Aufsätze in Wettbewerbsökonomik
(Essays in Competition Economics)

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Acknowledgments and Gratitude. This dissertation consists of three essays on three topics in competition economics. I thank the co-authors of the first two essays for the good cooperation. Moreover, I thank colleagues and professors for the support, in particular Yossi Spiegel and Konrad Stahl for the advice.

Inhaltsverzeichnis

General Introduction

This thesis consists of three essays in the field of competition economics. Chapter 1 contains an essay on resale price maintenance, co-authored by Johannes Muthers, doctoral student at the University of Würzburg. Chapter 2 contains an essay on strategic backward integration, co-authored by Lars-Hendrik Röller and Konrad Stahl. Chapter 3 contains an essay on the design of damage compensations in case of competition law infringements such as price cartels.

Each of the three essays is built around a game-theoretical model that is used to analyze how the allocation of rights to profits and control over strategies within a vertical chain influences the market outcome. The models provide insights in how arrangements, such as resale price maintenance, can relax competition without increasing efficiency – contrary to what is often argued in the existing literature. This yields new arguments to competition policy for how to treat resale price maintenance, partial backward ownership and cartel damage claims. Investigating the potential effects of such arrangements is in line with the more economic approach in competition policy.

Game-theoretical models are helpful to structure and focus the thinking about the complex interactions within vertically related markets. Yet, it is important to be aware of the underlying explicit and implicit assumptions and thus limitations when using their implications, both in competition policy and empirical tests of the theory.

Summary of the essay on resale price maintenance and manufacturer competition for retail services. In the essay on resale price maintenance, we investigate the incentives of manufacturers with common retailers to use resale price maintenance (RPM). We show that if retail price competition is intense, manufacturers use minimum RPM to induce favorable services through higher retail margins, whereas they use maximum RPM to reduce double marginalization in case of weak retail competition. Compared to no RPM, retail prices increase if minimum RPM is used and decrease if maximum RPM is used. The use of minimum RPM can collectively hurt manufacturers although total industry profits increase. The reason is that RPM intensifies the competition for favorable services. With minimum RPM, diverting sales away from the other manufacturer is less costly than without RPM as the manufacturer directly controls the retail margin.

Moreover, we show that the ability to use minimum RPM increases with the market power of a manufacturer. In case of manufacturers with different degrees of market power, the resulting asymmetric use of RPM tends to increase the asymmetry in margins and thus services. If retail price competition is strong, consumers are matched with the high priced product too often.

Finally, we show that although minimum RPM increases retail margins, it can reduce the incentives of retailers to invest in the quality of their matching services. The reason is that with RPM retailers have stronger ex-ante incentives to be uninformed about the consumers' preferences over the products. When less informed about product characteristics and match values, retailers perceive the products as less differentiated. Hence, manufacturers compete harder for favorable services when retailers are less informed and thus offer more attractive wholesale prices to the retailers. As manufacturers compete more directly for favorable sales services with RPM, retailers invest less in information about consumer preferences than without RPM. These results challenge the service argument as an efficiency defense for minimum RPM.

Summary of the essay on strategic backward integration. In the essay on backward integration, we analyze the effects of downstream firms' acquisitions of passive ownership in an efficient upstream supplier. Passive ownership involves pure cash flow rights, i.e. claims on the target's profits only, without controlling its decisions. We look at the pricing decisions of firms in a horizontally differentiated downstream market, and in an upstream homogeneous product market where firms produce at differing levels of marginal costs.

With an increasing participation in the profits of that efficient upstream supplier, the acquiring downstream firm's effective input price decreases as it receives a part of it back through the participation in the supplier's profits. The upstream supplier can thus increase the price he charges that downstream firm. With upstream competition, the effective price charged to the downstream firm cannot exceed the second efficient firm's marginal cost. Hence, the effective equilibrium upstream prices are not affected by passive backward ownership.

Yet, as the downstream competitors are naturally served by the same efficient upstream firm, the acquirer also incorporates the effect of its own actions on the downstream competitors' sales. Its participation in the upstream supplier's sales to competitors reduces its incentive to steal from the competing firms. It thus raises its price above the price under vertical separation. Strategic complementarity in turn induces all downstream competitors to increase their prices. Double marginalization is enhanced.

Whereas full vertical integration would lead to decreasing, passive backward ownership leads to increasing downstream prices and is more profitable, as long as competition is sufficiently intense. Downstream acquirers strategically abstain from vertical control, inducing the efficient supplier to commit to high prices. All results are sustained when upstream suppliers are allowed to charge observable two part tariffs.

For competition policy, it is important to recognize that controlling backward ownership does not necessarily raise more competitive concerns than passive backward ownership, but that indeed the reverse can be the case.

Summary of the essay on the design of cartel damage compensations. In the third essay, I study the effects of cartel damage compensation claims, which are supposed to increase deterrence, compensate losses and increase efficiency. Forcing infringers to pay claimants the profit lost due to the infringement is the ex-post measure that achieves full compensation. By investigating ex-ante incentives, I show that such a Lost Profit Compensation can have completely undesirable allocative effects. These effects arise if there is fringe competition upstream even if there is a cartel, e.g., due to imports or in-house production.

In particular, Lost Profit Compensation claims of downstream firms against upstream cartelists that do not monopolize the market can increase consumer prices. The reason is that once a downstream firm expects a positive compensation, it is willing to purchase from the cartelists at input prices above the competitive fringe cost. Hence the cartelists increase input prices and, in best response to that, consumer prices increase as well. This result is sustained with two-part tariffs as long as exclusivity clauses are not enforceable and there is sufficient price competition downstream. Moreover, the expected cartel profits can increase due to the Lost Profit Compensation. The reason is that the claims relax the constraints of the contracting problem between the upstream cartelists and each downstream firm. Hence, industry profits increase and the cartelists can appropriate part of that.

Another surprising finding is that suppliers of cartelists can be worse off when eligible to compensation. The reason is that suppliers have to lower the prices that they charge downstream cartelists to compensate these for expected compensation payments when trading with them, as otherwise the cartelists source from the fringe. Yet the lower are the marginal input prices of the efficient upstream firms, the more attractive it is for the cartelists to source only one input from the fringe and order more from the other upstream firm at the reduced price. Hence, the upstream firms need to lower their prices even more, which benefits the cartelists, but hurts the suppliers.

All these results, which apply both for cartels and excessive pricing of dominant firms, call for a more careful approach towards private enforcement of competition law.

KAPITEL 1

Resale price maintenance and manufacturer competition for retail services

Matthias Hunold[1][2] and Johannes Muthers[3]

Abstract. We investigate the incentives of manufacturers with common retailers to use resale price maintenance (RPM). When retailers provide product specific pre-sales services such as product information, minimum RPM is used by manufacturers who compete for favorable services. Minimum RPM increases consumer prices, but can create a prisoner's dilemma for manufacturers without increasing, and possibly even decreasing the overall service level. If manufacturer market power is asymmetric, minimum RPM tends to distort the allocation of sales services towards the high-priced products of the manufacturer with more market power. These results challenge the service argument as an efficiency defense for minimum RPM.

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[2]We thank participants at the JEI 2010, the MaCCI 2011 annual conference, the IIOC 2011, the IO Workshop Lecce 2011, the 2011 annual conferences of the EARIE and the Verein für Socialpolitik, and at seminars in Düsseldorf, Mannheim, Turunc and Würzburg, Firat Inceoglu, Martin Peitz, David Sauer, Norbert Schulz, Yossi Spiegel, Konrad Stahl, and Sebastian Wismer for helpful comments and suggestions.
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1.1. Introduction

There is a long debate on whether resale price maintenance (RPM) should be legal. Although it is established that RPM can facilitate collusion,[4] the US Supreme Court overturned the long standing per-se illegality of minimum RPM with the Leegin decision of 2007 and decided that minimum RPM has to be judged under the rule of reason.[5] The court argued that per-se illegality is not justified because minimum RPM can also benefit consumers. In the EU, minimum and fixed RPM are still considered core restrictions of competition.[6] The guidelines now state, however, that inducing retailers to provide pre-sales services may constitute an efficiency defense for minimum RPM.

The view that RPM may be beneficial is supported by economic theory: Retailers do not internalize the positive effect of their services on competing retailers and the manufacturer. A manufacturer uses minimum RPM to provide retailers with incentives for services that would otherwise be under-provided, also from a social point of view. This has been argued by Telser (1960) for sales advice, by Marvel and McCafferty (1984) for quality certification and by Winter (1993) for shopping time reduction. Whereas these models focus on a *single* manufacturer, we often observe that minimum RPM is imposed by manufacturers on retailers who carry a wide range of different brands. Examples include books, clothing, contact lenses, hearing devices, and household appliances.[7] Retailers of such products frequently offer services such as pre-sales advice.

A particular example is the aforementioned seminal Leegin case where competing manufacturers of women apparel sold through common retailers. Elzinga and Mills (2009) defend Leegin's use of minimum RPM by emphasizing the role of sales associates with a quote of Bear Stearns Equity Research: *"[I]t is critical that sales associates know the merchandise, have an understanding of the tastes and preferences of the target customer, and can offer fashion and wardrobing advice."* Elzinga and Mills conclude that *"Leegin's policy bears none of the marks of those economic theories of RPM that have anti-competitive effects".*[8]

With this paper, we contribute a theory of how minimum RPM can hurt all consumers – and even the manufacturers – when manufacturers compete for retail services. We show that manufacturers use RPM to divert retailer services away from other to own products even when the overall service level is not affected. Although minimum RPM increases prices, it can reduce retailers' incentives to invest in their services. Moreover, when

[4]See Marvel and McCafferty, 1984; Jullien and Rey, 2007; Rey and Vergé, 2010. RPM can also be used by a manufacturer to exclude more efficient rivals (Asker and Bar-Isaac, 2011 and references therein).

[5]Minimum RPM implies that retailers may not sell below a specific price. Leegin Creative Leather Products, Inc. v. PSKS, Inc., 551 U.S., 2007.

[6]Hardcore restrictions are presumed illegal with the possibility for the firm to plead an efficiency defense. See Commission Regulation (EU) No 330/2010 (2010), Article 4a and the EU Guidelines on Vertical Restraints (2010/C 130/01); Paragraph 223 of the guidelines states that an efficiency defense in terms of Article 101,3 TFEU (Treaty on the Functioning of the European Union) is possible also for minimum and fixed RPM. Par. 224 and 225 contain examples of potentially detrimental and beneficial practices.

[7]See Elzinga and Mills (2009) for a discussion of services in the Leegin case. Other recent RPM cases with common retailers and products where pre-sale advice potentially matters include contact lenses (see fine "Bußgeldbescheid B 3 - 123/08," German Federal Cartel Office, September 2009), hearing devices (press release "Bundeskartellamt verhängt Bußgeld gegen Hörgerätehersteller Phonak GmbH," German Federal Cartel Office, October 2009.), and household appliances (see press release "Bundeskartellamt verhängt Bußgelder wegen unzulässiger Preisbindung," German Federal Cartel Office, 2003).

[8]We agree with Elzinga and Mills (2009) that the existing service arguments are essentially pro-competitive. One should bear in mind, though, that Elzinga was a testifying expert in the Leegin case for the pro-rule-of-reason side. We thank an anonymous referee for pointing this out.

manufacturers have asymmetric market power, minimum RPM induces retailers to divert services towards products of manufacturers with more market power.

We set up a model with two differentiated manufacturers and two common retailers. Each consumer is interested in buying only one of the products, but is initially unaware of which product fits his preferences best. Similar to Mathewson and Winter (1984), we assume that consumers rely on the retailers' services to match them with products through recommendations, demonstrations, and general advice. Without RPM, each manufacturer can only use the wholesale price to influence both, the price consumers have to pay as well as the retail margin, and thereby service incentives. RPM as an additional instrument allows a manufacturer to target consumer prices and retail margins independently.

In a first step we hold each retailer's overall service level fixed and only allow retailers to shift services between the products. To focus on competition for services, we initially abstract from direct price competition between manufacturers. We show that if retail price competition is intense, manufacturers use minimum RPM to induce favorable services through higher retail margins, whereas in case of weak retail competition they use maximum RPM to reduce double marginalization. Instead, with RPM the intensity of retail price competition does not affect the equilibrium outcome as manufacturers fix the retail margins. For the incentives to deviate from the maintained price and cut or increase the retail price, however, it matters whether a retailer can attract many customers from its competitor or not, which yields either minimum or maximum RPM. Compared to no RPM, retail prices increase exactly if minimum RPM is used and decrease if maximum RPM is used, which is a non-trivial result as both wholesale and retail prices generally depend on whether RPM is employed.[9]

Interestingly, minimum RPM can collectively hurt the manufacturers although total industry profits increase. The reason is that RPM intensifies the competition for favorable services. With minimum RPM, diverting sales away from the other manufacturer is less costly than without RPM as the manufacturer directly controls the retail margin. Indeed, with linear wholesale tariffs and linear demand, minimum RPM implies a reduction in manufacturers' profits and benefits retailers, when compared to no RPM.

This prisoner's dilemma has some resemblance with those of dissipative advertising and paying for prominence (Armstrong and Zhou, 2011), but is nevertheless distinctively different: First, minimum RPM, though intensifying manufacturer competition, increases industry profits, whereas dissipative advertising is by definition wasteful and undesirable for the industry. Second, the benchmark for the dilemma is that manufacturers compete in wholesale prices for favorable services when competing retailers set retail prices, unlike the benchmark of no retail margins and no service incentives in Armstrong and Zhou (2011). Our dilemma result is important for competition policy because it contradicts the gist of the existing literature as well as policy debates that minimum RPM is beneficial for manufacturers, when compared to no RPM.

In a second step, we allow for asymmetric market power by introducing a third manufacturer who offers a perfect substitute to the product of one of the manufacturers, say B. Manufacturer B cannot offer supra-competitive margins to the retailers because the third manufacturer would profitably undercut. As a consequence, only manufacturer A can effectively use RPM as only manufacturer A has market power. The resulting asymmetric

[9]For example, Perry and Besanko (1991) show that minimum RPM may yield lower prices and maximum RPM higher prices compared to no RPM.

use of RPM tends to increase the asymmetry in margins and thus services. If retailer competition is sufficiently strong, consumers are matched with the high priced product too often. Banning RPM can reduce this distortion.

In a third step, we allow each retailer to initially invest in the overall level of its matching services. One may think of educating sales personnel to become more aware about the product characteristics and consumers' preferences. Investing more yields more precise information about which product suits which consumer. Although conventional wisdom suggests that minimum RPM, which increases the retail margins, induces retailers to invest more in service, we find that equilibrium investments are lower with minimum RPM than without it. The reason is that with RPM retailers have stronger ex-ante incentives to be *uninformed* about the consumers' preferences over the products. When less informed about product characteristics and match values, retailers perceive the products as less differentiated. Hence, manufacturers compete harder for favorable services when retailers are less informed and thus offer more attractive wholesale prices to the retailers. As manufacturers compete more directly for favorable sales services with RPM, retailers invest less in information about consumer preferences than without RPM.

As mentioned earlier, in most of the literature on service and RPM the authors focus on a *single* manufacturer and argue that minimum RPM allows the retailer to internalize the positive effects of its services on the manufacturer's profits (Winter, 1993) or on the sales of other retailers (Telser, 1960).[10] From a social welfare perspective, a monopoly manufacturer may nevertheless induce too little or even too much services, as it aligns services with preferences of marginal consumers rather than the average consumer purchasing. The dominating conclusion of this literature on RPM and services is that the positive effects of RPM are expected to prevail; see Winter (2009) for a recent discussion. By studying *two* manufacturers and two common retailers who provide matching services, we show that all consumers can be worse off with RPM.

Perry and Besanko (1991) study how two manufacturers use minimum RPM to compete for exclusive (i.e., single product) retailers. They argue that prices are lower with minimum RPM than with maximum RPM. Their comparison is special, however, in that they compare minimum RPM with franchise fees to maximum RPM with linear wholesale tariffs. Similarly, Shaffer (1994) compares two-part tariffs and no RPM with linear tariffs and RPM in case of one strategic manufacturer. Focusing on linear tariffs, we instead endogenously determine whether manufacturers impose minimum or maximum RPM on common retailers and find that prices are higher if manufacturers use minimum RPM.

Our understanding that common retailers divert demand to more profitable products is related to the articles of Raskovich (2007) as well as Inderst and Ottaviani (2011) on product advice, which also rely on linear tariffs. However, these authors do not consider price competition between retailers and the incentives of a manufacturer to relax this competition by using RPM, which is central to our argument.

We are aware of two articles on RPM in a setting with differentiated manufacturers and common retailers, but neither addresses service. Dobson and Waterson (2007) study bilateral Nash-bargaining between each manufacturer-retailer pair over a linear wholesale price. They find that if retailers have all the bargaining power, retail prices are higher with

[10]Several articles study RPM in the context of spillovers in case of stock-outs (Deneckere et al., 1997, 1996; Krishnan and Winter, 2007; Wang, 2004). Wang actually has two manufacturers, but exclusive retailers in Bertrand competition and finds that total surplus increases with RPM.

RPM. If, instead, manufacturers possess all the bargaining power, retail prices are lower with RPM.[11] Rey and Vergé (2010) show that the monopolization result of Bernheim and Whinston (1985) with a common retailer and two-part tariffs offered by manufacturers can be extended to competing common retailers if manufacturers can additionally use RPM.

1.2. Model

Two symmetric manufacturers ($i = A, B$) sell their differentiated products to two symmetric common retailers ($k = 1, 2$) who in turn sell the products to final consumers. Each consumer is interested in buying only one of the two products, but is initially unaware of which product fits his preferences best. Similar to Mathewson and Winter (1984), we assume that consumers rely on the retailers' services to match them with products through recommendations, demonstrations, and general advice.

We assume that more retailer service allocated to product i increases the demand for this product at both retailers. Initially, we will assume that the overall level of services that each retailer can provide is fixed; in Subsection 1.3.4 we relax this assumption and endogenize the overall level of services that the retailers offer. Hence, if retailer k allocates to product A a fraction $s_k \in [0, 1]$ of his services, the fraction he allocates to product B is $1 - s_k$. If $s_k > (<)\ 1/2$, retailer k biases his services towards product A (B). If $s_k = 1/2$, retailer k allocates services equally to the two products.

Using $p_{i,k}$ to denote the price retailer k charges for product i, and using $-k$ to denote the rival retailer, we assume that the demand for product i at retailer k is given by

$$D_{i,k} \equiv M_i(s_k, s_{-k})\, d_{i,k}(p_{i,k}, p_{i,-k}), \tag{1.2.1}$$

where $\frac{\partial d_{i,k}}{\partial p_{i,k}} < 0$, $\frac{\partial d_{i,k}}{\partial p_{i,-k}} > 0$ and $|\frac{\partial d_{i,k}}{\partial p_{i,k}}| > \frac{\partial d_{i,k}}{\partial p_{i,-k}}$.[12] Notice that $d_{i,k}(p_{i,k}, p_{i,-k})$ depends only on the prices that the two retailers charge for product i, but it is independent of the prices charged for product $-i$. Hence there is no direct price competition between the manufacturers. This feature of our model ensures that manufacturers' strategic delegation of pricing to retailers does not affect our results as in Bonanno and Vickers (1988) and Rey and Stiglitz (1995), so we can isolate the effects of service competition. We show in Subsection 1.3.6 that relaxing this assumption yields qualitatively the same results.

The demand structure stated in (1.2.1) allows us to separate the pricing of the products from the service decisions. One can think about $M_i(s_k, s_{-k})$ as the mass of consumers who consider buying product i given the services that the two retailers allocate to product i, and $d_{i,k}(p_{i,k}, p_{i,-k})$ as the quantity of product i that such a consumer buys from retailer k. The following Example contains a micro-foundation that is consistent with this demand system.

Example 1.1. In line with Mathewson and Winter (1984), assume that only a consumer who is presented by the retailer with a product learns about the product's existence and its characteristics. Assume that consumers initially randomly select either retailer to get informed about products. Each consumer will only consider buying if the product is suitable. If the product is not suitable, assume for simplicity that consumers do not

[11] Dobson and Waterson do not analyze cases with intermediate bargaining power and whether manufacturers would like to use RPM. See their footnote 26.

[12] We will suppress the arguments of (1.2.1) when this does not cause confusion.

consider the other product.[13] Hence a retailer has an incentive to present each consumer with the product which actually suits him. In line with the service and RPM literature, in particular also Mathewson and Winter (1984), we moreover assume that price search is costless, so consumers know the prices of a product at both retailers once they have learned the product characteristics. Each retailer decides which product to present based on noisy information about the consumer's preferences. Each retailer knows the probability $q \sim U[0,1]$ with which a particular consumer likes product B, and correspondingly product A. Both retailers have the same information about a consumer. Each retailer's product presentation decision (which is a function from q to the space of products) boils down to choosing a threshold probability s_k, such that the retailer presents consumers with product A for $q < s_k$ and with product B for $q > s_k$. Assuming that that each consumer who is matched to a specific product has linear-quadratic utility over buying units of that product at either retailer,[14] we derive the following demand parametrization: $M_A = \sum_k (2s_k - s_k^2)$, $M_B = \sum_k (1 - s_k^2)$ and $d_{i,k} = 1 - (\beta + \gamma)\, p_{i,k} + \gamma\, p_{i,-k}$ with $\beta, \gamma > 0$. See Appendix B for more details.

