F_{Kj}$. Solving the game with these status-quo profits yields the following equilibrium outcomes: $w^{*s} = \frac{2(1-a)(1-b)}{(2-\alpha)(2-b)}$, $t^{*s} = 0$, $F^{*s} = \frac{w^{*s}(4(1-a(1-b)-w^{*s}) + 2\alpha w^{*s} - b(4-(2-\alpha)w^{*s})}{4(1-a^2)(2-b-2b^2+b^3)}$. Final prices are unchanged: $p^{*s} = p^{TP} = \frac{1-b}{2-b}$. Condition (16) is satisfied. Producers' profit is $\Pi_K^{*s} = \frac{2(1-a)(1-b)}{(1+a)(2-\alpha)(2-b)^2(1+b)}$. It is larger than under *CB*.
- If $w_K > \widehat{w_{Ki}}(.)$, it is not profitable for i to buy product K if negotiations fail. The status-quo profit and equilibrium outcomes are thus those of the *CB* case. Note that among the *CB* equilibria, only those satisfying $w_K > \widehat{w_{Ki}}\left(p_{Kj}^{TP}, p_{Lj}^{TP}, t_{Li}^{TP}\right) = \frac{2(1-a-b+ab)}{2-b}$ still exist.

A.5.1.2. Price-floor. Assume that final prices are constrained ($p_{Ki} = w_K$) and that the bargaining between A and 1 breaks. Rewriting condition (16) yields a threshold $\underline{t}(w_A, w_B) \equiv 1-b+bw_B-\frac{(1-b)(1-w_A)}{a}$ such that status-quo profits are modified if and only if $t_{B1} \geq \underline{t}(w_A, w_B)$: $\Pi_1^{SQ} = (p_{A1}^{BR} - w_A)D_{A1}(P) + (w_B - t_{B1})D_{B1}(P) - F_{B1}$ and $\Pi_A^{SQ} = w_A D_{A1}(P) + t_{A2}D_{A2}(P) + F_{A2}$, with $P = (p_{A1}^{BR}, w_A, w_B, w_B)$.

Yet for any $a > \frac{1}{2}$, α and b, $t_{PF} < \underline{t}(w_A, w_B)$: all *CB* price-floor equilibria such that $0 < t_{Ki} < t_{PF}$ still exist. We prove in Allain and Chambolle (2010), webappendix that there are no new price-floor equilibria when $a > \frac{1}{2}$.

A.5.2. Secret vs. public contracts

Assume that $a = 0$ (*i.e.* a single producer P) and the outcome of each negotiation is published at the end of stage 2. Without legal restriction, in stage 3, each retailer knows the outcome of all negotiations and retail prices are $p_i = \frac{2-b(1+b)+2t_i+bt_j}{4-b^2}$. Yet in case of failure in negotiation between P and 1 in stage 2, 2 increases its price to the monopoly level $\frac{1+t_2}{2}$. Quantity sold thus decreases, as does P's status-quo profit which is now $\frac{(1-t_2)t_2}{2}$; 1's status-quo profit is still 0. Then, the transfers negotiated and retail equilibrium prices are lower than with secret contracts.

Under the law and without *EPO*, P would choose $\tilde{w} = \frac{1}{2}$ for $\alpha \leq \tilde{\alpha} = \frac{b}{(1+b)}$. EPO modifies status-quo profits: if the unit price set in stage 1 is w, when negotiation breaks with i, j may set his price above w. There exists $\{\underline{w^o}, \overline{w^o}\}$ such that

(i) if $w \leq \underline{w^o}$, retailers' pricing strategies are not constrained in stage 3 ($p_i \geq w$);
(ii) if $\underline{w^o} \leq w \leq \overline{w^o}$, retailers' pricing strategies are constrained in stage 3, unless a negotiation breaks, *e.g.* between P and 1: 2 sets then the optimal monopoly price $p_2^1 = \frac{1+t_2}{2} \geq w$, and the producer's status-quo profits is $\Pi_P^{sq} = t_2\left(\frac{1-t_2}{2}\right)$. The negotiations determine optimal transfers such that P's profit is concave in w.
(iii) if $w \geq \overline{w^o}$ retail prices are constrained in stage 3 and in the status-quo; the optimal transfers are thus $t_i = \frac{\alpha w}{1-b(1-\alpha)}$ and P's profit decreases in w for $w \geq \overline{w^o}$.

We show that $0 \leq \underline{w^o} \leq \overline{w^o} \leq 1$ and $\overline{w^o} \geq 1/2$. Furthermore, $\underline{w^o} \leq 1/2$ for all $\alpha \leq \alpha_{lim} = \frac{b(2-b-b^2)}{2-b^2-b^3}$, with $\alpha_{lim} \geq \tilde{\alpha}$. For all $\alpha \leq \alpha_{lim}$, if P sets the wholesale price $w = 1/2$, retailers are constrained in equilibrium but not in the status-quo case. The profit of P is thus higher, and it increases in w for $w \leq \frac{1}{2}$: the optimal binding wholesale price is in $]\frac{1}{2}, \overline{w^o}]$. P is better off with a binding wholesale price larger than $\tilde{w} = \frac{1}{2}$ and in a wider zone than without EPO (at least for $\alpha \leq \alpha_{lim}$).

Appendix B. Supplementary data

Supplementary data to this article can be found online at doi:10.1016/j.ijindorg.2010.07.006.

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