Throughout we maintain the following assumptions for the reduced form demand stated in (1.2.1):

Assumption 1. *M_i is strictly concave with $\frac{\partial M_A}{\partial s_k} > 0 > \frac{\partial M_B}{\partial s_k}$ and symmetric around $1/2$: $M_i(s_1, s_2) = M_{-i}(1 - s_1, 1 - s_2)$.*[15]

The concavity and symmetry of $M_i(s_1, s_2)$ imply that allocating services unevenly to the two products reduces the aggregate $M_A + M_B$.[16] Furthermore,

Assumption 2. *The effect of a retailer's service allocation on M_i is independent of the other retailer's service: $\frac{\partial^2 M_i}{\partial s_1 \partial s_2} = 0$, $i = A, B$.*

Finally, to ensure that there is a unique equilibrium when retailers set prices, we assume that the Hessian matrix of $d_{i,k}$ has a negative and dominant main diagonal:

Assumption 3. $\frac{\partial^2 d_{i,k}}{(\partial p_{i,k})^2} \leq 0$, $\frac{\partial^2 d_{i,k}}{(\partial p_{i,-k})^2} \leq 0$, $\frac{\partial^2 d_{i,k}}{\partial p_{i,k} \partial p_{i,-k}} \geq 0$, $\left| \frac{\partial^2 d_{i,k}}{(\partial p_{i,k})^2} \right| \geq \frac{\partial^2 d_{i,k}}{\partial p_{i,k} \partial p_{i,-k}}$.[17]

We assume that services are non-contractible and we study how the manufacturers can affect the retail services through RPM. We assume that if manufacturer i imposes RPM and restricts the retail price to p_i, it must be maintained by both retailers.[18] The sequence of events is as follows:

(1) Each manufacturer $i \in A, B$ sets a wholesale price w_i, and optionally fixes p_i under RPM.

[13] This can for example be motivated with increasing search costs and is particularly meaningful if there are more than two products, as is typically the case in practise.

[14] This assumption implies that consumers are not locked in the retailer who informs them. It is not necessary, but simplifies the computations.

[15] Strict concavity is convenient but our results are also valid as long as $aM_i + bM_{-i}$ is strictly quasi-concave for $a, b > 0$ and $s_1, s_2 \in (0, 1)$.

[16] The following assumptions on derivatives apply strictly only for the relevant range where M_i and $d_{i,k}$ are positive. Strict concavity of M_i in s_k implies strict concavity of $M_A + M_B$. By symmetry, $M_B(s_1, s_2) = M_A(1 - s_1, 1 - s_2)$. Thus $\frac{\partial}{\partial s_k}(M_A(s_1, s_2) + M_B(s_1, s_2)) = \frac{\partial}{\partial s_k}(M_A(s_1, s_2) + M_A(1 - s_1, 1 - s_2))$. This derivative is zero at $s_k = 0.5$, which by strict concavity is the unique maximizer of $M_A + M_B$.

[17] Assumption 3 implies that demand is weakly concave in prices.

[18] We focus here on a symmetric treatment of the retailers, as is common in the literature on RPM. Within the present setting, this is also optimal for each manufacturer.

(2) Each retailer $k \in 1, 2$ observes the manufacturers' prices, chooses the service allocation s_k, and sets its own retail prices $p_{i,k}$. Under RPM, $p_{i,k} = p_i$.
(3) Demand is realized.

Similar to Inderst and Ottaviani (2011) and Dobson and Waterson (2007), we will consider linear wholesale tariffs; this avoids non-existence problems as in Rey and Vergé (2010) and avoids to confound our service effects with their common agency effects.[19]

Normalizing all costs of manufacturing and retailing to zero, the profit of manufacturer i is given by

$$\pi_i \equiv w_i \sum_{k=1,2} D_{i,k}, \tag{1.2.2}$$

and the profit of retailer k by

$$\Pi_k \equiv \sum_{i=A,B} (p_{i,k} - w_i) D_{i,k}. \tag{1.2.3}$$

In the next section we solve the game for subgame perfect Nash equilibria, without and with RPM. We focus on symmetric equilibria, apart from Subsection 1.3.5, where we allow for asymmetric market power.

1.3. Analysis

1.3.1. Equilibrium without resale price maintenance. Assume for this subsection that manufacturers can only set wholesale prices, but cannot use RPM. For given wholesale prices, each retailer k chooses $p_{A,k}$, $p_{B,k}$ and s_k to maximize Π_k. The first order condition (FOC) for the retail price is

$$\frac{\partial \Pi_k}{\partial p_{i,k}} = d_{i,k} + (p_{i,k} - w_i) \frac{\partial d_{i,k}}{\partial p_{i,k}} = 0, \tag{1.3.1}$$

which is given our assumptions independent of s_1 and s_2 as well as of the wholesale and retail prices of product $-i$. Denote by $p_i^*(w_i)$ the equilibrium retail price for product i. The dominance of the own price effect and the assumption on weak concavity of $d_{i,k}$ imply that the pass through rate, $\partial p_i^*/\partial w_i$, is positive and below one. Hence the retail profitability $(p_i^* - w_i)\, d_{i,k}\,(p_i^*, p_i^*)$ decreases with w_i.

The FOC with respect to s_k is

$$\frac{\partial \Pi_k}{\partial s_k} = \frac{\partial M_i}{\partial s_k} (p_{i,k} - w_i)\, d_{i,k} + \frac{\partial M_{-i}}{\partial s_k} (p_{-i,k} - w_{-i})\, d_{-i,k} = 0. \tag{1.3.2}$$

The FOC (1.3.2) together with the strict concavity of M_i (Assumption 2) implies that retailer k sets s_k to shift demand towards the more profitable product. If the products are equally profitable, each retailer maximizes profits by maximizing the mass of attracted consumers: $M_A + M_B$. From the strict concavity and symmetry of M_A and M_B follows that each retailer chooses $s_k = 1/2$ as this maximizes $M_A + M_B$.

Using $s_k^*(w_A, w_B)$ to denote the equilibrium service decisions and by $M_i^*(w_i, w_{-i}) \equiv M_i\,(s_1^*, s_2^*)$ the corresponding mass of attracted consumers, we summarize in

Lemma 1.1. *Without RPM, there exists a unique equilibrium of the continuation game – starting in stage 2 – in which the retailers' decisions are symmetric. In particular*

[19] For delegated common agencies Rey and Vergé point out that common agency equilibria fail to exist because the binding participation constraint for a retailer to sell the product of a manufacturer can always be profitably undermined by the other manufacturer.

(1) *the retail price p_i^* increases in w_i and is independent of w_{-i} and s_k.*
(2) *the retail profitability $(p_i^* - w_i)\, d_{i,k}\,(p_i^*, p_i^*)$ decreases in w_i.*
(3) *the equilibrium matches M_i^* decrease in w_i. If $w_A = w_B$, then $s_1^* = s_2^* = 1/2$.*

Proof. All proofs are in Appendix A. □

We now turn to stage 1. Taking the retailer continuation equilibrium into account, each manufacturer solves

$$\max_{w_i} \pi_i = w_i\, M_i^*\,(w_i, w_{-i}) \sum_k d_{i,k}(p_i^*(w_i),\, p_i^*(w_i)), \tag{1.3.3}$$

facing a trade-off between price and quantity.

Equation (1.3.3) shows that an increase in w_i increases the manufacturer's margin, but decreases demand in two ways: First, the retail profitability decreases so that retailers allocate services to product $-i$ and thus attract fewer consumers to product i. Second, the retail prices of product i increase and hence the attracted consumers buy less quantity of that product.

The FOC implied by (1.3.3), evaluated at symmetric wholesale prices $w_A = w_B = w^N$ and symmetric retail prices $p_{i,k} = p^N$ for all i, k, can be written as

$$w^N \quad = - \quad \frac{d_{i,k}(p^N, p^N)}{\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right)\frac{\partial p_i^*}{\partial w_i} + \lambda\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\frac{\partial p_i^*}{\partial w_i}\right)}, \tag{1.3.4}$$

and the FOC (1.3.1) evaluated at symmetric retail prices as

$$p^N = p_i^*(w^N) = w^N - \frac{d_{i,k}(p^N, p^N)}{\partial d_{i,k}(p^N, p^N)/\partial p_{i,k}}, \tag{1.3.5}$$

where

$$\lambda \quad = \quad \frac{\partial M/\partial s_k}{M} \times \frac{\partial M/\partial s_k}{-\partial^2 M/\partial s_k^2} > 0 \tag{1.3.6}$$

and $M \equiv M_A(1/2, 1/2) = M_B(1/2, 1/2)$.

In what follows, we restrict attention to demand functions that give rise to quasi-concave reduced-form manufacturer profits and a stable interior equilibrium such that implicit differentiation of the manufacturer FOCs can be applied.[20]

The lower λ, the more consumers the retailer loses when focusing service on one product. The first factor of λ measures the fraction of the mass of consumers that is shifted by a change in s_k. The second factor measures how much total mass is lost for a given shift of consumer mass. The higher the second derivative of M_i is in absolute value, the lower the gain in consumers compared to the loss of attracted consumers for the other product, and the lower is λ. In summary, a lower λ means that the products are less substitutable for a retailer when allocating services.

For $\lambda = 0$, products are not substitutable for a retailer and the equilibrium prices implied by (1.3.4) and (1.3.5) are as if there were no retail service decisions. As λ increases, manufacturer competition for favorable retail services drives the wholesale price w^N towards zero and increases the retail margin $p^N - w^N$.

[20] This holds for the parametrization in Example 1.

PROPOSITION 1.1. *In any symmetric equilibrium without RPM the wholesale prices* w^N *and retail prices* p^N *are defined by* (1.3.4) *and* (1.3.5)*, and service is allocated symmetrically, i.e.,* $s_k^* = 1/2$. *The prices* w^N *and* p^N *decrease in* λ*, whereas retail profits increase in* λ.

For the demand parametrization in Example 1 the symmetric equilibrium is unique.[21]

1.3.2. Equilibrium with resale price maintenance. For this subsection, assume that RPM is enforceable. Both manufacturers have weak incentives to use RPM because a manufacturer who unilaterally fixes the retail price can reproduce the equilibrium prices without RPM by setting $p_i^R = p^N$ and $w_i^R = w^N$ and is thus at least as well off as without RPM. Manufacturer i fixing both w_i and p_i faces the following trade-offs:

- increasing w_i increases its own margin, but decreases the retail margin $p_i - w_i$ and thus induces retailers to allocate services away from product i;
- increasing p_i increases the retail margin and thus retailers allocate more services to product i. A higher p_i also implies that attracted consumers buy less quantity of product i.

With RPM, a manufacturer can adjust its wholesale price to trade off its own margin and retail service incentives without affecting the retail price. With the additional instrument of RPM the manufacturer can thus separate the product's optimal retail pricing from the provision of service incentives to the retailers. Hence each manufacturer maximizes joint rents from selling its product by fixing a price of

$$p^M \equiv \arg\max_{p_i} \sum_k p_i \, d_{i,k}(p_i, p_i). \tag{1.3.7}$$

Focusing again on demand functions that give rise to interior solutions yields

PROPOSITION 1.2. *There exists a unique symmetric equilibrium with*

$$p^R = p^M, \quad w^R = \frac{p^M}{1+\lambda}. \tag{1.3.8}$$

Service is allocated symmetrically and the retail margin increases in λ.

Having characterized the equilibrium prices and service decisions both with and without RPM, we now compare them to evaluate the effects of RPM on profits and welfare.

1.3.3. Competitive effects of resale price maintenance. An interesting question is under which circumstances RPM increases or decreases retail prices. With RPM, the retail price always equals p^M, whereas without RPM, the retail price p^N depends on both the intensity of manufacturer and of retail competition. Comparing p^N and p^M yields

PROPOSITION 1.3. *The retail prices under RPM are higher than the prices when no manufacturer uses RPM if and only if*

$$\lambda > \lambda^M \equiv \frac{-\partial\, d_{i,k}(p^M, p^M)}{\partial\, p_{i,k}} \Big/ \frac{\partial\, d_{i,k}(p^M, p^M)}{\partial\, p_{i,-k}} - 1. \tag{1.3.9}$$

[21]For linear $d_{i,k}$ (as in Example 1) the right hand side of (1.3.4) is monotone in the price level, which ensures that w^N and p^N are unique.

Correspondingly, RPM decreases retail prices if and only if the above inequality is reversed. At $\lambda = \lambda^M$, $p^N = p^M$.[22]

The more exchangeable the retailers are from the consumer's perspective, the smaller is the right hand side of (1.3.9) and thus retail price competition. The more exchangeable the products are for the retailers when allocating services, the larger is λ on the left hand side of (1.3.9) and the more intense is the competition of manufacturers for favorable services. Hence, if competition among manufacturers and retailers is sufficiently intense, the price level without RPM is lower than the level with RPM.

We model RPM as fixing the retail price at a particular level. But for competition policy it is important to distinguish the effects of minimum and maximum RPM on retail prices and total surplus. For the distinction of minimum and maximum RPM it is not sufficient to compare the price level with and without RPM and argue that if prices with RPM are higher, then it must be minimum RPM, and maximum RPM otherwise. The reason is that the wholesale prices generally depend on whether RPM is in place or not. For instance, the wholesale price in case of RPM can be lower than without RPM. In the RPM regime, the retailers may thus individually want to decrease the retail price, even if it is fixed below the level they would choose in the case without RPM.

Yet if RPM imposes a binding constraint on retailers, it acts either as a price floor or a price ceiling. Whether the manufacturers use minimum and maximum RPM can thus be identified by answering the question: Would a retailer at the equilibrium prices with RPM benefit from reducing or from increasing its retail price? By evaluating a retailer's marginal profit with respect to its retail prices at the equilibrium values $\{w^R, p^R\}$ we obtain

Proposition 1.4. *In equilibrium, manufacturers use minimum RPM if and only if $\lambda > \lambda^M$. Manufacturers use maximum RPM if and only if $\lambda < \lambda^M$. Compared to the regime without RPM, minimum RPM always increases retail prices and maximum RPM always decreases retail prices. The equilibrium allocation of services is not affected by RPM.*

At $\lambda = \lambda^M$, the equilibria with and without RPM coincide ($p^*(w^N) = p^M$, $w^N = w^R$) and RPM is a superfluous instrument. When raising λ above λ^M, the wholesale prices both with and without RPM decrease (Propositions 1.1 and 1.2). In turn, RPM implies a price floor because each retailer individually prefers to set a price below p^M. Analogously, for $\lambda < \lambda^M$, wholesale prices are higher and maximum RPM restricts the retail price to p^M because retailers individually prefer to raise prices further.

We can derive from Proposition 1.4 a simple optimal policy in case the retail service level for the product category can be assumed to be fixed: forbid minimum RPM because it unambiguously increases retail prices and leaves the equilibrium service allocation unchanged, but allow maximum RPM as it decreases prices. In the next subsection, we investigate the effects of RPM on investments in the overall service level. But before doing so, let us consider the effects of RPM on manufacturer and retailer profits.

[22]Although the symmetric equilibrium is not necessarily globally unique, at $\lambda = \lambda^M$ equation (1.3.9) *uniquely* defines the price p^N. Starting from this locally unique symmetric equilibrium, the monotone comparative statics of p^N in λ allow us to compare the symmetric equilibrium prices with and without RPM globally and unambiguously. However, asymmetric equilibria in which one product has a lower wholesale price and higher service and the other has a higher wholesale price and lower services cannot generally be ruled out.

Are manufacturers better off when minimum RPM is enforceable? Recall that the unilateral introduction of RPM is always weakly profitable for a manufacturer as it yields direct control over the retail margin. However, this additional control induces manufacturers to compete harder for retail services. Collectively, manufacturers can thus be worse off, even if industry profits increase through RPM. The next remark characterizes this case.

Remark 1.1. The equilibrium profit of a manufacturer under the regime with enforceable RPM is lower than under the regime without RPM if $w^R\, d_{i,k}(p^R, p^R) < w^N\, d_{i,k}(p^N, p^N)$.

The inequality in Proposition 1.1 is independent of M_i, which is the same in any symmetric equilibrium. Minimum RPM implies $p^R > p^N$ (Proposition 1.4) and, in turn, lower demand because $d_{i,k}$ decreases when both retail prices increase, i.e., $d_{i,k}(p^R, p^R) < d_{i,k}(p^N, p^N)$. Thus a sufficient condition for minimum RPM to impose a prisoner's dilemma is that the wholesale price is weakly lower with RPM. Unfortunately, with only implicit definitions of w^R and w^N it is difficult to establish general conditions for $w^R \leq w^N$. Using a linear parametrization of $d_{i,k}$, we obtain

Example 1.2. Assume that demand is linear in prices as in Example 1.1. If minimum (maximum) RPM results in equilibrium, the manufacturers' profits are lower (higher) than in the regime without RPM. Retailers benefit from minimum RPM and suffer from maximum RPM (see Appendix A for the derivation).

Without RPM, a manufacturer has to decrease the wholesale price to increase the retail margin. But when faced with lower input costs, the retailers lower the retail prices, which decreases the retail margin again and thereby affects the product's overall profitability. The manufacturer thus targets two goals with only one instrument, which makes it costly for the manufacturer to induce favorable services. Instead, with minimum RPM as another instrument, a manufacturer can prevent retailers from lowering the retail price and in turn manufacturers compete more directly and thus more fiercely for favorable services.

A caveat applies as the dilemma result is derived for linear wholesale tariffs. With two-part tariffs, a manufacturer can generally extract retail rents with an upfront-payment, but has to ensure that a retailer prefers carrying its product over exclusively carrying the other product. This trade-off and thus the retailer's outside option to carrying the product generally depend on whether RPM is used in the industry, hence it is an open question whether the dilemma ceases to exist.[23]

1.3.4. Investments in the service level. For a fixed overall service level, we have shown that manufacturers competing for service use minimum RPM to increase consumer prices even without any welfare benefit. Conventional wisdom suggests that minimum RPM induces retailers to invest more in services. By contrast, we provide an argument how minimum RPM reduces the incentives of retailers to invest in services, although minimum RPM increases the retail margin. Towards this we now allow each retailer to invest in the level (i.e., quality) of its matching services. Retailers decide how much to invest in a new initial stage, after which investments become public knowledge and the game proceeds as before. This timing implies that manufacturers observe the service level and can change prices more easily than retailers can change the service level.

[23]See also footnote 21.

Recall that each consumer likes only one of the products, but is ex-ante uninformed about the existence of the products. The retailer matches each consumer to a product. We build upon Example 1 where a retailer has only imperfect information on which product a consumer likes, and allow each retailer to invest in the quality of this information. For instance, the retailer can train the sales agents to be better informed about the products so that they know which product fits a particular consumer's need.

Formally, each consumer is of one of two types: he either values product A or B, but not both. Each retailer can invest in information precision α_k, which represents the share of consumers whose type the retailer knows with certainty.

A retailer's probability assessment q that a consumer likes product B (and with $1-q$ product A) has full support on $[0,1]$ with mass points of $\alpha_k/2$ at 0 and 1. We assume that the remaining mass $1-\alpha_k$ is uniformly distributed in the interior $(0,1)$ as in Example 1. The parameter s_k is again the cut-off probability such that for higher $q \in (0,1)$ retailer k matches the consumer to product B instead of A. Assuming that the mass of each consumer type at each retailer is 1, the mass of consumers successfully matched to product A as a function of service levels and allocations is given by

$$M_A(\alpha_1, \alpha_2, s_1, s_2) \equiv \sum_{k\in\{1,2\}} \left[\alpha_k + (1-\alpha_k)\, 2\left(s_k - s_k^2/2\right)\right]. \tag{1.3.10}$$

The mass of attracted consumers, M_A, clearly increases in α_1 and α_2 (the same holds for M_B). Note that the assumptions on M_i, i.e., concavity and symmetry around $1/2$, are met. See Appendix B for more details on the derivation of M_A and M_B.

We also maintain the assumption that manufacturers set uniform wholesale prices. The subgame equilibrium prices $\left(p^N, w^N, p^R, w^R\right)$ are characterized as before and are not directly affected by α_k, but only indirectly through λ.[24] For any α_k, $k \in \{1,2\}$, equilibrium service allocations are $s_k^* = 1/2$ as before. The relation between α_k and λ is given by

$$\lambda(\alpha_1, \alpha_2) \equiv \frac{2-\alpha_1-\alpha_2}{6+\alpha_1+\alpha_2} \tag{1.3.11}$$

with $\partial\lambda/\partial\alpha_k < 0$.[25] Let us from now on suppress the arguments of λ and use $\widetilde{M}_i(\alpha_1,\alpha_2) \equiv M_i(\alpha_1, \alpha_2, s_1 = 1/2, s_2 = 1/2)$ for the equilibrium mass contingent on investments. The equilibrium prices with and without RPM are denoted by $w^l(\lambda)$ and $p^l(\lambda)$, $l \in \{R, N\}$.

Hence, in the investment stage, each retailer solves

$$\max_{\alpha_k} \Pi_k = \sum_{i\in\{A,B\}} \widetilde{M}_i(\alpha_k, \alpha_{-k}) \underbrace{\left[\left(p^l(\lambda) - w^l(\lambda)\right) d_{i,k}\left(p^l(\lambda), p^l(\lambda)\right)\right]}_{\text{retail profitability}} - C(\alpha_k),$$

where $C(\alpha_k)$ denotes the investment costs as a function of the overall service level, assumed to be increasing and well behaved to ensure unique interior solutions.[26]

The retailer faces a trade-off when choosing α_k: More precise information on consumer types increase sales through $\widetilde{M}_i$, but the product substitutability λ decreases in α_k. By investing less, a retailer commits to perceive the products of the manufacturers as more substitutable, which invites the manufacturers to offer lower wholesale prices. So even

[24]Note that for a given λ the expressions (1.3.4), (1.3.5),(1.3.7), and (1.3.8) are independent of M_i.
[25]Expression (1.3.11) is derived by plugging (1.3.10) in the definition of λ in (1.4.5).
[26]In particular, assume that C increases in α_k with $C'(0) = 0$, $C'(1) = \infty$ and $C'' > 0$.

without investment costs, a retailer will not necessarily choose the maximal information precision.

Comparing the equilibrium service levels with and without RPM, with $d_{i,k}$ linear in prices, we obtain

PROPOSITION 1.5. *If demand is linear in prices and the uncertain information q is uniformly distributed on $(0, 1)$, the equilibrium service level α_k^*, $k \in \{1, 2\}$, is lower with RPM.*

Because of manufacturer competition, each retailer has an incentive to be uninformed about which product fits which consumer. When uninformed about the suitability of a product to a consumer, a retailer simply advises the consumer to buy the product that is most profitable to the retailer. Thus manufacturers compete harder for favorable sales advice of uninformed retailers.

With RPM, the manufacturers directly controls the products' retail profitabilities and therefore compete more immediately for retail services. With RPM, it is thus more profitable for a retailer to invite manufacturer competition by investing less in information.

1.3.5. Asymmetric market power and resale price maintenance. In this subsection we examine the effect of market power on the allocation of services. To this end we assume that product B is produced by two different manufacturers. Without RPM, Bertrand competition between the manufacturers of B forces the wholesale prices of that product to zero. This implies a retail price of $p^*(0)$ for product B (Lemma 1.1).

Manufacturer A earns positive profits by setting a positive wholesale price. As the retail profitability decreases in a product's wholesale price (Lemma 1.1), retailers divert demand to product B in equilibrium. Without RPM, retailers thus allocate more services to product B.

Now assume that RPM is admitted. By nature of perfect competition, the manufacturers of product B cannot effectively increase the retail price with RPM. To see this, assume to the contrary that both manufacturers offer tariffs with wholesale prices of zero and a fixed retail price different from $p^*(0)$, which implies that they effectively use RPM. This cannot be an equilibrium as a manufacturer of product B could profitably offer a contract with a slightly positive wholesale price and let retailers choose the price. Each retailer strictly prefers such an offer as it can play its best response to the other retailer.

LEMMA 1.2. *In any equilibrium, $w_B = 0$ and $p_{B,1} = p_{B,2} = p^*(0)$. It is an equilibrium that each manufacturer of product B offers $w_B = 0$ and does not fix the retail price.*[27]

Lemma 1.2 implies that the perfectly substitutable manufacturers of product B cannot effectively use RPM. Hence the retail profitability on product B is not affected by the enforceability of RPM.

The profitability of product A generally depends on whether manufacturer A uses RPM. Faced with the same equilibrium prices on product B independent of whether RPM is feasible, manufacturer A is at least as well off when fixing the retail price. With RPM, manufacturer A sets $p_A = p^M$ to maximize the overall profitability on product A and sets a positive w_A by trading off the own margin and retailers' service incentives.

[27] Both manufacturers of B setting $w_B = 0$ and fixing $p_B = p^*(0)$ is not necessarily an equilibrium as one manufacturer could offer $w_B \geq 0$ and fix a much higher p_B and possibly be accepted by both retailers. Moreover, there is no equilibrium in strictly mixed strategies with RPM.

To understand the effects of RPM on prices and service allocations, consider two polar cases: retail monopolies vs. close substitutes (i.e., small competitive retail margins). A monopoly retailer faced with input costs of $w_B = 0$ sets the profit maximizing price $p_B = p^M$. Hence in case of retail monopolies, the retail profitability is maximal on product B and strictly smaller on product A as $w_A > w_B = 0$ and $p_A = p_B = p^M$. Thus service is excessively allocated to product B, although double marginalization on product A is reduced. By contrast, in case of fierce retail competition the profitability on product B is arbitrarily low and manufacturer A uses RPM to raise the retail margin and thereby the profitability of A over that of B. Hence service is allocated more to product A in equilibrium. In this case, RPM raises the price level of product A and yields that services are allocated excessively to the more expensive product.

Proposition 1.6. *Assume that two manufacturers sell product B and one manufacturer sells product A. If RPM is not enforceable, service is allocated more to product B than to the more expensive product A. If RPM is enforceable and retailers are close substitutes, product A is more expensive than product B and services are allocated more to product A.*

The case with fierce retail competition and enforceable RPM exhibits that A has a high, manufacturer-maintained retail price and is favorably sold by retailers, whereas product B is both less expensive and less endowed with services, e.g., is less advised or advertised. For instance, A could be a branded product and B a private label which can be produced by several manufacturers. Interestingly, the price-service differential (high price & high service vs. low price & low service) is not caused by different product qualities (vertical differentiation), but by asymmetric market power at the manufacturer level.

1.3.6. Direct inter-brand price competition. The assumption of no direct cross price effects between products A and B simplified the previous exposition, but is certainly not always realistic. In this section we show that also under direct price competition, manufacturers use minimum RPM to increases prices even without any benefit to consumers and minimum RPM can create a prisoner's dilemma to manufacturers.

We allow for cross price effects between the products of the different manufacturers by allowing $d_{i,k}$ to depend on the retail prices of product $-i$. We focus on perfect retailer competition with discrete money. Perfect retail competition ensures that minimum RPM is used in equilibrium and strategic delegation of pricing is not relevant. Discrete money ensures that retailers have a positive equilibrium margin even without RPM so that the service decision is meaningful.[28] Denoting the smallest unit of money by $\triangle > 0$, the competitive retail margins equal $\triangle$.[29] Clearly, the translation from wholesale to retail price is $\frac{\partial p_i^*}{\partial w_i} = 1$.

Formally, because of perfect retail competition the total quantity demanded of product i only depends on the lowest price for each product: $D_i = M_i \, d_i(p_A = \min(p_{A,1}, p_{A,2}), p_B = \min(p_{B,1}, p_{B,2}))$, presumed to satisfy

Assumption 4. The own price effect is dominant and the Hessian matrix of d_i has a negative dominant main diagonal.

[28]If a retailer makes zero margins on both products, he makes zero profits with every service allocation.
[29]One can equivalently assume that money is continuous so that retailers make zero margins, but that retailers, given that they make zero profits anyway, maximize the quantity of sales.

Assuming that for $p_{i,k} = p_{i,-k}$ the demanded quantity distributes equally over retailers, without RPM each retailer's profit reduces to $1/2\triangle \sum_i M_i d_i$. A manufacturer can still influence service incentives by lowering its wholesale price as this increases d_i. Yet there is now one additional effect: The demand for product $-i$ increases in the retail prices of product i. Hence retailers shift more services to product $-i$ in response to a retail price increase of product i. Solving for the wholesale price analogously to Proposition 1.1 yields

$$w^N = \frac{d_i\left(p^N, p^N\right)}{-\frac{\partial d_i(p^N,p^N)}{\partial p_i}(1+\lambda) + \lambda \frac{\partial d_{-i}(p^N,p^N)}{\partial p_i}} \tag{1.3.12}$$

with $d_{i,k}$ evaluated at p^N. As $\triangle \to 0$, $p^N \to w^N$. We assume that $\triangle$ is very small and use $p^N \approx w^N$ from now on. Following analogously the steps of the proof to Proposition 1.2 yields $w^R = \frac{p^R}{1+\lambda}$ as before and

$$p^R = \frac{d_{i,k}\left(p^R, p^R\right)(1+\lambda)}{-\frac{\partial d_i(p^R,p^R)}{\partial p_i}(1+\lambda) + \frac{\partial d_{-i}(p^R,p^R)}{\partial p_i}\lambda}. \tag{1.3.13}$$

Comparing (1.3.12) and (1.3.13) and using Assumption 4 reveals that $p^R > p^N$ and $w^R < w^N$. Hence RPM implies a prisoner's dilemma for the manufacturers as both manufacturer margins and sales quantities decrease in comparison to the regime without RPM.

PROPOSITION 1.7. *With discrete money, direct price competition between manufacturers, and perfect price competition between retailers, manufacturers always use minimum RPM and, in equilibrium, $p^R > p^N$ and $w^R < w^N$.*

1.4. Conclusion

In this paper we study the incentives of manufacturers to use RPM when they compete for sales services of common retailers. To induce favorable services by the retailers, a manufacturer can use minimum RPM to increase the retail margin of its product. Holding the overall service level constant, we show that in equilibrium the competition of manufacturers for retail services yields minimum RPM and higher retail prices. In consequence, all consumers – and even manufacturers – can be worse off. Moreover, we show that RPM is related to market power at the manufacturer level. With RPM, this market power can translate into high retail prices and excessive retail sales efforts allocated to these high-priced products. When retailers can invest in the overall level of their matching services, we show that retailers have incentives to invest less when minimum RPM is used, although retail margins are higher.

Our model features two differentiated manufacturers and two common retailers, endogenous wholesale and retail prices, as well as endogenous service allocations and levels. As the analysis of such a setting is inherently complicated when all four agents behave strategically, we have imposed simplifying assumptions. First, we have focused on linear wholesale tariffs to avoid complications such as the non-existence of an equilibrium, which has been pointed out by Rey and Vergé (2010). Second, we have assumed that retailers contribute with their services to a common pool of consumers who are informed about the prices at both retailers. Although we have indicated that the assumptions can be relaxed without qualitatively changing the results, a full fledged analysis under alternative assumptions is beyond the scope of this paper, but appears promising for future research.

Service incentives are the major efficiency defense in favor of minimum RPM. In light of our results, we believe that competition policy relies too much on the established service arguments with a single manufacturer which – overall – suggest beneficial effects of minimum RPM. With this paper, we contribute a theory of how minimum RPM can hurt all consumers – and even manufacturers – in markets where manufacturers compete for services of common retailers.

Appendix A: Proofs

Proof of Lemma 1.1. (i.) The FOC for the retail price is given by (1.3.1) and is independent of w_{-i} and s_k. Evaluating the FOC at symmetric retail prices defines the unique and symmetric equilibrium price $p_{i,1} = p_{i,2} = p_i^*(w_i)$, where uniqueness follows by a contraction mapping argument (dominant diagonal of the Hessian matrix). To obtain the pass trough rate, $\frac{\partial p_i^*}{\partial w_i}$, implicitly differentiate (1.3.1). The regularity assumptions imposed on $d_{i,k}$ imply $0 < \frac{\partial p_i^*}{\partial w_i} < 1$.

(ii.) Let $\varphi_{i,k}^*(w_i) \equiv (p_i^*(w_i) - w_i) d_{i,k}(p_i^*, p_i^*)$. To see that $\frac{\partial \varphi_{i,k}^*}{\partial w_i} < 0$, note that the retail margin decreases in w_i as $\frac{\partial p_i^*}{\partial w_i} < 1$; moreover, $d_{i,k}$ decreases in w_i because $\frac{\partial p_i^*}{\partial w_i} > 0$ and $\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}} < 0$ (own price effect dominates).

(iii.) The equilibrium value s_k^* is defined by the FOC (1.3.2) evaluated at $p_{i,k} = p_i^*(w_i)$ $\forall\, i, k$. By symmetry of the retailers, $s_1^* = s_2^*$. Implicit differentiation of (1.3.2) yields

$$\frac{\partial s_k^*}{\partial w_i} = -\frac{\partial^2 \Pi_k}{\partial s_k \partial w_i} / \frac{\partial^2 \Pi_k}{(\partial s_k)^2} = -\frac{\frac{\partial M_i}{\partial s_k} \frac{\partial \varphi_{i,k}^*}{\partial w_i}}{\frac{\partial^2 M_A}{(\partial s_k)^2} \varphi_{A,k}^* + \frac{\partial^2 M_B}{(\partial s_k)^2} \varphi_{B,k}^*}. \tag{1.4.1}$$

$\frac{\partial^2 \Pi_k}{(\partial s_k)^2} < 0$ holds as M_i is strictly concave. The sign of $\frac{\partial s_k^*}{\partial w_i}$ thus equals the sign of $\frac{\partial^2 \Pi_k}{\partial s_k \partial w_i} = \frac{\partial M_i}{\partial s_k} \frac{\partial \varphi_{i,k}^*}{\partial w_i}$. As shown in part (ii.), $\frac{\partial \varphi_{i,k}^*}{\partial w_i} < 0$. From Assumption 1, $\frac{\partial M_A}{\partial s_k} > 0 > \frac{\partial M_B}{\partial s_k}$. Hence, $\frac{\partial s^*}{\partial w_A} < 0$ and $\frac{\partial s^*}{\partial w_B} > 0$. Thus $\frac{\partial M_i^*}{\partial w_i} = \left[\frac{\partial M_i}{\partial s_k} + \frac{\partial M_i}{\partial s_{-k}}\right] \frac{\partial s^*}{\partial w_i} < 0$ as the term in brackets is positive for $i = A$ and negative for $i = B$. Equal wholesale prices $w_A = w_B$ imply equal retail prices $p_A^* = p_B^*$ and thus equal profitabilities $\varphi_{A,k}^* = \varphi_{B,k}^* \equiv \varphi^*$. Hence $s^* = \arg\max_{s_k} M_A \cdot \varphi^* + M_B \cdot \varphi^* = \arg\max_{s_k} M_A + M_B = 1/2$, i.e. service is allocated evenly. $\square$

.

Proof of Proposition 1.1. Differentiating a manufacturer's profit π_i from (1.3.3) with respect to w_i yields the FOC

$$M_i^* d_{i,k} + w_i M_i^* \left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right) \frac{\partial p_i^*}{\partial w_i} + w_i d_{i,k} \left[\frac{\partial M_i}{\partial s_k} \frac{\partial s_k^*}{\partial w_i} + \frac{\partial M_i}{\partial s_{-k}} \frac{\partial s_{-k}^*}{\partial w_i}\right] = 0. \tag{1.4.2}$$

Evaluating the FOC at $w_A = w_B = w^N$, and correspondingly $p_A = p_B = p^N$ and $s_k^* = 1/2 \forall k$, and dividing by M_i yields

$$d_{i,k} + w^N \left[\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right) \frac{\partial p_i^*}{\partial w_i} + \frac{d_{i,k}}{M_i} \left(\sum_k \frac{\partial M_i}{\partial s_k} \frac{\partial s_k^*}{\partial w_i}\right)\right] = 0. \tag{1.4.3}$$

Quasi-concavity of $\pi_i(w_i)$ implies that the above condition characterizes the equilibrium wholesale price. Substituting for $\frac{\partial s_k^*}{\partial w_i}$ from (1.4.1) yields

(1.4.4)
$$d_{i,k} + w^N \left[\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right) \frac{\partial p_i^*}{\partial w_i} + d_{i,k} \cdot \frac{\partial \varphi_{i,k}^*}{\partial w_i} / \varphi_{i,k}^* \cdot \left(\frac{-1}{2M_i} \sum_k \left(\frac{\partial M_i}{\partial s_k}\right)^2 / \frac{\partial^2 M_i}{(\partial s_k)^2}\right)\right] = 0.$$

Let

$$\lambda \equiv \frac{-1}{2\, M_i} \sum_k \left(\frac{\partial M_i}{\partial s_k}\right)^2 / \left(\frac{\partial^2 M_i}{(\partial s_k)^2}\right). \tag{1.4.5}$$

Use (1.4.5) and $d_{i,k} \cdot \frac{\partial \varphi^*_{i,k}}{\partial w_i}/\varphi^*_{i,k} = \frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\frac{\partial p^*_i}{\partial w_i}$ (implied by the FOC (1.3.1)) to reduce (1.4.4) to

$$w^N \left\{ \left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}} \right) \frac{\partial p^*_i}{\partial w_i} + \lambda \left[\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}} \frac{\partial p^*_i}{\partial w_i} \right] \right\} + d_{i,k} = 0. \tag{1.4.6}$$

Rearranging (1.4.6) yields (1.3.4). Note that (1.3.6) follows from symmetry in k, i.e., at $s^* = 1/2$, $\lambda = \frac{-1}{2\,M_i} \sum_k \left(\frac{\partial M_i}{\partial s_k}\right)^2 / \left(\frac{\partial^2 M_i}{(\partial s_k)^2}\right) = \frac{\partial M_i/\partial s_k}{M_i} \times \frac{\partial M_i/\partial s_k}{-\partial^2 M_i/(\partial s_k)^2}$. To see that $\frac{\partial w^N}{\partial \lambda} < 0$, implicitly differentiate the equilibrium FOC (1.4.6) to obtain

$$\frac{\partial w^N}{\partial \lambda} = -\frac{\partial^2 \pi_i \left(w^N, w^N\right)}{\partial w_i \partial \lambda} / \left(\frac{\partial^2 \pi_i \left(w^N, w^N\right)}{\partial w_i \partial w_i} + \frac{\partial^2 \pi_i \left(w^N, w^N\right)}{\partial w_i \partial w_{-i}} \right).$$

Local stability implies $\frac{\partial^2 \pi_i \left(w^N, w^N\right)}{\partial w_i^2} + \frac{\partial^2 \pi_i \left(w^N, w^N\right)}{\partial w_i \partial w_{-i}} < 0$. Moreover,

$$\frac{\partial^2 \pi_i}{\partial w_i \partial \lambda} = w^N \left[\frac{\partial d_{i,k}(p^N, p^N)}{\partial p_{i,k}} + \frac{\partial d_{i,k}(p^N, p^N)}{\partial p_{i,-k}} \frac{\partial p^*_i}{\partial w_i} \right] < 0$$

follows from the assumption that the own price effect dominates and $0 < \frac{\partial p^*_i}{\partial w_i} < 1$ (Lemma 1.1). Thus $\frac{\partial w^N}{\partial \lambda} < 0$. The retail profit decreases in w_i by Lemma 1.1 and hence increases in λ. □

.

Proof of Proposition 1.2. As argued in the text, using RPM is a dominant strategy for a manufacturer. Given wholesale and retail prices, each retailer chooses $\hat{s} = \arg\max_{s_k} \Pi_k$. Let $\varphi_{i,k}(p_i, w_i) \equiv (p_i - w_i) d_{i,k}(p_i, p_i)$. Implicit differentiation of the FOC $\partial \Pi_k / \partial s_k = 0$ yields

$$\frac{\partial \hat{s}}{\partial w_i} = \left(\frac{\partial M_i}{\partial s_k}\, d_{i,k}(p_i, p_i) \right) / \left(\frac{\partial^2 M_i}{(\partial s_k)^2}\, \varphi_{i,k} + \frac{\partial^2 M_i}{(\partial s_k)^2}\, \varphi_{-i,k} \right), \tag{1.4.7}$$

and, analogously,

$$\frac{\partial \hat{s_k}}{\partial p_i} = -\left(\frac{\partial M_i}{\partial s_k} \frac{\partial \varphi_{i,k}}{\partial p_i} \right) / \left(\frac{\partial^2 M_i}{(\partial s_k)^2}\, \varphi_{i,k} + \frac{\partial^2 M_i}{(\partial s_k)^2}\, \varphi_{-i,k} \right). \tag{1.4.8}$$

A manufacturer solves $\max_{w_i, p_i} \pi_i = w_i M_i(s_k, s_{-k}) \sum_k d_{i,k}(p_i, p_i)$, taking the prices w_{-i} and p_{-i} of the other product as given. This yields the FOCs

$$\frac{\partial \pi_i}{\partial w_i} = 2\, d_{i,k}\, M_i + 2\, w_i d_{i,k} \left(\frac{\partial M_i}{\partial s_k} \frac{\partial \hat{s}}{\partial w_i} \right) \quad = \quad 0, \tag{1.4.9}$$

$$\frac{\partial \pi_i}{\partial p_i} = 2\, w_i \left[\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}} \right) M_i + 2\, d_{i,k} \left(\frac{\partial M_i}{\partial s_k} \frac{\partial \hat{s}}{\partial p_i} \right) \right] \quad = \quad 0. \tag{1.4.10}$$

Impose symmetry $w^R = w_A = w_B$, substitute for $\frac{\partial \hat{s}}{\partial w_i}$ from (1.4.7) in (1.4.9) and substitute λ to obtain

$$\frac{\partial \pi_i}{\partial w_i} = 2\, d_{i,k}\, M_i + 2\, w_i d_{i,k} \left(-\frac{d_{i,k}}{(p-w)d}\, \lambda * M_i \right) \quad = \quad 0 \tag{1.4.11}$$

$$\implies w^R \quad = \quad \frac{p^R}{1+\lambda}. \tag{1.4.12}$$

Condition (1.4.12) characterizes the relationship between the wholesale price and the equilibrium retail price p^R. To determine p^R, substitute for $\frac{\partial \hat{s}}{\partial p_i}$ from (1.4.8) in (1.4.10) to obtain

$$(1.4.13) \qquad \left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right) + \left(\frac{d_{i,k}}{(p^R - w^R)} + \frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right)\lambda \;=\; 0.$$

Substitute for w^R from (1.4.12) to obtain

$$(1.4.14) \qquad p^R \;=\; \frac{d_{i,k}}{-\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right)}.$$

This is the FOC implied by (1.3.7) which holds if and only if $p_i = p^M$. The wholesale price clearly decreases in λ as p^R is independent of λ. For $\lambda \to \infty$, $w^R \to 0$ and for $\lambda \to 0$, $w^R \to p^M$. □

.

Proof of Proposition 1.3. The condition $p^N = p^M$ defines a λ such that prices with and without RPM are equal. Substituting for p^N from (1.3.4) and (1.3.5), and for p^M from the FOC implied by (1.3.7), the condition $p^N = p^M$ becomes

$$\frac{-d_{i,k}}{\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\right)\frac{\partial p_i^*}{\partial w_i} + \lambda\left(\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}\frac{\partial p_i^*}{\partial w_i}\right)} + \frac{-d_{i,k}}{\frac{\partial d_{i,k}}{\partial p_{i,k}}} = \frac{-d_{i,k}}{\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}}}.$$

Note that all expressions with $d_{i,k}$ are evaluated at prices p^M and $\frac{\partial p_i^*}{\partial w_i}$ at $\left(p^M, w^N\right)$. Isolating λ yields

$$(1.4.15) \qquad \lambda = \frac{-\partial d_{i,k}(p^M, p^M)/\partial p_{i,k}}{\partial d_{i,k}(p^M, p^M)/\partial p_{i,-k}} - 1 \equiv \lambda^M.$$

To see that $\lambda \gtrless \lambda^M$ implies $p^M \gtrless p^N$, note that p^M does not depend on λ, whereas w^N decreases in λ by Proposition 1.1 and $\frac{\partial p^N}{\partial w^N} = \frac{\partial p_i^*(w)}{\partial w} > 0$ by Lemma 1.1. □

.

Proof of Proposition 1.4. Strict concavity of Π_k in $p_{i,k}$ (which follows from weak concavity of $d_{i,k}$) implies that $\frac{\partial \Pi_k}{\partial p_{i,k}}$ is monotone in $p_{i,k}$. Thus if $\frac{\partial \Pi_k}{\partial p_{i,k}}$ is negative (positive) at $w_i = w^R$ and $p_{i,k} = p_{i,-k} = p^M$, each retailer wants to decrease (increase) its price and thus RPM is used as minimum (maximum) RPM. Hence minimum RPM is used if and only if

$$\frac{\partial d_{i,k}(p^M, p^M)}{\partial p_{i,k}}\left(p^M - w^R\right) + d_{i,k}(p^M, p^M) < 0.$$

Add $0 = \frac{\partial d_{i,k}}{\partial p_{i,-k}}p^M - \frac{\partial d_{i,k}}{\partial p_{i,-k}}p^M$ on the left hand side to obtain

$$\underbrace{\frac{\partial d_{i,k}}{\partial p_{i,k}}p^M + p^M\frac{\partial d_{i,k}}{\partial p_{i,-k}} + d_{i,k}}_{=0 \text{ at } p^M} - w^R\frac{\partial d_{i,k}}{\partial p_{i,k}} - p^M\frac{\partial d_{i,k}}{\partial p_{i,-k}} < 0.$$

Substitute $w^R = \frac{p^M}{1+\lambda}$ (Proposition 1.2) to get $\lambda > \left[-\frac{\partial d_{i,k}(p^M, p^M)}{\partial p_{i,k}} / \frac{\partial d_{i,k}(p^M, p^M)}{\partial p_{i,-k}}\right] - 1 \equiv \lambda^M$. For $\lambda = \lambda^M$, RPM is not needed as $p^N(w^R) = p^M$; for $\lambda < \lambda^M$, maximum RPM is used in equilibrium. □

.

Derivation of Example 1.2. Let $d_{i,k} = 1 - (\beta+\gamma)\,p_{i,k} + \gamma\,p_{i,-k}$ with $\beta, \gamma > 0$. Hence $\frac{\partial d_{i,k}}{\partial p_{i,-k}} = \gamma$, $\frac{\partial d_{i,k}}{\partial p_{i,k}} = -(\beta+\gamma)$, $\frac{\partial d_{i,k}}{\partial p_{i,k}} + \frac{\partial d_{i,k}}{\partial p_{i,-k}} = -\beta$. p_i^* is obtained from substituting the linear demand expressions into (1.3.2) and letting $p_{i,1} = p_{i,2} = p$. This yields $1 - \beta\,p + \gamma\,p + (p-w)(-\beta) = 0$. Solving for p yields $p_i^* = \frac{1+w\,(\beta+\gamma)}{2\beta+\gamma}$, $\frac{\partial p_i^*}{\partial w_i} = \frac{\beta+\gamma}{2\beta+\gamma}$, and $d_{i,k}^* = 1 - \beta\frac{1+w\,(\beta+\gamma)}{2\beta+\gamma}$. The demand factor M_i is kept in reduced form, yielding the parameter λ. Equilibrium prices are obtained by plugging the linear-demand analogs into the reduced form expressions (1.3.7), (1.3.4), (1.3.5), and (1.3.8). This yields $w^N = \frac{1}{2\beta(1+\lambda)}$, $p^N = \frac{1+w^N\,(\beta+\gamma)}{2\beta+\gamma} = \frac{1}{2\beta+\gamma}(1+\frac{\beta+\gamma}{2\beta(1+\lambda)})$, $p^R = p^M = \frac{1}{2\beta}$, and $w^R = \frac{p^M}{1+\lambda} = \frac{1}{2\beta\,(1+\lambda)}$. Note that $w^N = w^R$, i.e., the wholesale price does not depend on the pricing regime. As argued in the text, this condition implies that manufacturer profits with minimum (maximum) RPM are lower (higher) than without RPM. Retailers benefit from minimum RPM as it maximizes industry profits and manufacturers lose. Retailers lose when maximum RPM is used as input prices remain unchanged, but their margins are lower than is individually optimal for a retailer. □

.

Proof of Proposition 1.5. If for any given α_k the marginal profit $\frac{\partial \Pi_k}{\partial \alpha_k}$ is higher without than with RPM, then the equilibrium service quality must be strictly higher without RPM in an interior equilibrium. For $l = N, R$ the marginal profit $\frac{\partial \Pi_k}{\partial \alpha_k}$ is generally given by

(1.4.16)
$$\sum_{i\in\{A,B\}} \frac{\partial \widetilde{M}_i}{\partial \alpha_k}\,(p^l(\lambda) - w^l(\lambda))\,d_{i,k}(p^l, p^l) + \widetilde{M}_i\,\frac{\partial}{\partial \alpha_k}\underbrace{[(p^l(\lambda) - w^l(\lambda))\,d_{i,k}(p^l(\lambda), p^l(\lambda))]}_{\text{retail profitability}} - C'(\alpha_k).$$

To determine which regime yields higher investment levels, we evaluate the sign of the difference in marginal profits without and with RPM, i.e. $\frac{\partial \Pi_k(w^N,p^N)}{\partial \alpha_k} - \frac{\partial \Pi_k(w^R,p^R)}{\partial \alpha_k}$ at symmetric investments ($\alpha_1 = \alpha_2 = \alpha$). Under symmetry, (1.3.10) and (1.3.11) imply $\widetilde{M}_i = \frac{1}{2}(3+\alpha)$, $\frac{\partial \widetilde{M}_i}{\partial \alpha_k}|_{\alpha_1=\alpha_2=\alpha} = \frac{1}{4}$, $\lambda = \frac{(1-\alpha)}{2\,(3+\alpha)}$, and $\partial\lambda/\partial\alpha_k = -\frac{2}{(3+\alpha)^2}$. For linear demand, the retail profitabilities without and with RPM are given by $\frac{(\beta+\gamma)(1+2\lambda)^2}{4(2\beta+\gamma)^2(1+\lambda)^2}$ and $\frac{\lambda}{4\beta+4\beta\lambda}$ (see Example 1 and the Proof of Lemma 1.2). The difference in marginal profits reduces to

$$\frac{3\beta^2(3+\alpha)^2 + 3\beta(3+\alpha)^2\gamma + 8(1+\alpha)\gamma^2}{128\,\beta(2\beta+\gamma)^2}$$

and is straightforwardly shown to be positive for $0 \le \alpha \le 1$, $\beta > 0$ and $\gamma > 0$. □

.

Proof of Proposition 1.7. The derivation of w^N is analogous to the proof of Proposition 1.1. Because of perfect price competition, $\frac{\partial p_i^*}{\partial w_i} = 1$, $d_{i,k} = d_{i,-k} = {}^1\!/\!_2 d_i$ and $p_i^*(w_i) - w_i = \Delta$. By the implicit function theorem on the FOC to the problem $\max_{s_k} {}^1\!/\!_2\Delta M_i d_i$ we get

$$\frac{\partial s_k}{\partial w_i} = -\frac{\frac{\partial M_i}{\partial s_k}\left(\frac{\partial d_i}{\partial p_i}\right) + \frac{\partial M_{-i}}{\partial s_k}\left(\frac{\partial d_{-i}}{\partial p_i}\right)}{\frac{\partial^2 M_A}{(\partial s_k)^2}\,d_A + \frac{\partial^2 M_B}{(\partial s_k)^2}\,d_B}. \tag{1.4.17}$$

Substituting from (1.4.17) in the analogue to (1.4.2) gives us the characterization of w^N in (1.3.12).

For the equilibrium with RPM, the expressions for $\frac{\partial \hat{s}}{\partial w_i}$, $\frac{\partial \pi_i}{\partial w_i}$ and $\frac{\partial \pi_i}{\partial p_i}$ in the proof to Proposition (1.2) remain analogously valid and $\frac{\partial \hat{s_k}}{\partial p_i}$ changes analogously to $\frac{\partial s_k}{\partial p_i}$ above and is given by

$$\frac{\partial \hat{s_k}}{\partial p_i} = -\frac{\frac{\partial M_i}{\partial s_k}\left(d_{i,k} + (p_i - w_i)\frac{\partial d_i}{\partial p_i}\right) + \frac{\partial M_{-i}}{\partial s_k}\left((p_{-i} - w_{-i})\frac{\partial d_{-i}}{\partial p_i}\right)}{\frac{\partial^2 M_i}{(\partial s_k)^2}\varphi_i + \frac{\partial^2 M_i}{(\partial s_k)^2}\varphi_{-i}}.$$

Using these expressions, w^R and p^R are derived. Noting that the right hand sides of the equations are monotonous in the price level under Assumption 4. The comparison of (1.3.13) and (1.3.12), implies $p^R > p^N$. Substituting for p^R in the expression for w^R, we obtain

$$w^R = \frac{d_i\left(p^R, p^R\right)}{-\left(\frac{\partial d_i(p^R,p^R)}{\partial p_i}\right)(1+\lambda) + \frac{\partial d_{-i}(p^R,p^R)}{\partial p_i}\lambda} \quad < \quad \frac{d_i\left(p^N, p^N\right)}{-\frac{\partial d_i(p^N,p^N)}{\partial p_i}(1+\lambda) + \frac{\partial d_{-i}(p^N,p^N)}{\partial p_i}\lambda} = w^N$$

which is true because $p^R > p^N$ and again each side of the inequality is decreasing monotonically in the retail price level. □

Appendix B: Parametric example

Assume that the total mass of consumers is 4; of them 50% like product A, and 50% product B. Initially, consumers are neither informed about the existence nor the match value of products A and B, and distribute equally among retailers. Consumers need a retailers' advice to learn about products. Once a consumer seeks advice from a retailer, the retailer receives private information about the consumer's preferences. This information is captured by each retailer's posterior belief $q \in [0,1]$ which corresponds to the probability that the consumer prefers A and thus not B. We assume that q is distributed uniformly in the interior. In Subsection 1.3.4, we allow for symmetric retailer specific mass points of $\alpha_k/2$ at zero and 1. In that case, for each product retailer k knows for a mass α_k of the consumers the type with certainty.

The product presentation boils down to each retailer choosing a threshold probability s_k, such that the retailer presents consumers with product A and for $q < s_k$ and with product B for $q > s_k$.[30] The mass of consumers who are correctly matched with product i by retailer k is thus given by

$$M_{A,k} = \alpha_k + 2\int_0^{s_k}(1-q)(1-\alpha_k)\,dq, \tag{1.4.18}$$

$$M_{B,k} = \alpha_k + 2\int_{s_k}^{1} q(1-\alpha_k)\,dq. \tag{1.4.19}$$

Note that for $\alpha_k = 0$, the choice $s_k = 1$ implies that the retailer informs all consumers about product A. Half of these consumers are actually of type A which yields $M_{A,k} = 1$.

Summing over both retailers and integrating out yields

$$M_A = \sum_k \alpha_k + (1-\alpha_k)2\left(s_k - s_k^2/2\right),$$

$$M_B = \sum_k \alpha_k + (1-\alpha_k)2\left(1/2 - s_k^2/2\right).$$

For $\alpha_k = 0$ this corresponds to the parametrization of Example 1.

[30] There is no reason for a retailer to present product A to a consumer when he has a belief $q' > q$ and B to a consumer with q.

KAPITEL 2

Strategic backward integration

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Abstract. We analyze the effects of downstream firms' acquisition of pure cash flow rights in an efficient upstream supplier when all firms compete in prices. With backward acquisition, downstream firms internalize the effects of their actions on their rivals' sales. Double marginalization is enhanced. While full vertical integration would lead to decreasing, passive backward ownership leads to increasing downstream prices and is more profitable, as long as competition is sufficiently intense. Downstream acquirers strategically abstain from vertical control, inducing the efficient supplier to commit to high prices. All results are sustained when upstream suppliers are allowed to charge two part tariffs.

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2.1. Introduction

Passive partial ownership across horizontally and vertically related firms is very common, but has traditionally not been of welfare concern, nor of concern in competition policy.[4] Whereas the anti-competitive effect of horizontal cross-shareholding on prices is hardly controversial, the effect of vertical ownership arrangements on pricing and foreclosure is much more so.[5]

By the classic Chicago challenge vertical mergers are competitively neutral at worst (Bork, 1978; Posner, 1976). Several arguments are around, however, of how vertical mergers can yield higher consumer prices, or even foreclosure. These rely on particular assumptions, such as additional commitment power of the integrated firm (Ordover et al., 1990), secret contract offers (Hart and Tirole, 1990), or costs of switching suppliers (Chen, 2001).[6]

Throughout, the authors compare a particular form of integration, namely from complete separation between the raider and the target firm to full joint ownership and control of the two. Partial ownership, either non-controlling or controlling, is not considered.

Even hindsight suggests, however, that empirically, partial vertical ownership between related firms is the rule rather than the exception.[7] Yet there is very little formal analysis on the allocation effects of partial interests. This is the focus of our research project.

Before moving on to the specifics reported in this article, we should emphasize a general point on passive partial interests between vertically related firms. Unlike in the case of full merger, *the identity of the acquiring party matters in partial integration.* In particular, *passive forward ownership* of an upstream supplier in one of its customers induces *vertical coordination, by reducing double marginalization and thus downstream prices.* We demonstrate this in a companion article (Hunold et al., 2012b). By sharp contrast, a result of this article is that *passive backward ownership* induces exactly the opposite effect, namely *horizontal coordination, by exacerbating double marginalization and increasing downstream prices.*

This is our answer to one of the central questions addressed in this article: Is passive partial backward integration really as innocent as believed heretofore, with respect to anti-competitive effects such as increasing prices or foreclosure?

Towards this, we focus on passive ownership interests that price setting downstream firms may hold in their suppliers. Passive ownership involves pure cash flow rights, i.e. claims on the target's profits only, without controlling its decisions. We look at the pricing decisions of firms in a horizontally differentiated downstream market, and in an upstream homogeneous product market where firms produce at differing levels of marginal costs. We concentrate on the case of effective upstream competition in which the difference in

[4]Yet in 2011, Joaquín Almunia, the EU commissioner for competition policy, voiced that there is potentially an enforcement gap, as the EU Merger Regulation does not apply to minority shareholdings. See "Merger Regulation in the EU after 20 years", co-presented by the IBA Antitrust Committee and the European Commission, March 10, 2011.

[5]See Flath (1991), or more recently Brito et al. (2010) or Karle et al. (2011) for a theoretical analysis of the profitability of horizontal partial ownership, and Gilo (2000) for examples and an informal discussion of the antitrust effects.

[6]Other explanations include input choice specifications (Choi and Yi, 2000), two-part tariffs (Sandonis and Fauli-Oller, 2006), exclusive dealing contracts (Chen and Riordan, 2007), only integrated upstream firms (Bourreau et al., 2011) and information leakages (Allain et al., 2010).

[7]Allen and Phillips (2000), for instance, identify 40 per cent of their sample of alliances, agreements and joint ventures as related to the exchange of a product or service.

the marginal costs between the efficient supplier and its competitors restrict that supplier in its price setting.

Towards our main result, the reasoning is as follows: with an increasing participation in the profits of that efficient upstream supplier, the acquiring downstream firm softens its reaction to any upstream price increase. The upstream supplier incorporates this reaction by increasing its price. Only the effective price charged to the downstream firm cannot exceed the second efficient firm's marginal cost. Therefore, the nominal price charged by the efficient upstream firm can be higher. Thus, upstream competition is relaxed by passive backward integration. By virtue of the constraint on the efficient upstream firm's pricing activity, the two effects, softened reaction of the downstream acquirer, and increase in the upstream price, perfectly compensate each other.

Yet, as the downstream competitors are naturally served by the same efficient upstream firm, the acquirer also incorporates the effect of its own actions on the downstream competitors' sales. Its participation in the upstream supplier's sales to competitors reduces its incentive to steal from the competing firms. It thus raises its price above the price under vertical separation. Strategic complementarity in turn induces all downstream competitors to increase theirs.

Flath (1989) shows that with successive Cournot oligopolies, constant elasticity demand and symmetric passive ownership, the effects cancel out, so in his model, pure passive backward integration has no effect. Greenlee and Raskovich (2006) confirm this invariance result for equilibria involving an upstream monopoly and symmetric downstream firms under competition in both, price and quantity. These invariance results would suggest that there is no need for competition policy to address passive vertical ownership. By contrast, we show that the invariance property of downstream prices does not apply within a more general industry structure involving upstream Bertrand competition with asymmetric costs.

Beyond this central result, we show that as long as competition in both markets is sufficiently intense, the possibility to raise downstream prices incentivizes downstream firms to acquire passive interests in the efficient upstream supplier. Yet, in contrast to what one might expect, partial backward acquisition by a downstream firm does *not* invite the input foreclosure of downstream competitors.[8] Indeed, via increasing equilibrium prices, the competitors tend to *benefit* from the acquiring firm's decision.

This acquisition, however, *takes place short of a level at which the downstream firm takes control over the upstream target's pricing decisions.* By contrast, if it did, the upstream firm would lose its power to commit to high transfer prices, and thus all downstream prices would decrease. Hence, in the setting analyzed here, *backward acquisitions have an anti-competitive effect only if they are passive.*

In the extension section, we show that backward acquisition is more profitable for the participating firms than full merger, and that all the effects hold even when the upstream suppliers are allowed to charge two-part tariffs, that in concentrated markets tend to alleviate the double marginalization problem. In all, we claim that the pricing consequences of passive backward integration should indeed be of concern to competition authorities.

The present analysis is related to Chen (2001). He investigates the effects of a full vertical merger in a similar setting. For such a merger to increase downstream prices,

[8] See Spiegel (2011) for an analysis of controlling partial vertical ownership and foreclosure.

the unintegrated downstream rival needs to incur costs of switching between upstream suppliers. These switching costs allow the integrated firm to charge the downstream competitor an input price higher than that charged by the next efficient upstream supplier.

We show that for all downstream prices to increase, neither full vertical integration nor switching costs are necessary, nor does the input price charged to independent downstream firms need to increase. Indeed, partial backward integration without the transfer of control rights is effective in raising consumer prices when full integration is not, i.e. when the Chicago argument about the efficiency increasing effect of vertical mergers does hold. In consequence, downstream firms have incentives to only acquire profit claims of suppliers to relax downstream competition.

Separating control from ownership in order to relax competition is the general theme in the literature on strategic delegation – a term coined by Fershtman et al. (1991). Our result is most closely related to the earlier example provided by Bonanno and Vickers (1988), where manufacturers extract retail profits through two-part tariffs, but delegate the control over retail prices towards inducing a softer price setting of the competitor. In the present case, strategic delegation involves backward oriented activities. The particular twist we add to that literature is that *the very instrument of share purchases that firms use to acquire control is used here short of implementing it.*

The competition dampening effect identified in the present article relies on internalizing rivals' sales through a common efficient supplier. This relates to Bernheim and Whinston (1985)'s common agency argument. Strategic complementarity is essential in the sense that rivals need to respond with price increases to the raider's incentive to increase price. Indeed, acquiring passive vertical ownership is a fat cat strategy, in the terms coined by Fudenberg and Tirole (1984).

A different kind of explanation for backward integration without control is that transferring residual profit rights can mitigate agency problems, for example when firm specific investment or financing decisions are taken under incomplete information (Riordan, 1991; Dasgupta and Tao, 2000). Güth et al. (2007) analyze a model of vertical cross share holding to reduce informational asymmetries, and provide experimental evidence.[9] Whereas such potentially desirable effects of partial vertical ownership should be taken into account within competition policy considerations, we abstract from them for expositional clarity.

The remainder of this article is structured as follows: We introduce the model in Section 2.2. In Section 2.3, we solve and characterize the 3rd stage downstream pricing subgame. In Section 2.4, we solve for, and characterize the equilibrium upstream prices arising in Stage 2. We also derive the essential comparative statics with respect to the downstream firms' backward interests. In Section 2.5, we analyze a key element involved in the solution to the first stage of the game, namely the profitability of partial acquisitions. In the Extension Section 2.6, we first compare the results derived in the baseline model with those derived under full vertical integration. Second, we look at the effects of bans on upstream price discrimination common to many competition policy prescriptions. Third and fourth, we consider the effects of relaxing structural assumptions: We replace sequential by simultaneous pricing decisions, and then allow the upstream firms to charge observable two-part, rather than linear tariffs. The results remain unchanged. Fifth, we

[9] Höffler and Kranz (2011a,b) investigate how to restructure former integrated network monopolists. They find that passive ownership of the upstream bottleneck (legal unbundling) may be optimal in terms of downstream prices, upstream investment incentives and prevention of foreclosure. A key difference to our setting is that they keep upstream prices exogenous.

touch at the case in which upstream competition is ineffective, so that the efficient firm can exercise complete monopoly power.[10] Last, we briefly compare the effects of passive partial backward integration with those of passive partial horizontal integration. We conclude with Section 3.7. All proofs are removed to an appendix.

2.2. Model

Two symmetric downstream firms $i, i \in \{A. B\}$ competing in prices p_i produce and sell imperfect substitutes obeying demands $q_i(p_i, p_{-i})$, that satisfy

Assumption 5. $\infty > -\frac{\partial q_i(p_i,p_{-i})}{\partial p_i} > \frac{\partial q_i(p_i,p_{-i})}{\partial p_{-i}} > 0$ *(product substitutability).*

The production of one unit of downstream output requires one unit of a homogenous input produced by two suppliers $j \in \{U, V\}$ with marginal costs c^j, who again compete in prices. Assume that $c^U \equiv 0$ and $c^V \equiv c > 0$, so that firm U is more efficient than firm V, and c quantifies the difference in marginal costs between U and its less efficient competitor.[11] All other production costs are normalized to zero. Upstream suppliers are free to price discriminate between the downstream firms.

Let x_i^j denote the quantities firm i buys from supplier j, and w_i^j the associated linear unit price charged to i by supplier j.[12] Finally, let $\delta_i^j \in [0,1]$ denote the ownership share downstream firm i acquires in upstream firm j. Information is assumed to be perfect.

The game has three stages:

(1) Downstream firms A and B simultaneously acquire ownership shares δ_i^j of suppliers.
(2) Suppliers simultaneously set sales prices w_i^j.
(3) Downstream firms simultaneously buy input quantities x_i^j from suppliers, produce quantities q_i^j, and sell them at prices p_i.

Underlying the sequencing is the natural assumption that ownership is less flexible than prices are, and also observable by industry insiders. This is crucial, as in the following we employ subgame perfection to analyze how (pure cash flow) ownership affects prices. Yet the assumption that suppliers can commit to upstream prices before downstream prices are set is inessential here.

Upstream supplier j's profit is given by

$$\pi^j = \sum_{i \in \{A,B\}} \left(w_i^j - c^j\right) x_i^j. \tag{2.2.1}$$

Downstream firm i's profit, including the return from the shares held in upstream firms,

$$\Pi_i = \underbrace{p_i\, q_i(p_i, p_{-i}) - \sum_{j \in \{U,V\}} w_i^j\, x_i^j}_{\text{operational profit}} + \underbrace{\sum_{j \in \{U,V\}} \delta_i^j\, \pi^j}_{\text{upstream profit shares}}, \tag{2.2.2}$$

is to be maximized with respect to its own price p_i, subject to the constraint $\sum_j x_i^j \geq q_i$, so that input purchases are sufficient to satisfy quantity demanded.

[10] In our companion article Hunold et al. (2012b), we consider ineffective competition and compare the effects of passive and controlling partial backward and forward integration.

[11] The symmetry assumption downstream, and the restriction to two firms downstream and upstream, respectively, are without loss of generality. One should be able to order the upstream firms by degree of efficiency, however. Rather than from V, the downstream firms could procur from the world market at marginal cost c.

[12] We show in Subsection 2.6.4 that the results extend to observable two part tariffs.

We use the term *partial ownership* for an ownership share strictly between zero and one. We call *passive* an ownership share that does *not* involve control over the target firm's pricing strategy, and *active* one that does. The possibility to control the target's instruments is treated as independent of the ownership share in the target. With this we want to avoid the discussion of at which level of shareholdings control arises. That depends on institutional detail and the distribution of ownership share holdings in the target firm. Although a restriction of ownership shares to below 1/2 appears highly plausible for ownership to be passive, our results on passive ownership hold for any partial ownership share. See O'Brien and Salop (1999), as well as Hunold et al. (2012) for a discussion of when control arises.

Finally, we define an allocation to involve *effective* (upstream) *competition,* if the efficient upstream firm is constrained in its pricing decision by its upstream competitor, i.e. can charge effective unit input prices, as perceived by downstream firms, no higher than c.

An equilibrium in the third, downstream pricing stage is defined by downstream prices p_A^* and p_B^* as functions of the upstream prices w_i^j and ownership shares δ_i^j, $i \in \{A, B\}; j \in \{U, V\}$ held by the downstream in the upstream firms, subject to the condition that upstream supply satisfies downstream equilibrium quantities demanded. In order to characterize that equilibrium, it is helpful to impose the following conditions on the profit functions:

Assumption 6. $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial {p_i}^2} < 0$ *(concavity),*

Assumption 7. $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i \partial p_{-i}} > 0$ *(strategic complementarity),*

Assumption 8. $\frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i \partial p_{-i}} / \frac{\partial^2 \Pi_i(p_i, p_{-i})}{\partial p_i \partial p_i} > \frac{\partial^2 \Pi_{-i}(p_{-i}, p_i)}{\partial p_{-i} \partial p_{-i}} / \frac{\partial^2 \Pi_{-i}(p_{-i}, p_i)}{\partial p_{-i} \partial p_i}$ *(stability).*[13]

An equilibrium in the second, upstream pricing stage specifies prices w_i^{j*} conditional on ownership shares δ_i^j, $i \in \{A, B\}; j \in \{U, V\}$.

We sometimes wish to obtain closed form solutions for the complete game, by using the linear demand specification

$$q_i(p_i, p_{-i}) = \frac{1}{(1+\gamma)} \left(1 - \frac{1}{(1-\gamma)} p_i + \frac{\gamma}{(1-\gamma)} p_{-i}\right), \quad 0 < \gamma < 1, \tag{2.2.3}$$

with γ quantifying the degree of substitutability between the downstream products so that $\gamma = 0$ if the two products are independent, and as $\gamma \to 1$ the products become perfect substitutes. With this demand specification, Assumptions 5 to 8 are satisfied.

2.3. Stage 3: Supplier choice and the determination of downstream prices

Downstream firm i's cost of buying a unit of input from supplier j in which it holds δ_i^j shares is obtained by differentiating the downstream profit (2.2.2) with respect to the

[13] The stability assumption implies that the best-reply function of i plotted in a (p_i, p_{-i}) diagram is flatter than the best-reply function of $-i$ for any p_{-i}, implying that an intersection of the best reply functions is unique.

input quantity x_i^j, i.e.

$$\frac{\partial \Pi_i}{\partial x_i^j} = -\underbrace{w_i^j}_{\text{input price}} + \underbrace{\delta_i^j \left(w_i^j - c^j\right)}_{\text{upstream profit increase}}.$$

Thus, the unit input price w_i^j faced by downstream firm i is reduced by the contribution of that purchase to supplier j's profits. Call $-\frac{\partial \Pi_i}{\partial x_i^j}$ the *effective input price* downstream firm i is confronted with when purchasing from firm j. The minimal effective input price for downstream firm i is given by

$$w_i^e \equiv \min \left\{ w_i^U \left(1 - \delta_i^U\right),\, w_i^V \left(1 - \delta_i^V\right) + \delta_i^V c \right\}. \tag{2.3.1}$$

As natural in this context, firm i buys from the upstream supplier j offering the minimal effective input price. If both suppliers charge the same effective input price, we assume that i buys the entire input quantity from the efficient supplier U, as that supplier could slightly undercut to make its offer strictly preferable. Let $j(-i)$ denote the supplier j from which the other downstream firm $-i$ buys its input. Differentiating the two downstream firms' profits with respect to their own downstream price yields the two first order conditions

$$\frac{\partial \Pi_i}{\partial p_i} = (p_i - w_i^e) \frac{\partial q_i}{\partial p_i} + q_i (p_i,\, p_{-i}) + \delta_i^{j(-i)} \left(w_{-i}^{j(-i)} - c^{j(-i)}\right) \frac{\partial q_{-i}}{\partial p_i} = 0, \qquad i \in \{A,\, B\}. \tag{2.3.2}$$

Observe that whenever $\delta_i^{j(-i)} > 0$, downstream firm i takes into account that changing its sales price affects the upstream profits earned via sales quantities q_{-i} to its competitor.[14]

By Assumptions 1–4, the equilibrium of the downstream pricing game is unique, stable and fully characterized by the two first order conditions for given input prices and ownership shares. Note that strategic complementarity holds under the assumption of product substitutability if margins are non-negative and $\frac{\partial^2 q_{-i}}{\partial p_i \partial p_{-i}}$ is not too negative (cf. Equation (2.3.2)). Also observe that if prices are strategic complements at $\delta_A = \delta_B = 0$, then strategic complementarity continues to hold for small partial ownership shares.

2.4. Stage 2: Determination of upstream prices under passive ownership

V cannot profitably sell at a (linear) price below its marginal production cost c. U as the more efficient supplier can profitably undercut V at any positive upstream price. This implies that, in equilibrium, U supplies both downstream firms, and this at effective prices at most as high as c.[15] To simplify notation, let henceforth $\delta_i \equiv \delta_i^U$ and $w_i \equiv w_i^U$. Let $p_i^*(w_i,\, w_{-i}|\delta_A,\, \delta_B)$ denote the equilibrium prices of the downstream subgame as a function of the input prices. Formally, $U's$ problem is

$$\max_{w_A, w_B} \pi^U = \sum_{i=A,B} w_i\, q_i \left(p_i^*(w_i,\, w_{-i}|\delta_A,\, \delta_B),\, p_{-i}^*(w_{-i},\, w_i|\delta_A,\, \delta_B)\right) \tag{2.4.1}$$

subject to the constraints $w_i (1 - \delta_i) \leq c$, $i \in \{A,\, B\}$ such that downstream firms prefer to source from U. Differentiating the reduced-form profit in (2.4.1) with respect to w_i

[14]This effect is not present with quantity competition, as then q_{-i} is not a function of the strategic variable q_i.

[15]This also implies that none of the downstream firms has an interest in obtaining passive shares from the unprofitable upstream firm V.

yields

$$\frac{d\pi^U}{dw_i} = q_i(p_i^*, p_{-i}^*) + w_i \frac{dq_i(p_i^*, p_{-i}^*)}{dw_i} + w_{-i} \frac{dq_{-i}(p_{-i}^*, p_i^*)}{dw_i}. \tag{2.4.2}$$

Starting at $w_i = w_{-i} = 0$, it must be profit increasing for U to marginally increase upstream prices, because both $q_i > 0$ and $q_{-i} > 0$. By continuity and boundedness of the derivatives, this remains true for not too large positive upstream prices. Hence if c is sufficiently small, then the constraints are strictly binding for any partial ownership structure, so there is *effective upstream competition.* In this case, the *nominal upstream equilibrium prices* are given by

$$w_i^* = c/(1 - \delta_i), \tag{2.4.3}$$

and the *effective upstream prices* both equal c. We assume this regime to hold in the core part of the article.[16] In this regime, U's profits are uniquely given by

$$\pi^U = \frac{c}{(1-\delta_A)}\, q_A(p_A^*, p_B^*) + \frac{c}{(1-\delta_B)}\, q_B(p_B^*, p_A^*), \tag{2.4.4}$$

and V's profits are zero. We summarize in

LEMMA 2.1. *The efficient upstream firm U supplies both downstream firms at any given passive partial backward ownership shares* (δ_A, δ_B)*. Under effective upstream competition, i.e. for sufficiently small c, U charges prices* $w_i^* = c/(1-\delta_i), i \in \{A, B\}$*, so that the effective input prices are equal to the marginal cost c of the less efficient supplier V.*

With these upstream prices, downstream profits reduce to

$$\Pi_i \quad = \quad (p_i - c)\ q_i + \delta_i \frac{c}{1-\delta_{-i}} q_{-i}. \tag{2.4.5}$$

Observe that if firm i holds shares in firm U so that $\delta_i > 0$, its profit Π_i, via its upstream holding, *increases* in the quantity demanded of its rival's product q_{-i}. All else given, this provides for an incentive to raise the price for its own product. Formally, firm i's marginal profit

$$\frac{\partial \Pi_i}{\partial p_i} = q_i + (p_i - c)\frac{\partial q_i}{\partial p_i} + \delta_i \frac{c}{1-\delta_{-i}} \frac{\partial q_{-i}}{\partial p_i} \tag{2.4.6}$$

increases in δ_i. Also, if $\delta_i > 0$, then the marginal profit of i increases in δ_{-i}, as this increases the upstream margin earned on the product of $-i$. If the downstream products were not substitutable, i.e. $\frac{\partial q_{-i}}{\partial p_i} = 0$, the marginal profit and thus the downstream pricing would not be affected by backward ownership. As the products $(i, -i)$ become closer substitutes, $\frac{\partial q_{-i}}{\partial p_i}$ increases and the external effect internalized via the cash flow right δ_i becomes stronger, and with it the effect on equilibrium prices.

In all, this yields the following central result:

PROPOSITION 2.1. *Let Assumptions 1-4 hold and upstream competition be effective. Then*

(i) both equilibrium downstream prices p_i^* *and* p_{-i}^* *increase in both* δ_i *and* δ_{-i} *for any non-controlling ownership structure,*

(ii) the increase is stronger when the downstream products are closer substitutes.

[16]Clearly, if $\pi^U(w_A, w_B)$ is concave, one, or both of the constraints do not bind for c sufficiently large, in which case U can charge the unconstrained monopoly price below c. When both constraints do not bind, we are in the case of ineffective competition analyzed in Hunold et al. (2012b).

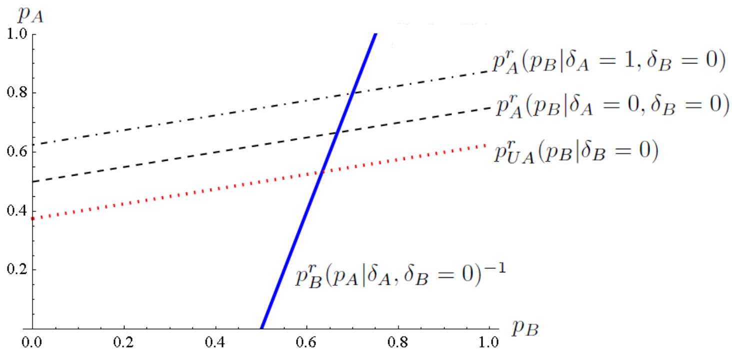

FIGURE 2.4.1. Best-reply functions of downstream firms A, B and the vertically integrated unit UA for linear demand as in (2.2.3), with $\gamma = 0.5$ and $c = 0.5$.

The following corollary is immediate:

COROLLARY 2.1. *Any increase in passive ownership in U by one or both downstream firms is strictly anti-competitive.*

Proposition 2.1 is illustrated in Figure 2.4.1 for the case $\delta_A > \delta_B = 0$. The solid line is the inverted best-reply function $p^r_B(p_A)^{-1}$ of B at a given $\delta_A > 0$. The dashed line is $A's$ best reply $p^r_A(p_B)$ for $\delta_A = 0$, and the dashed-dotted line above this is $A's$ best reply for $\delta_A \to 1$. Hence, choosing δ_A amounts to choosing the best-reply function $p^r_A(p_B)$ in the subsequent pricing game. This becomes central when analyzing the profitability of acquisitions in the next section.

Before going on, we should emphasize that the nominal transfer prices charged here are higher for the firm with the larger interest in the efficient upstream supplier. This is interesting because, in view of its potential impact on foreclosure, the competition policy analyst usually considers dangerous preferentially low transfer prices between vertically related firms.

2.5. Stage 1: Acquisition of shares by downstream firms

Here we assess the profitability of downstream firms' backward acquisitions of passive stakes in upstream firms. We restrict our attention to the acquisition of stakes in firm U. This is easily justifiable within the context of our model: As both downstream firms decide to acquire input from the more efficient firm, the less efficient firm V does not earn positive profits in equilibrium. Hence, there is no scope for downstream firms to acquire passive interests in V.

Rather than specifying how bargaining for ownership stakes takes place and conditioning the outcome on the bargaining process, we determine the central incentive condition for backward acquisitions to materialize, namely that there are gains from trading claims to profits in U between that upstream firm and one of the downstream firms. For the sake of brevity, we abstain from modeling the ownership acquisition game, that would specify the redistribution of rents to the industry generated from passive backward integration.

In order to enhance the intuition, fix for the moment the stakes held by firm B at $\delta_B = 0$. Gains from trading stakes between A and U arise if the joint profit of A and U,

$$\Pi^U_A(\delta_A|\delta_B = 0) \equiv p^*_A\, q^*_A + c\, q^*_B,$$

is higher at some $\delta_A \in (0,1)$ rather than at $\delta_A = 0$, where p_A^*, q_A^* and q_B^* all are functions of δ_A.[17] The drastic simplification of this expression results from the fact that a positive δ_A just redistributes profits between A and U. The gains from trade between A and U can thus arise only via indirect effects on prices and quantities induced by increases in δ_A. Why should there be such gains from trade at all?

The vertical effects of an increase in δ_A between A and U are exactly compensating as the effective transfer price remains at c (Lemma 2.1). All that changes are A's marginal profits. They increase in δ_A, because with this A internalizes an increasing share of U's sales to B. Again, this leads A to increase p_A, which in turn induces B to increase p_B. That price increase is not only profitable to B, but eventually yields a net benefit to A and U. Intuition suggests that this competition softening effect increases the profits of U and A if competition in the industry is fierce. Indeed, evaluating $d\Pi_A^U/d\delta_A$ at small c yields

PROPOSITION 2.2. *An increasing partial passive ownership stake of firm i firm in firm U increases the combined profits of i and U, if upstream competition is sufficiently intense.*

This argument continues to hold if both downstream firms buy shares in the efficient upstream firm, under the obvious restriction that control is *not* transferred from U to any one of the downstream firms.[18]

COROLLARY 2.2. *Increasing partial passive ownership stakes of firms i and $-i$ in firm U increase the industry profit $\Pi_{AB}^U \equiv p_A^* q_A^* + p_B^* q_B^*$, if upstream competition is sufficiently intense.*

Using the linear demand example introduced in (2.2.3), we can make explicit how our case assumption that upstream competition is intense enough relates to the intensity of downstream competition. Let $\delta_{-i} = 0$. Then the joint profits of firms i and U are maximized at a positive passive ownership share δ_i if $c < \gamma^2/4$. For close to perfect downstream competition, i.e. γ close to 1, this implies that passive backward ownership is profitable for a range of marginal costs up to 1/2 of the industry's downstream monopoly price.

As a firm's backward interests confer a positive externality on the second firm's profits, the industry profits $p_A^* q_A^* + p_B^* q_B^*$ are maximized at strictly positive passive ownership shares by both firms if the less restrictive condition $c < \gamma/2$ holds. The fact that $\gamma^2/4 < \gamma/2$ indicates the internalization of the positive externality on the downstream competitor when interests in the efficient upstream firm are acquired to maximize industry profits.

One might worry about the magnitude of the effect derived; also when many inputs are procured to produce a unit of the downstream product. Let us start with the baseline case, in which the downstream products are produced with only one input. Under the assumed close substitutability between the downstream products, the change in own demand induced by a price change is of the same order of magnitude as the change in the competitor's demand. In equilibrium, the former is weighted by the margin $p_A - c$,

[17] Passive backward ownership of A in U benefits B as A prices more softly. Our assessment of the profitability of backward ownership is conservative as this benefit cannot be extracted by U who can at most charge B a unit price of c. With commitment to exclusive supply from U or two-part tariffs, U can extract the profit increase of B through a higher marginal price or an up-front fee. See Subsection 2.6.4 for details.

[18] In Subsection 2.6.1, we consider the effect of a transfer of control, and compare the outcome with the present one.

whence the latter is weighed by $\frac{\delta_A}{1-\delta_B}c$. The former can be easily dominated by the latter, even when the shares held by the downstream firms in the upstream efficient supplier are small.

Take now a $2-1$ technology, in which the downstream product is produced by two inputs. Suppose that input 1 is produced in an industry structured as in the baseline model, and commodity 2 can be procured at a price of c_2. The effective downstream margin is now given by $p_A - c - c_2$, and can be easily dominated by $\frac{\delta_A}{1-\delta_B}c$. What matters is that the margin of the input on which backward integration takes place is relatively large when compared to the downstream margin. Note also that if a downstream firm integrates backward in the efficient supplier of each input, the overall effect is that of backward integration in case of a 1:1 technology.

In passing, all of these results give rise to interesting hypotheses to be tested empirically. A particularly intricate one is that the externality alluded to here provides incentives to acquire passive shares in suppliers to competitors. This hypothesis could provide an explanation for the empirical puzzle demonstrated by Atalay et al. (2012) that a majority of backward acquisitions is *not* accompanied by physical product flows. Yet it still needs to be looked at empirically.

One also might want to speculate about the consequences of the effect derived here for the entry of firms downstream and upstream. Due to the externality generated on the outsiders by increasing prices, downstream entry may be invited rather than deterred. By contrast, upstream, the externality results from the fact that all downstream firms are supplied by the efficient firm. This tends to constitute an entry barrier.

2.6. Extensions

2.6.1. Effects of control. In this extension, we compare the effects of passive partial backward integration of one of the downstream firms (say A) into the efficient upstream firm U, with those generated by a merger between the two firms. We first consider the merger.

Let the ownership structure under vertical integration be described by $\{\delta_A = 1,\ \delta_B = 0\}$, and let A control U's pricing decisions. As U is more efficient than V, the fully integrated firm continues, as heretofore, to meet any positive price w_B^V charged by V. Under effective upstream competition, it is again optimal to set $w_B^U = c$. Yet, by virtue of being merged with U, A takes account of the true input cost normalized to zero.[19]

Consider now the effect of full integration of A and U on downstream prices. Still faced with marginal input cost c, B's best-reply function remains unchanged. Yet full integration has two countervailing effects on the setting of p_A. Upward price pressure arises because the integrated unit fully internalizes the upstream profit from selling to firm B, that is $c\,q_B(p_B, p_A)$. Conversely, downward price pressure arises because double marginalization on product A is eliminated, as the downstream costs, $c\,q_A(p_A, p_B)$ under separation, are decreased to zero. Indeed, downward pressure is stronger when the own price effect dominates the cross price effect, yielding

Proposition 2.3. *Under Assumptions 1 to 4, a vertical merger between one downstream firm and U decreases both downstream prices, as compared to complete separation.*

[19]In line with the literature – examples are Bonanno and Vickers (1988), Chen (2001), and Hart and Tirole (1990) – the integrated firm is considered unable to commit to an internal transfer price higher than its true marginal cost.

As another consequence, observe that input foreclosure does not arise under vertical integration.

Returning to Figure 2.4.1, note that for any $\delta_A > 0$, the best response of the merged entity, $p^r_{UA}(p_B)$, represented by the dotted line in Figure 2.4.1, is located below the one arising under separation.

Proposition 3 is also contained in Chen (2001). Yet for an anti-competitive increase in downstream prices to occur in that model, Chen needs to assume that B has to make supplier specific investments to buy from U, so that the integrated firm can set $w^U_B > c$ and still continue to be the exclusive supplier of B. By contrast, as we state in Proposition 2.1, downstream prices increase even without switching costs, once we allow for the separation of profit claims and control of the target. Summarizing:

Corollary 2.3. *Under Assumptions 1 to 4 and effective upstream competition, a vertical merger between one of the downstream firms and the efficient upstream firm leads to a decrease of all downstream prices when compared to those arising under vertical separation, whence any passive partial backward ownership of one or both downstream firms in the efficient supplier U leads to an increase in all downstream prices.*

We now turn to a comparison of the combined profits of A and U under full vertical separation and full integration. By Proposition 2.3, vertical integration decreases both downstream prices. This is not necessarily desirable for A and U, as long as the overall margins earned under vertical separation are below the industry profit maximizing level. In order to assess whether separation increases the combined profits Π^U_A, we ask whether, at vertical separation, it is profitable to move towards integration. Indeed, we can show that this is strictly unprofitable, as long as c is sufficiently small. By continuity, there exists an interval $(0, \bar{c}]$ such that for any c in this interval vertical separation is more profitable than integration. Hence

Lemma 2.2. *A merger between A and U is less profitable than complete vertical separation if upstream competition is sufficiently intense.*

Combining Proposition 2.2 and Lemma 2.2 yields

Corollary 2.4. *Passive partial backward integration of firm i into firm U is more profitable than vertical integration, if upstream competition is sufficiently intense. Then, downstream firms have the incentive to acquire maximal backward interests, short of controlling the upstream firm U.*

As mentioned before, this result is nicely related to the literature on strategic delegation. The particular twist here is that *the very instrument intended to acquire control, namely the acquisition of equity in the target firm, is employed short of controlling the target. This benefits the industry, but it harms consumer welfare.*

A remark on control with partial ownership. The key driver behind Corrollary 2.4 is that passive ownership preserves double marginalization, whereas a vertical merger eliminates it. It is common in the literature on vertical relations to assume that a merged entity cannot commit to internal transfer prices above marginal costs (see footnote 19).

This assumption is arguably less straightforward with controlling partial ownership, say when A has a block of voting shares of U. If downstream competition is sufficiently strong, the shareholders of A and U collectively have an incentive to commit to a high transfer price w_A. However, A has an individual incentive to be charged a low price, or at least wants to be compensated with a fixed payment. If A cannot be compensated or commitment to a high price is not feasible as renegotiations remain possible, A will use its control to decrease w_A, its own input costs. In a standard bargaining framework, the price w_A decreases more, the more control A has over U, whereas the price for B remains unchanged as there is no conflict of interest over it among the shareholders of U.

2.6.2. Non-discriminatory upstream prices. Many competition laws require a firm to charge non-discriminatory prices. While by the U.S. Robinson-Patman Act, non-discrimination is a widely applied rule, Article 102 of the Treaty on the Functioning of the European Union restricts the application of the rule to dominant firms.

Clearly, under effective competition, symmetric passive ownership with $\delta_A = \delta_B > 0$ may arise as an equilibrium. Supplier U then has no incentive to price discriminate. Yet, as we have shown in Proposition 2.1, symmetric passive ownership is clearly anti-competitive, so in this case, a non-discrimination rule has no effect at all, and in particular no pro-competitive effect.

Consider instead one of the firms', say A's, incentive to acquire a backward interest in firm U when non-discrimination is effective and $\delta_B = 0$. Then U must charge a uniform price c if it wants to serve both downstream firms. This yields profits to A of

$$\Pi_A \quad = \quad (p_A - c) \cdot q_A + \delta_A \, c \cdot \, (q_A + q_B) \, .$$

Differentiating with respect to p_A and δ_A yields

$$\frac{\partial^2 \Pi_A}{\partial p_A \partial \delta_A} \quad = \quad c \cdot \left[\frac{\partial q_A(p_A, p_B)}{\partial p_A} + \frac{\partial q_B(p_B, p_A)}{\partial p_A} \right] . \tag{2.6.1}$$

By Assumption 5, the own price effect dominates the cross price effect, and therefore the cross derivative in (2.6.1) is negative at $\delta_A = 0$. Thus marginally increasing δ_A decreases the marginal profit of A. Hence, the best reply $p_A^r(p_B|\delta_A)$ and, in consequence, both equilibrium downstream prices, decrease in δ_A at $\delta_A = 0$. By continuity, this holds for small positive δ_A. This result generalizes to all feasible δ_A as long as $\frac{\partial q_B}{\partial p_A} \leq \frac{\partial q_A}{\partial p_B}$ for $p_A < p_B$, e.g. in case of linear demand. Under this condition, if only one downstream firm has passive ownership in U, and U optimally serves both downstream firms, then such ownership is not anti-competitive under a non-discrimination rule.[20]

2.6.3. Simultaneous price setting. So far, we have assumed that upstream prices are set before downstream prices. Consider now that all prices are set simultaneously. In this situation, upstream firms take downstream prices as given. For U, increasing effective prices up to c does not affect quantity. Hence, effective equilibrium upstream prices must be equal to c. However, with simultaneous price setting, an equilibrium does only exist as long as the participation constraints of downstream firms are not violated at effective upstream prices of c.

LEMMA 2.3. *Under effective competition, sequential and simultaneous setting of up- and downstream prices are outcome equivalent.*

[20] U wants to serve both downstream firms for a small δ_i, given $\delta_{-i} = 0$. Once δ_i becomes large, U may find it profitable to set a high nominal price at which only i wants to purchase. This makes $-i$ dependent on V. In turn, V can raise the price charged to $-i$ above c, yielding partial foreclosure. However, it is unclear whether partial foreclosure is an equilibrium. In a forthcoming article, we will discuss in detail the effects of non-discrimination rules in the different case situations.

Note that as long as the participation constraints of downstream firms do not bind, the simultaneous price setting is equivalent to the case in which downstream prices are set first, followed by upstream prices and, finally, downstream firms choose where to buy inputs.

2.6.4. Two-part tariffs. The assumption of linear upstream prices is clearly restrictive, as argued already in Tirole (1988). Caprice (2006) as well as Sandonis and Fauli-Oller (2006) have pointed out that with effective upstream competition, observable two part tariffs offered by the efficient supplier U implement downstream prices below the industry profit maximizers. One reason is that U does not want to offer marginal input prices as high so that they maximize industry profits, because downstream firm $i's$ alternative to sourcing from U, given its rival $-i$ sources from U, is more valuable when U charges $-i$ a higher marginal price. This induces U to lower the marginal prices below the industry profit maximizing level, in order to obtain more rents through the fixed fees.

Moreover, if U cannot offer exclusive contracts, a downstream firm will source inputs alternatively once the marginal input price charged by U exceeds the alternative input price. In our setting, this implies that without backward interests by a downstream firm, U cannot implement a marginal price above c to that firm. We show that in the case discussed heretofore, U indeed would like to offer marginal prices above c. Thus marginal input prices in equilibrium equal c and the fixed fee F equals zero, i.e. the transfer prices U charges are endogenously linear.

In what follows, we formally characterize the two-part contracting problem and show that passive backward ownership can increase downstream prices.

We start from complete vertical separation, so that $\delta_A = \delta_B = 0$, and maintain the assumptions that all contract offers are observable to all downstream firms upon acceptance; in particular that acceptance decisions are observed when downstream prices are set. A tariff offered by supplier j to downstream firm i is summarized by $\{F_i^j, w_i^j\}$, where F_i^j is the fixed fee downstream firm i has to pay the upstream firm j upon acceptance of the contract, and w_i^j continues to be the marginal input price. Denote by $\pi_i^*(w_i^j, w_{-i}^k)$, $j,k \in \{U,V\}$, firm i's reduced form downstream profits at downstream equilibrium prices as a function of the marginal input price relevant for each downstream firm, but gross of any fixed payment. With the model constructed as in the main part of the article, the Bertrand logic still holds: U can always profitably undercut any (undominated) offer by V, so in equilibrium U exclusively supplies both downstream firms. Yet if upstream competition is effective as assumed throughout, U is restricted by V in its price setting. We require that V's offers, if accepted, yield it non-negative profits.

More formally, for given contract offers of V to firm A and B, U's problem is

$$\begin{aligned} \max_{f_A^U, f_B^U, w_A^U, w_B^U} \pi^U &= \sum_{i \in \{A,B\}} \left[w_i^U q_i + F_i^U \right] \\ s.t. \qquad & \pi_i^* \left(w_i^U, w_{-i}^U \right) - F_i^U \geq \pi_i^* \left(w_i^V, w_{-i}^U \right) - F_i^V . \end{aligned} \tag{2.6.2}$$

U has to ensure that each downstream firm's deviation to source from V is not profitable. In equilibrium, the profit constraints of both downstream firms must be binding, as otherwise U could profitably raise the respective fixed fee F_i^U, until downstream firm i is indifferent between its and V's contract offer.

Let the contracts offered by upstream firms first be non-exclusive, so that an upstream firm cannot contractually require a downstream firm to exclusively procure from it. Then, setting a marginal input price $w_i^U > c$ with $F_i^U < 0$ cannot be an equilibrium, as V could profitably offer $\{F_i^V = 0, w_i^V \in [c, w_i^U)\}$, which would provide incentives to downstream firm i to accept U's contract offer in order to cash in F_i^U, but to source its entire input at the marginal cost w_i^V offered by V.

The equilibrium contract offers made by V must be best replies to U's equilibrium contract offers. Hence

LEMMA 2.4. *If U offers two-part tariffs with $w_i^U \leq c$, $i \in \{A, B\}$, then $\{0, c\}$ is V's unique non-exclusive counteroffer that maximizes the downstream firms' profits and yields V a non-negative profit.*

Using this insight and letting $w_i \equiv w_i^U$ and $F_i \equiv F_i^U$ to simplify notation, $U's$ problem reduces to

$$\max_{w_A, w_B} \pi^U = \underbrace{\sum_{i\in\{A,B\}} p_i^*(w_i, w_{-i})\, q_i^*}_{\text{industry profit}} - \underbrace{\sum_{i\in\{A,B\}} \pi_i^*\,(c,\, w_{-i})}_{\text{outside options}} \tag{2.6.3}$$

subject to the no-arbitrage constraints $w_i \leq c$, $i \in \{A, B\}$.

For $c = \infty$, the outside options equal 0, and U simply maximizes the industry profit by choosing appropriate marginal input prices. As c decreases, sourcing from V eventually yields downstream firms positive profits. Moreover, firm i's outside option, the profit $\pi_i^*\,(c,\, w_{-i})$ it would obtain when sourcing from V, increases in the rival's cost w_{-i}. Hence the marginal profit $\partial\pi^U/\partial w_i$ is below the marginal industry profit. For c sufficiently small, the marginal industry profit is still positive when the arbitrage constraints are binding, i.e. at $w_A = w_B = c$. Hence the motive of devaluing the contract partners' outside options is dominated by the incentive to increase double marginalization, yielding the result that *upstream tariffs are endogenously linear.* We summarize in

PROPOSITION 2.4. *Let upstream competition be sufficiently intense. Then under vertical separation, $\{c, 0\}$ is the unique symmetric equilibrium non-exclusive two-part tariff offered by both upstream to both downstream firms.*

As before, *sufficient intensity* of upstream competition is to be seen relative to the intensity of downstream competition. In our linear demand example, it suffices to have $c < \gamma^2/4$. In passing, this is also the condition ensuring the profitability of an initial increase of passive backward ownership δ_i to i and U.

What does change if we allow for passive partial backward integration? As $\{0, c\}$ is a corner solution, (at least some) passive backward ownership does not change the efficient upstream firm's incentive to charge maximal marginal prices.

Moreover, recall that passive backward ownership of i in U exerts a positive externality on $-i$ as i prices more softly, but only if $-i$ sources from U. With two-part tariffs, U can extract the upward jump in $-i$'s payoffs by charging a positive fixed fee.[21] Assuming that commitment to only buy from U is not feasible, we obtain

LEMMA 2.5. *Let upstream competition be sufficiently intense and $\delta_i > \delta_{-i} = 0$. The non-exclusive two-part tariff offered by U to i has $w_i = c/(1 - \delta_i)$ and $F_i = 0$, and the tariff to $-i$ has $w_{-i} = c$ and $F_{-i} > 0$.*

[21] U could also charge B marginal price above c, but only if commitment to exclusive dealing of B with U is possible. To remain consistent with the main part, we rule this out here, as does Chen (2001).

Thus, when firm i has acquired a positive share, the effective input price U charges it remains at c as under linear tariffs. With non-exclusivity, a higher marginal input price is not feasible, as then firm i would buy the inputs from V, that continues to charge $\{0, c\}$. Hence Proposition 2.2 still applies and we obtain

COROLLARY 2.5. *Let upstream competition be sufficiently intense. Then partial passive ownership of downstream firm i in supplier U increases bilateral profits* Π_i^U *as well as industry profits* Π_{AB}^U *compared to complete separation, even if non-exclusive two-part tariffs are allowed for.*

Hence the results derived in the main part of the article for linear tariffs are upheld with non-exclusive observable two-part tariffs, if competition is sufficiently intense. When upstream competition is less intense, it is optimal for U to charge effective marginal prices below c to reduce the downstream firms' outside options. Thus the no-arbitrage constraint $w_i \leq c/(1-\delta_i)$ is no longer binding, which is also the case when U offers exclusive two-part tariffs. Yet passive backward integration still relaxes downstream competition for given effective input prices. Moreover, U can still extract the positive externality of backward ownership on downstream competitors by raising either the fixed fee or the marginal price. Assuming that demand is linear and V offers $\{0, c\}$, one can show that passive backward ownership is indeed both profitable and increases downstream prices for large parameter ranges of c and γ where contracts with effective marginal input prices above or below c result.[22]

2.6.5. Ineffective competition. In the baseline model, we have analyzed the effects of passive partial backward integration when there is *effective upstream competition*, as generated by a small difference c in marginal costs between the efficient firm U and the less efficient firm V, such that U was constrained in its pricing. We now sketch the case that the cost difference c is so large that U can behave as an unconstrained upstream monopolist.

Consider first complete vertical separation. With linear upstream prices, the well known double marginalization problem arises, so that the equilibrium downstream prices are above the level that maximizes industry profits, and approach the industry profit maximizing prices from above only as downstream competition tends to become perfect. For the industry, it is not desirable to further relax competition. Instead, it is desirable to reduce margins with, for example, resale price maintenance, passive forward integration, or observable two-part tariffs. With observable two-part tariffs, U can maximize the industry profits by choosing the marginal price in accordance to downstream competition and extracting all downstream profits through fixed fees. Hence the owners of U have no interest in backward ownership because the profits they can extract are already maximized.

The case with linear tariffs is less straightforward. As before, for given marginal input prices w_A and w_B, an increase in the passive backward ownership share δ_A in the supplier reduces A's effective input price, so that A has an incentive to lower its sales price. Yet a positive δ_A also induces A to internalize its rivals' sales, so that A wants to increase its sales price. The first effect tends to dominate, so that downstream prices decrease in

[22]If V can also offer exclusive contracts, the analysis is more complicated. We simplify here to increase expositional clarity.

δ_A for given (nominal) input prices. As U is unconstrained, it can adjust w_A and w_B in response to any ownership change until its marginal profits are zero again. Hence, both effects of an increase in δ_A on downstream prices are internalized by the unconstrained upstream monopolist. This gives rise to invariant downstream prices in case of symmetric backward ownership.[23]

By contrast, with effective upstream competition in our model, only the first, marginal cost decreasing effect of an increase in δ_A is counterbalanced by the efficient upstream firm U, and that perfectly. Hence the overall effect equals the second effect of internalizing the rivals' sales, and thus both downstream prices increase in δ_A.

2.6.6. Comparing passive backward with passive horizontal integration. We have shown that passive backward integration of downstream firms, rather than inviting foreclosure, induces downstream horizontal coordination, leading to increasing downstream prices. One might be tempted to ask how this price change compares to that induced by direct passive horizontal integration. Let us compare the profits of the integrating downstream firm, say A, under the two forms of integration, with the same block share $\delta_A > 0$, and let $\delta_B = 0$. Under backward integration as heretofore, they are, at competitive upstream prices, given by

$$\Pi_A = (p_A - c)\, q_A + \delta_A\, c\, q_B, \tag{2.6.4}$$

whence under horizontal integration, they are given by

$$\Pi_A = (p_A - c)\, q_A + \delta_A\, (p_B - c)\, q_B. \tag{2.6.5}$$

By a first order argument, A internalizes the sales of B more under backward integration if $c > p_B - c$, i.e. if the upstream margin of product B is larger than its downstream margin. With linear demand and effective upstream competition, passive backward integration yields a higher price level than passive horizontal integration if $c > g(\gamma)$, where g is a decreasing function.[24] For a given upstream margin c, passive backward integration is more anti-competitive if downstream products are sufficiently close substitutes ($g \to 0$ as $\gamma \to 1$).

2.7. Conclusion

In this article, we consider vertically related markets with differentiated, price setting downstream firms, that produce with inputs from upstream firms supplying a homogeneous product at differing marginal costs. We analyze the impact on equilibrium prices of one or more downstream firms holding passive, that is non-controlling ownership shares in the efficient, and therefore common, supplier. In sharp contrast to earlier studies who focused either on Cournot competition or upstream monopoly, we find that if competition is sufficiently intense, *passive ownership leads to increased downstream prices and thus is strictly anti-competitive.* Also, *passive ownership is anti-competitive where a full vertical merger would be pro-competitive.*

[23]For linear upstream tariffs and symmetric passive backward ownership in the monopoly supplier, Greenlee and Raskovich (2006) show that upstream and downstream price adjustments exactly compensate, so downstream prices stay the same independent of the magnitude of partial ownership and the intensity of downstream competition. In Hunold et al. (2012b), we show that for linear demand, linear prices and upstream price discrimination, there is no incentive to acquire passive backward ownership in the monopoly supplier; moreover, consumer surplus increases with asymmetric backward ownership.

[24]In fact, $g(\gamma) = \frac{2-\gamma-\gamma^2}{6-\gamma-\gamma^2(2+\delta_A)}$.

Confronted with the choice between passive backward integration and a full vertical merger, the firms prefer the former. They voluntarily abstain from controlling the upstream firm, because this would do away with its power to commit to a high transfer price, that increases industry profit. *The very instrument typically employed to obtain control is used up to the point where control is not attained.* This brings an additional feature to the strategic delegation literature.

Our result is driven primarily by a realistic assumption on the upstream market structure, in which an efficient supplier faces less efficient competitors, allowing it to increase upstream prices only when the price increasing effect is absorbed by the downstream firm(s), via their claims on upstream cash flows. We show the result to be robust to changes in other assumptions such as linear upstream prices, and sequential price setting upstream and then downstream. Indeed, once allowing upstream firms to offer observable two-part tariffs, we find that the *equilibrium contracts are endogenously linear* if competition is sufficiently intense. Interestingly enough, under effective upstream competition, passive ownership in suppliers tends *not* to be anti-competitive under a non-discrimination clause.

For competition policy, it is important to recognize that anti-competitive passive ownership in common suppliers is profitable when there is both up- and downstream competition and thus foreclosure potentially *not* the main concern. Most importantly, proposing passive backward ownership in a supplier as a remedy to a proposed vertical merger tends *not* to benefit competition but eventually worsens the competitive outcome, as long as upstream competition is effective and the upstream supplier serves competitors of the raider. The reason is that full vertical integration tends to remove double marginalization via joint control, whilst partial backward integration tends to enhance that.

In the present setting, we abstract from other, potentially socially desirable motives for partial backward ownership. A particularly important effect is the mitigation of agency problems in case of firm-specific investments (Riordan, 1991; Dasgupta and Tao, 2000) such as investment in specific R&D. Indeed, Allen and Phillips (2000) show for a sample of US companies that vertical partial ownership is positively correlated with a high R&D intensity. Yet such potentially pro-competitive effects need to be weighed against the anti-competitive effects of passive backward integration presented here.

Appendix: Proofs

Proof of Proposition 2.1. Suppose for the moment that only downstream firm i holds shares in U, i.e. $\delta_i > \delta_{-i} = 0$. The first order condition $\frac{\partial \Pi_{-i}}{\partial p_{-i}} = 0$ implied by (2.4.6) and, hence, the best-reply $p^r_{-i}(p_i)$ of $-i$ is independent of δ_i. In contrast, the marginal profit $\frac{\partial \Pi_i}{\partial p_i}$ increases in $i's$ ownership share δ_i for $\delta_{-i} \in [0, 1)$. This implies a higher best reply $p^r_i(p_{-i}|\delta_i)$ for any given p_{-i}. By continuity, $\frac{\partial p^r_i(p_{-i}|\delta_i)}{\partial \delta_i} > 0$. Strategic complementarity of downstream prices implies that an increase in δ_i increases both equilibrium prices. This argument straightforwardly extends to the case where both firms hold shares in U because then $\frac{\partial^2 \Pi_i}{\partial p_i \partial \delta_{-i}} > 0$. □

Proof of Proposition 2.2. Differentiating the combined profits of A and U with respect to δ_A and using that $\delta_B = 0$ yields

$$\frac{d\Pi^U_A}{d\delta_A} = \left(p^*_A \frac{\partial q_A}{\partial p_A} + q_A + c\frac{\partial q_B}{\partial p_A}\right)\frac{dp^*_A}{d\delta_A} + \left(p^*_A \frac{\partial q_A}{\partial p_B} + c\frac{\partial q_B}{\partial p_B}\right)\frac{dp^*_B}{d\delta_A}. \tag{2.7.1}$$

Clearly, at $c = 0$, the derivative is equal to zero as $dp^*_i/d\delta_A = 0$ as the upstream margin is zero. To assess the derivative for small, but positive c, further differentiate with respect to c to obtain

$$\begin{aligned}\frac{d^2\Pi^U_A}{d\delta_A dc} &= \frac{d}{d\,c}\left(p^*_A \frac{\partial q_A}{\partial p_A} + q^*_A + c\frac{\partial q_B}{\partial p_A}\right)\frac{dp^*_A}{d\delta_A} + \frac{d}{d\,c}\left(p^*_A \frac{\partial q_A}{\partial p_B} + c\frac{\partial q_B}{\partial p_B}\right)\frac{dp^*_B}{d\delta_A} \\ &+ \left(p^*_A \frac{\partial q_A}{\partial p_A} + q_A + c\frac{\partial q_B}{\partial p_A}\right)\frac{d^2p^*_A}{d\delta_A dc} + \left(p^*_A \frac{\partial q_A}{\partial p_B} + c\frac{\partial q_B}{\partial p_B}\right)\frac{d^2p^*_B}{d\delta_A dc}.\end{aligned}$$

Evaluating this derivative at $c = 0$ yields

$$\frac{d^2\Pi^U_A}{d\delta_A dc}|_{c=0} = p^*_A \frac{\partial q_A}{\partial p_B}\frac{d^2p^*_B}{d\delta_A dc}|_{c=0},$$

because $\frac{dp^*_A}{d\delta_A}|_{c=0} = \frac{dp^*_B}{d\delta_A}|_{c=0} = 0$ and $p_A\frac{\partial q_A}{\partial p_A} + q_A = 0$ (this is the FOC of π_A with respect to p_A at $c = 0$). Recall that $\frac{dp^*_B}{d\delta_A} > 0$ for $c > 0$ (Proposition 2.1) whereas $\frac{dp^*_B}{d\delta_A} = 0$ at $c = 0$. By continuity, this implies $\frac{d^2p^*_B}{d\delta_A\, dc}|_{c=0} > 0$. It follows that $\frac{d^2\Pi^U_A}{d\delta_A dc}|_{c=0} > 0$ which, by continuity, establishes the result. □

Proof of Proposition 2.3. The best response function of A under complete separation is characterized by

$$\frac{\partial \Pi_A}{\partial p_A} = (p_A - c)\frac{\partial q_A}{\partial p_A} + q_A = 0. \tag{2.7.2}$$

rices of c. When maximizing the integrated profit $p_A q_A + w_B q_B$, it is – as argued before – still optimal to serve B at $w_B \leq c$ and, hence, the corresponding downstream price reaction is characterized by

$$p_A\frac{\partial q_A}{\partial p_A} + q_A + w_B\frac{\partial q_B}{\partial p_A} = 0. \tag{2.7.3}$$

Subtract the left hand side (lhs) of (2.7.2) from the lhs of (2.7.3) to obtain $\Delta \equiv c\frac{\partial q_A}{\partial p_A} + w_B\frac{\partial q_B}{\partial p_A}$. The symmetric fixed point under separation ($\delta_A = \delta_B = 0$ and no shift in price control) has $p_A = p_B$. This implies $\frac{\partial q_B}{\partial p_A} = \frac{\partial q_A}{\partial p_B}$. Hence, at equal prices, Δ is negative as $-\frac{\partial q_A}{\partial p_A} > \frac{\partial q_A}{\partial p_B} > 0$ by Assumption 5 and $w_B \leq c$. A negative Δ implies that the marginal profit of A under integration is lower and thus the integrated A wants to set a lower p_A. The best-reply function of B is characterized by

$$\frac{\partial \Pi_B}{\partial p_B} = (p_B - y)\,\frac{\partial q_B}{\partial p_B} + q_B(p_B, p_A) = 0 \tag{2.7.4}$$

with $y = c$ under separation and $y = w_B \leq c$ under integration of A and U. Hence the best reply function $p_B^r(p_A)$ of B is (weakly) lower under integration. Taken together, strategic complementarity and stability (Assumptions 7 and 8) implies that the unique fixed point of the downstream prices under integration must lie strictly below that under separation. □

Proof of Lemma 2.2. We look at the joint profit Π_A^U of A and U when we move from vertical separation to vertical integration. Recall that under effective competition, the upstream firm, integrated or not, will always set the maximal input price $w_B^* = c$ when selling to firm B, and this independently of any choice of w_A. Also recall that $\Pi_A^U = p_A^*\, q_A(p_A^*,\, p_B^*) + c\, q_B(p_B^*, p_A^*)$. Let the equilibrium downstream prices as a function of input prices be given by $p_A^*(w_A, c) \equiv \arg\max_{p_A}\; p_A\, q_A(p_A, p_B^*) + c q_B - w_A\,[q_A + q_B]$ and $p_B^*(c, w_A) \equiv \arg\max_{p_B}\,(p_B - c)\, q_B(p_B, p_A^*)$. Note that $w_A = 0$ yields the downstream prices under integration, and $w_A = c$ those under separation.

The effect of an increase of w_A on Π_A^U is determined by implicit differentiation. This yields

$$\frac{d\Pi_A^{U*}}{dw_A} = \frac{d\Pi_A^{U*}}{dp_A^*}\,\frac{dp_A^*}{dw_A} + \frac{d\Pi_A^{U*}}{dp_B^*}\,\frac{dp_B^*}{dw_A}.$$

First, Assumptions 1-4 imply that at $w_A = c$ and hence $p_A^* = p_B^*$, we have both $\frac{dp_A^*}{dw_A} > 0$ and $\frac{dp_B^*}{dw_A} > 0$ for $c \geq 0$. Second,

$$\frac{d\Pi_A^{U*}}{dp_A^*} = \underbrace{q_A(p_A^*, p_B^*) + (p_A^* - c)\,\frac{\partial q_A}{\partial p_A}}_{=0} + c\,\underbrace{\left[\frac{\partial q_A}{\partial p_A} + \frac{\partial q_B}{\partial p_A}\right]}_{<0\; at\; p_A = p_B} < 0,$$

but approaches 0 as c goes to zero. Third, $\frac{d\Pi_A^{U*}}{dp_B^*} = p_A^*\frac{\partial q_A}{\partial p_B} + c\,\frac{\partial q_B}{\partial p_B}$ is strictly positive for c sufficiently close to zero. In consequence, $\left[\frac{d\Pi_A^{U*}}{dp_B^*}\frac{dp_B^*}{dw_A}\right]_{w_A=c} > 0$ dominates $\left[\frac{d\Pi_A^{U*}}{dp_A^*}\frac{dp_A^*}{dw_A}\right]_{w_A=c} < 0$ as c goes to zero. Summarizing, $\frac{d\Pi_A^{U*}}{dw_A}|_{w_A=c} > 0$ for c sufficiently small. By continuity, decreasing w_A from c to 0 decreases Π_A^{U*} for c sufficiently small which implies that moving from separation to integration is strictly unprofitable. □

Proof of Lemma 2.4. Suppose that firm $-i$ sources only from U. The most attractive contract that V can offer i must yield V zero profits, i.e. $F_i^V = x_i^V \cdot (c - w_i^V)$, with x_i^V denoting the quantity i sources from V. Given $w_i^U \leq c$, the arbitrage possibility due to multiple sourcing renders contracts with $w_i^V > c$ and thus $F_i^V < 0$ unprofitable as x_i^V would be 0. Recall that $p_i^*(w_i, w_{-i})$ denotes the downstream equilibrium price of i as a function of the marginal input prices. The net profit of i when buying all inputs from V is given by

$$\Pi_i = (p_i^*(w_i^V, w_{-i}^U) - w_i^V)\, q_i(p_i^*(w_i^V, w_{-i}^U), p_{-i}^*(w_{-i}^U, w_i^V)) - F_i^V.$$

Substituting for F_i^V using the zero profit condition of V with $x_i^V = q_i$ yields

$$\Pi_i = (p_i^*(w_i^V, w_{-i}^U) - c)\, q_i(p_i^*(w_i^V, w_{-i}^U), p_{-i}^*(w_{-i}^U, w_i^V)).$$

Increasing w_i^V at $w_i^V = c$ is profitable if $d\Pi_i/dw_i^V|_{w_i^V=c} > 0$. Differentiation yields

$$d\Pi_i/dw_i^V = \frac{d\Pi_i}{dp_i^*}\frac{dp_i^*}{dw_i^V} + \frac{d\Pi_i}{dp_{-i}^*}\frac{dp_{-i}^*}{dw_i^V}.$$

Optimality of the downstream prices implies $\frac{d\Pi_i}{dp_i^*} = 0$. Moreover, $\frac{dp_{-i}^*}{dw_i^V} > 0$ follows from the strategic complementarity of downstream prices, and with it, the supermodularity of the downstream pricing subgame. Finally, $\frac{d\pi_i}{dp_{-i}^*} > 0$ follows directly from $\frac{\partial q_i}{\partial p_{-i}} > 0$ (substitutable products). Combining these statements yields

$$\frac{d\Pi_i}{dw_i^V}|_{w_i^V=c} = \frac{d\Pi_i}{dp_{-i}^*}\frac{dp_{-i}^*}{dw_i^V} > 0.$$

This implies that raising w_i^V above c would be profitable for i. However, the no arbitrage condition and $w_i^U \leq c$ renders this impossible. Analogously, decreasing w_i^V below c and adjusting F_i^V to satisfy zero profits of V is not profitable for i. In consequence, the contract offer of V most attractive to any downstream firm i is given by $\{0, c\}$. □

Proof of Proposition 2.4. Recall that for marginal input prices of w_i and w_{-i}, $i's$ equilibrium downstream price is given by $p_i^*(w_i, w_{-i})$. Also recall that

$$\pi_i^*\,(w_i,\, w_{-i}) \equiv [p_i^*(w_i, w_{-i}) - w_i]\; q_i\left(p_i^*(w_i, w_{-i}), p_{-i}^*(w_{-i}, w_i)\right)$$

and substitute for $\pi_i^*(c, w_{-i})$ in (2.6.3) to obtain

$$\begin{aligned}\pi^U = &\sum_i p_i^*(w_i, w_{-i})\, q_i\left(p_i^*(w_i, w_{-i}), p_{-i}^*(w_{-i}, w_i)\right)\\ &- \sum_i \left(p_i^*(c, w_{-i}) - c\right)\; q_i\left(p_i^*(c, w_{-i}), p_{-i}^*(w_{-i}, c)\right).\end{aligned}$$

The first sum captures the industry profits and the second, as $\{0, c\}$ is V's tariff that maximizes the downstream firms' profits (Lemma 2.4), the value of each of the downstream firms' outside option. An obvious candidate equilibrium tariff of U is $\{F^* = c, w^* = 0\}$ to both downstream firms. This results in $\pi^U = 2c\, q_i(p^*(c,c), p^*(c,c))$. Let $\{F^*, w^*\}$ denote alternative symmetric equilibrium candidates offered by U. Recall that $w^* > c$ with $F^* < 0$ is not feasible, as then the downstream firms would source all quantities from V. Towards assessing whether U would benefit from lowering w below c (and increasing F), we differentiate π^U with respect to w at and evaluate it at $w = c$. If that sign is positive for $w_i, i \in \{A, B\}$ separately and jointly, then U has no incentive to decrease its price below c. Differentiation of π^U with respect to w_i yields

(2.7.5)
$$\begin{aligned}\frac{d\pi^U}{dw_i} = &\frac{\partial p_i^*}{\partial w_i}q_i + p_i^*\left(\frac{\partial q_i}{\partial p_i}\frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_i}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i}\right) + \frac{\partial p_{-i}^*}{\partial w_i}q_{-i} + p_{-i}^*\left(\frac{\partial q_{-i}}{\partial p_i}\frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i}\right)\\ &- \frac{\partial p_{-i}^*}{\partial w_i}q_{-i} - \left(p_{-i}^* - c\right)\left(\frac{\partial q_{-i}}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_i}\frac{\partial p_i^*}{\partial w_i}\right).\end{aligned}$$

Evaluating the derivative at $w_i = w_{-i} = c$, subtracting and adding $c\frac{\partial q_i}{\partial p_i}\left(\frac{\partial p_i^*}{\partial w_i} + \frac{\partial p_{-i}^*}{\partial w_i}\right)$, making use of downstream firm i's FOC $\frac{\partial \pi_i}{\partial p_i} = (p_i^* - c)\frac{\partial q_i}{\partial p_i} + q_i = 0$ and simplifying, we obtain

$$(2.7.6)\quad \frac{d\pi^U}{dw_i} = c\left(\frac{\partial q_i}{\partial p_i}\frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i} + \frac{\partial q_{-i}}{\partial p_i}\frac{\partial p_i^*}{\partial w_i} + \frac{\partial q_i}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i}\right) + (p_i^* - c)\,\frac{\partial q_i}{\partial p_{-i}}\frac{\partial p_{-i}^*}{\partial w_i}.$$

Substituting for $p_i^* - c = -q_i/\frac{\partial q_i}{\partial p_i}$ from the FOC $\frac{\partial \pi_i}{\partial p_i} = 0$ yields that $\frac{d\pi^U}{dw_i} > 0$ iff

$$(2.7.7)\quad c < \frac{q_i}{-\left(\frac{\partial q_i}{\partial p_i} + \frac{\partial q_i}{\partial p_{-i}}\right)} \cdot \frac{\frac{\partial q_i}{\partial p_{-i}}}{-\frac{\partial q_i}{\partial p_i}} \cdot \frac{\frac{\partial p_i^*}{\partial w_{-i}}}{\frac{\partial p_i^*}{\partial w_i} + \frac{\partial p_i^*}{\partial w_{-i}}}.$$

The rhs of (2.7.7) remains positive as c goes to zero. Hence (2.7.7) holds for c sufficiently small. This establishes the result. □

Proof of Lemma 2.5. With passive backward ownership $\delta_A > \delta_B = 0$, the important distinction is that when B buys from V, A does not internalize the sales of B. Again, given that V charges $\{0, c\}$, U sets the downstream firms indifferent with fees of

$$\begin{aligned} F_A &= \Pi_{A(U)}(w_A, w_B) - \Pi_{A(V)}(c, w_B), \\ F_B &= \Pi_{B(U)}(w_B, w_A) - \Pi_{B(V)}(c, w_A), \end{aligned}$$

where $\Pi^\delta_{i(j)}, \Pi_{i(j)}$ are the reduced form total downstream profits of i when sourcing from j as a function of nominal marginal input prices. Substituting the fees in the profit function of U yields

$$(2.7.8)\quad \pi^U = \sum_{i\in\{A,B\}} \left[p_i^*\, q_i\left(p_i^*, p_{-i}^*\right)\right] - \Pi_{A(V)}(c, w_B) - \Pi_{B(V)}(c, w_A).$$

As before, the profit consists of the industry profit $\pi^I \equiv \sum_i p_i^* q_i$ less the off-equilibrium outside options. The optimal marginal input prices are characterized by

$$\begin{aligned} \partial\pi^U/\partial w_A &= \partial\pi^I/\partial w_A - \partial\Pi_B(c, w_A)/\partial w_A, \\ \partial\pi^U/\partial w_B &= \partial\pi^I/\partial w_B - \partial\Pi_A(c, w_B)/\partial w_B. \end{aligned}$$

For $w_B = c$ and $w_A = c/(1-\delta_A)$, the derivatives converge to (2.7.6), used in the Proof of Proposition 2.4, when $\delta_A \to 0$. Thus the derivatives are still positive when δ_A increases marginally at 0. By continuity, the corner solutions are sustained for small backward integration shares and c sufficiently small. Moreover, $F_A = \Pi_{A(U)}(c/(1-\delta_A), c) - \Pi_{A(V)}(c, c) = 0$ and $F_B = \Pi_{B(U)}(c, c/(1-\delta_A)) - \Pi_{B(V)}(c, c/(1-\delta_A)) > 0$ as A prices more aggressively when B sources from V, because then A does internalize sales via the profit part $\delta_A w_B q_B$. This logic extends to the case that also δ_B increases at 0. □

KAPITEL 3

The design of cartel damage compensations

Matthias Hunold[1]

Abstract. Damage compensation claims in case of cartels are supposed to increase deterrence, compensate losses and increase efficiency. I show that such claims can instead have adverse effects: If suppliers or buyers of cartelists are compensated in proportion to the profits lost due to the cartel, expected cartel profits can increase. Claims of downstream firms against upstream cartelists who do not monopolize the market increase consumer prices. Suppliers of cartelists can be worse off when eligible to compensation. These results apply also to abuses of dominance and call for a more careful approach towards private enforcement of competition law.

JEL classification: K21, L41
Keywords: competition law, cartel damage compensation, deterrence, overcharge, private enforcement, vertical relations

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3.1. Introduction

It is common in the US that private agents sue infringers of competition law for damage compensation. In particular, buyers of cartelists typically claim treble the overcharge for each unit bought. Salant (1987) and Baker (1988) have pointed out that this Overcharge Compensation (OCC) may not be effective if the compensation payment is anticipated by cartelists and buyers when trading. The reason is that the OCC constitutes a discount paid by cartelists to buyers, which is perfectly compensated by an increase in the cartel price. Hence, expected prices as well as profits of cartelists and buyers are not affected by the presence of private enforcement.[2] Baker suggests that an efficient compensation should rather be proportional to actual losses.[3] Indeed, compensating in proportion to actual losses is in line with results about efficient deterrence (Landes, 1983) and a common principle in civil law. The actual loss of a downstream firm due to an upstream cartel equals the difference in downstream equilibrium profits as a result of different upstream prices. This encompasses pass-on of increased input prices, adjustments in quantities as well as competitive reactions, whereas the OCC is simply a multiple of the actual quantity purchased from a cartelist times the cartel price overcharge.

In this paper, I show that compensating for actual losses (Lost Profit Compensation, LPC) can instead have adverse effects on cartel profits, allocative efficiency, and effective compensation. In other words, I demonstrate that in cases where the OCC has at worst no effect, the LPC actually increases the undesired effects of an infringement. This result is obtained for typical industry structures with up- and downstream competition where contracting with externalities occurs (Segal, 1999). The LPC rule enables firms to write supply contracts that increase industry profits to the benefit of cartelists, when compared to no compensation rule.

This research relates to the ongoing policy debate in Europe. The European Court of Justice stated in Courage (2001) and Manfredi (2006) that everybody can claim compensation for the damages actually incurred due to competition law infringements – this is what I call Lost Profit Compensation.[4] Backed by these decisions, the European Commission (2005, 2008) has expressed its intention to facilitate private enforcement. The Commission aims at improving deterrence, efficiency, and corrective justice by enabling compensation of those who suffered losses. It has stressed that it aims at full compensation, taking into account lost profits and not only the overcharge that customers of cartelists have to pay. By showing that the overcharge is often a poor estimate of actual purchaser damages, Han, Schinkel and Tuinstra (2008) underline that accounting for quantity effects and pass on is important to calculate the appropriate compensation.

With this paper, I add to the discussion by showing that facilitating the compensation of actual damages can increase consumer prices, increase the expected profits of cartelists and even decrease the expected profits of suppliers to cartelists. To derive the results, I use a simple vertical model where downstream firms sell to consumers and need homogenous inputs, which are offered by two upstream firms and a competitive fringe. The fringe

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[2] This neutrality result can fail for several reasons, see Section 3.6.

[3] See his Theorem 3.

[4] ECJ, Decision of 20th September 2001, C-453/99 Courage Ltd. v. Crehan and Cases C-295/04 to C-298/04 Vincenzo Manfredi v Lloyd Adriatico Assicurazioni SpA, 13 July 2006. See Wagner (2007) for a legal discussion. In line with this, the Federal Court of Justice of Germany (BGH) based a cartel damage decision on the norm that those who suffered losses should be compensated accordingly (Decision of 29th June 2011 – KZR 75/10).

should be understood broadly as any alternative source such as the world market or in-house production.

Though framed in terms of horizontal cartels, the present analysis applies analogously to excessive pricing of dominant firms. The main assumption underlying the model is that the cartelists and their trade partners rationally anticipate the compensation payments when trading. Informally speaking, this means that there needs to be at least some suspicion in the industry that there could be a cartel or an abuse of a dominant position and that damage claims have a chance to succeed.

I study the effects of the LPC in case of both upstream and downstream cartels. I begin with the case that the upstream firms form a cartel by fixing their sales prices and that the downstream firms can claim compensation for the profits lost due to the upstream cartel. The compensation payments are modeled as a proballistic process which can, for example, be interpreted as follow-on lawsuits after a public detection. For the case in which sourcing from the competitive fringe is attractive (i.e., it is relatively efficient), I initially assume that claims are valid only if the claimants actually trade with the cartelists. This is plausible because when trade with a cartelist has not taken place, it appears very difficult to prove that trade would have taken place, were there no cartel.[5] There are two interesting effects of LPC claims in this case.

First, *consumer prices increase* when downstream firms are entitled to LPC claims against upstream cartelists. The reason is that once a downstream firm expects a positive LPC, it is willing to purchase from the cartelists at input prices above the competitive fringe cost. Hence the cartelists increase input prices and, in best response to that, consumer prices increase as well. This result is sustained with two-part tariffs as long as exclusivity clauses are not enforceable and there is sufficient price competition downstream.

Second, the *expected cartel profits can increase* when LPC claims are in place. The reason is that the claims relax the constraints of the contracting problem between the upstream cartelists and each downstream firm. Hence, the industry profits increase and the cartelists can appropriate part of that.

Without a competitive fringe, instead, purchaser claims against an upstream cartel reduce consumer prices, hurt the cartelists, and benefit the downstream firms – if upstream tariffs are linear. This is in line with common sense of how private enforcement should work. With two-part tariffs, however, consumer prices are not affected and claimants do not gain in expected value. This neutrality is analogous to the result of Salant (1987) and Baker (1988) for both tariffs and compensation linear in actual quantity. This finding indicates that the assumption of linear tariffs, made in essentially all articles on cartel damages, is not innocuous and its consequences not yet fully investigated in this literature.[6]

In the second part of this paper I investigate the LPC in case of downstream cartels. In principle, everybody can claim compensation for the damages suffered from a competition law infringement. This includes suppliers of cartelists. Although there is not yet an established practice for these cases in Europe, they will potentially be more relevant

[5] Note, however, that downstream firms sourcing from the efficient upstream firms in case of upstream competition is the right counter-factual.

[6] See for instanceBaker (1988); Besanko and Spulber (1990); Boone and Müller (2011); Han et al. (2008); Hellwig (2007); Salant (1987); Schinkel et al. (2008); Spiller (1986); Verboven and Dijk (2009).

once private enforcement becomes more common.[7] From both an academic and a policy perspective, it is therefore interesting to study the implications of facilitating supplier damage compensations with respect to social welfare goals. Towards this I consider the case that downstream firms jointly fix their sales prices (cartelize). For each downstream firm there is one efficient supplier. Suppliers compete and can claim compensation for damages due to the cartel.

A damage occurs to suppliers when the downstream cartelists order less quantity. Additionally, a downstream cartel tends to exert pressure on the upstream margins. The reason is that when jointly maximizing profits, the downstream firms tend to pass on cost increases for one product to a larger extent than it would be the case under imperfect competition. Hence, upstream firms have more individual incentives to lower their prices in case of a downstream cartel. The LPC accounts for these damages.

The LPC rule, however, adds another effect that is detrimental to suppliers, when compared to the situation with a cartel and no compensation rule. Upstream firms have to additionally lower their prices to compensate downstream cartelists for expected compensation payments when trading with them, as otherwise the cartelists source from the fringe. Yet the lower marginal input prices of the efficient upstream firms, the more attractive it is for the cartelists to source only one input from the fringe, by that save one expected damage obligation, and order more from the other upstream firm at the reduced price. Hence the upstream firms need to lower their prices even more, which benefits the cartelists, but hurts the suppliers. This yields a surprising finding: Entitling suppliers of cartelists to claim damage compensations can actually decrease the expected profits of the claimants below the level that would result were there a cartel and no private enforcement. In other words, it may not even be desirable for suppliers to have the right to sue.

3.2. Related literature

This paper is most closely related to Salant (1987) and Baker (1988) who show that the Overcharge Compensation has at worst no welfare effects. The main point which the present paper adds to the literature is that facilitating private compensation claims for profits lost due cartels or excessive pricing of dominant firms can have, surprisingly, distinctively undesirable effects because more profitable supply contracts become feasible. These effects include higher consumer prices, higher expected cartel profits and even a decrease in the expected profits of the damaged firms, when compared to no compensation rule.

Somewhat related is Harrington (2004, 2005) who investigates in a dynamic setting the pricing of cartelists when these fear to raise suspicion about the cartel's existence. Harrington shows that under specific conditions, higher cartel prices can result when public fines are higher (2004) and when the but-for-price price used for calculating damages is lower (2005). The reasoning for the first effect is that public fines can stabilize a cartel and thus allow for higher prices. The reasoning for the second effect is that a lower but-for-price increases the Overcharge Compensation to be paid, i.e., the quantity sold times the overcharge. To decrease that overcharge compensation, the cartelists may want to increase the cartel price to decrease the quantity sold. These mechanisms are clearly different from those analyzed in the static framework of this paper.

[7] See Han et al. (2008) for a discussion of US cases.

More generally, by investigating private damage compensation claims, the present paper adds to the literature on optimal private and public enforcement of competition law, see Segal and Whinston (2006) for an overview. One focus of that literature is on the use of private information for law enforcement. An advantage of private enforcement may arise if private parties are better informed about infringements than the authority. Yet the objectives of private agents to initiate lawsuits generally differ from social welfare objectives. For instance, with private enforcement there can be incentives for private claimants to delay actions that induce a cartel breakdown if additional compensation payments exceed additional losses (Spiller, 1986). In a related vein, Schinkel et al. (2008) show that cartelists can bribe direct purchasers to not whistle-blow the cartel, to the detriment of indirect purchasers. Another concern is that private parties can have incentives to initiate socially detrimental lawsuits. McAfee et al. (2008) show that remuneration of private agents for providing hints that help the authority to detect anti-competitive behavior may be better than establishing private damage claims. In a similar spirit, Polinsky and Che (1991) suggest that part of a damage payment should not be paid to the claimant, but to the treasury. Such a decoupling can achieve both a high deterrence and avoid excessive lawsuits. Moreover, Baker (1988) points out that the cartel profitability tends to be lower if damage payments are payable to the treasury. The reason is that the price adjustments, which counterbalance the implicit discounts that accrue to the cartelists' trade partners, disappear. I show that such a decoupling can hurt suppliers of cartelists who nevertheless need to reduce their prices to remain attractive.

3.3. Framework

Two upstream firms $U1$ and $U2$ supply homogenous products at constant marginal costs normalized to 0. Two symmetric downstream firms $D1$ and $D2$ can transform these upstream products one-to-one into final products.[8] Alternatively to sourcing inputs from $U1$ or $U2$, each downstream firm can source equivalent inputs from a competitive fringe at a marginal price $c > 0$.[9] The game is structured as follows:

(1) Each supplier Ui, $i \in \{1, 2\}$, offers tariffs with unit prices w^i to both downstream firms.
(2) Each downstream firm Di, $i \in \{1, 2\}$,
   (a) observes all input prices,
   (b) publicly accepts or rejects the tariff offers,
   (c) sets the sale price p_i,
   (d) sources inputs, produces and sells to consumers demanding $q_i(p_i, p_{-i})$ units.
(3) If there is a cartel, with probability $\alpha \in [0, 1)$ the cartelists have to pay compensation.

In Section 3.4, I study the case that upstream firms cartelize and downstream firms compete, and in Section 3.5 the reverse: upstream firms compete and downstream firms cartelize. All firms are risk neutral. Competitive prices maximize individual profits, whereas upstream (downstream) cartel prices maximize joint profits of $U1$ and $U2$ ($D1$ and $D2$). With this I abstract from the questions of how the cartel is stabilized – one may assume that cartelists are sufficiently patient to play trigger strategies – and why

[8] Note that symmetry is not necessary for the analysis, but simplifies the exposition.

[9] The assumptions imply that the input is essential and correspond to a fixed proportions technology such as Leontief.

there is a cartel instead of implicit collusion. See Subsection 3.6.2 for a discussion on cartel stability. It is common knowledge whether there is a cartel. This assumption is not necessary in its strict form and relaxed in Subsection 3.6.1.

Similar to Baker (1988) and Salant (1987), the game structure reduces cartel detection and lawsuits to an exogenous process. This is done mainly for tractability, but also appears justifiable, as follow-on suits of public investigations play a major role for private damage compensation. The probability α with which the cartelists have to pay compensation is nevertheless allowed to increase in the cartel price for most of the analysis. For instance, a higher cartel price may ease the burden of proof in a lawsuit and thus increase its success rate. The probability α is common knowledge in the baseline model. Information asymmetries between cartelists and claimants about α are investigated in Subsection 3.6.1.

3.4. Upstream cartel

Assume for this section that upstream firms $U1$ and $U2$ cartelize to maximize joint profits, whereas $D1$ and $D2$ set prices non-cooperatively. I only analyze damage claims of the direct purchasers $D1$ and $D2$. This appears to be the by far most relevant case as indirect purchasers, in particular consumers, often lack both knowledge and damage volume to consider lawsuits. In the first three subsections I study linear tariffs. Two part tariffs follow in Subsection 3.4.4.

The profit of downstream firm i when sourcing at unit price w^i is given by $(p_i - w^i)\, q_i$, yielding the first order condition for p_i of

$$\left(p_i - w^i\right) \frac{\partial q_i}{\partial p_i} + q_i = 0,\ i \in \{1,2\}. \tag{3.4.1}$$

Assume that for the relevant input costs $\{w^i, w^{-i}\}$ there are unique equilibrium downstream prices $p^*(w^i, w^{-i})$ for each firm i, characterized by (3.4.1). Let $p(w) \equiv p_i^*(w^i = w, w^{-i} = w)$ and $q(w) \equiv q_i(p(w), p(w))$. Denote the equilibrium downstream profits without any compensation payment by $\pi(w^i, w^{-i}) \equiv (p_i^* - w^i) q_i(p_i^*, p_{-i}^*)$ and $\pi(w) \equiv \pi(w^i = w, w^{-i} = w)$. To have a simple expression for the effect of an increase in the upstream price level, denote $\pi'(w) \equiv \left[\frac{\partial \pi(w^1,w^2)}{\partial w^1} + \frac{\partial \pi(w^1,w^2)}{\partial w^2}\right]_{w^1=w^2=w}$ and $p'(w) \equiv \left[\frac{\partial p^*(w^1,w^2)}{\partial w^1} + \frac{\partial p^*(w^1,w^2)}{\partial w^2}\right]_{w^1=w^2=w}$. Moreover, impose

Assumption 9. *The downstream profit $\pi(w)$ decreases and the downstream price level $p(w)$ increases in the upstream price level w: $\pi'(w) < 0$ and $p'(w) > 0$.*

That profits decrease in the input price level is generally the case for downstream monopolies and highly plausible for competition, though not necessary.[10] The price increase holds under standard regularity conditions, as does

Assumption 10. *If downstream products are substitutable ($\partial q_i/\partial p_{-i} > 0$), the profit of downstream firm i increases in the input price of firm $-i$: $\partial \pi(w^i, w^{-i})/\partial w^{-i} > 0$.*

Let w^N denote the competitive upstream price. A downstream firm's profit in case of upstream competition is given by $\pi(w^N)$. For instance, with Bertrand competition, the upstream equilibrium prices equal the marginal costs of 0 and downstream profits equal $\pi(0)$. Note that the assumption of Bertrand competition is not necessary: any competitive price below the monopoly level yields the same qualitative results.

[10] Downstream profits decrease in the uniform input price w in case of downstream substitutes if demand q_i does not become less own price sensitive when the price level increases, e.g., if demand is linear.

3.4.1. Lost profit compensation. The downstream profit lost due to an upstream cartel is the difference between the equilibrium downstream profits earned under upstream competition and upstream cartelization.[11] The counter-factual profit of a downstream firm in case of upstream competition, $\pi(w^N)$, is assumed to be common knowledge of the firms; the profit under the cartel is yet to be determined.

The LPC to downstream firm i when sourcing from the cartelists at a price w^i is given by

$$\text{LPC}_i \equiv \max\left\{0,\ \left[\pi(w^N) - \left(p_i - w^i\right)\ q_i\left(p_i, p_{-i}\right)\right]\right\}, \tag{3.4.2}$$

where $\pi(w^N)$ is the counter-factual profit absent a cartel and $(p_i - w^i)\ q_i$ the actual downstream profit in the presence of a cartel. The LPC is paid with probability α,[12] so the expected total profit of a downstream firm is

$$\Pi_i \ \equiv\ \left(p_i - w^i\right)\ q_i\left(p_i, p_{-i}\right) + \alpha\,\text{LPC}_i. \tag{3.4.3}$$

Note that $\alpha = 0$ is equivalent to no compensation rule, i.e. $\text{LPC}_i = 0\ \forall\ i$. For $LPC_i > 0$, substituting from (3.4.2) yields

$$\Pi_i \ =\ \left[\left(p_i - w^i\right)\ q_i\left(p_i, p_{-i}\right)\right]\ (1-\alpha) + \pi(w^N)\,\alpha. \tag{3.4.4}$$

Note that the first term consists of the operational profit scaled down by $1-\alpha$, as with a profit tax of α. Differentiation of (3.4.4) with respect to p_i yields the first order conditions stated in (3.4.1), independent of α. Hence the translation from upstream to downstream prices is unaffected by whether a LPC rule is in place ($\alpha > 0$) or not ($\alpha = 0$) and given by $p(w)$ for uniform upstream prices of w.

The two upstream firms fix a cartel price of w. The upstream cartel profit when both downstream firms source all inputs from the cartelists is given by

$$\Pi^U \ \equiv\ 2\,w\,q(w) - \alpha \sum_{i\in\{1,2\}} \text{LPC}_i = 2\left\{w\,q(w) - \alpha\ \left[\pi(w^N) - \pi(w)\right]\right\}. \tag{3.4.5}$$

For $\alpha > 0$ and a positive cartel overcharge $w - w^N$, the expected LPC is positive and reduces the cartel profit for all relevant w. The factual downstream profit $\pi(w)$ enters the cartel profits positively, so the cartelists partly internalize the downstream profits. This effect is the same as with forward integration. As downstream profits decrease in the cartel price (Assumption 9), the marginal cartel profit

$$\frac{\partial \Pi^U}{\partial w} = 2\ \left\{q(w) + w\,q'(w) - \left[\alpha'(w)\ \left(\pi(w^N) - \pi(w)\right) - \alpha(w)\,\pi'(w)\right]\right\} \tag{3.4.6}$$

is lower with the compensation rule (equivalently: $\alpha > 0$) than without it ($\alpha = 0$). This is the case even if the probability of a compensation payment is exogenous ($\alpha'(w) = 0$) because $\frac{\partial^2 \Pi^U}{\partial w \partial \alpha} = \pi'(w) < 0$. If the probability increases in the cartel price ($\alpha'(w) > 0$), the marginal cartel profit is reduced further (see (3.4.6)). Overall, marginal cartel profits are lower with a compensation rule in place.

No competitive fringe. A downstream firm only buys from the cartelists if its expected profit when sourcing from the cartelists is weakly higher than when it sources from the

[11] One may generally ask whether comparing the equilibrium outcomes is the appropriate standard. Though logically sound, one can argue that a reduction in lost profits of a claimant resulting from the cartelists' increase of the claimant's competitors' input costs should not reduce the claim. For a further discussion along these lines see Hellwig (2007).

[12] The solution does not change if one scales the LPC by a positive factor μ, such as 3 for treble damages, as long as $\alpha\mu < 1$. Using the normalization $\mu = 1$ throughout reduces notation.

fringe at a price of c. For c sufficiently large and under the assumption that cartel profits are strictly concave, the FOC $\frac{\partial \Pi^U}{\partial w} = 0$ uniquely characterizes the optimal cartel price, denoted by w^K. If $\alpha > 0$, the cartelists fix a lower price w^K than if $\alpha = 0$.[13] As $p'(w) > 0$, also consumer prices $p(w^K)$ are lower for $\alpha > 0$. Analogously, expected downstream profits, $(1-\alpha)\pi(w^K) + \alpha\pi(w^N)$, are higher for $\alpha > 0$ than the downstream profits $\pi(w^K)$ that result for $\alpha = 0$. Hence

Proposition 3.1. *Without a competitive fringe (c sufficiently large) and with linear tariffs, when compared to no compensation rule, consumer prices and upstream cartel profits are strictly lower, whereas expected downstream profits are strictly higher under the LPC rule.*

See Figure 3.4.1 for an illustration (please disregard the dashed vertical lines for now). With the LPC, the cartel profit shifts down and to the left. Hence its maximizer also shifts to the left with the LPC and the expected cartel profit decreases.

Competitive fringe. Consider now that there is an attractive competitive fringe, i.e., c is sufficiently small such that absent a compensation rule ($\alpha = 0$) the cartelists fix the maximal price of c. To make the problem interesting, assume that the competitive price w^N is strictly below c. For instance, with Bertrand competition, $w^N = 0$. Let us first focus on the case that single sourcing is necessary, either because suppliers offer exclusive contracts or for technological reasons. Without exclusivity, qualitatively equivalent results are obtained, see Subsection 3.4.3.

Recall the assumption that a downstream firm can only claim a LPC if it actually sources from the cartelists. If one downstream firm sources from a cartelist at a price of w, the expected profit of the other downstream firm from doing the same must be at least as high as the profit of sourcing from the fringe at a price of c:

$$\pi(w, w) + \alpha \left[\pi(w^N, w^N) - \pi(w, w)\right] \;\geq\; \pi(c, w). \tag{3.4.7}$$

For $\alpha > 0$ and $w = c$, the incentive compatibility constraint (3.4.7) reduces to $\pi(w^N, w^N) \geq \pi(c, c)$, which holds with strict inequality as $\pi'(w) < 0$ by Assumption 1. Hence the cartelists can raise w above c until (3.4.7) holds with equality. This implies an equilibrium cartel price $w^K > c$ and consumer prices exceeding the price level $p(c)$ which results without any compensation rule. Intuitively, the cartelists can demand a higher marginal price because in expectation the buyers receive a fixed fee. This is similar to the logic of slotting fees (Shaffer, 1991). Note that when compared to no compensation, the LPC rule reduces consumer surplus!

Total equilibrium downstream profits equal the value of sourcing from the fringe, i.e., the right hand side of (3.4.7) evaluated at $w = w^K$, i.e. $\pi(c, w^K)$. If downstream products are independent ($\partial q_i/\partial p_{-i} = 0$), this profit equals the profit without an LPC. With substitutes ($\partial q_i/\partial p_{-i} > 0$), this profit is strictly higher, so competing downstream firms benefit from the LPC rule.

What happens to cartel profits? Without the LPC, the cartel price equals c. The first order effect of introducing an LPC is a decrease in the expected cartel profits in (3.4.5). Yet, cartelists can charge a price above c once the LPC is in place. Indeed, in expectation the LPC works like an upfront payment that the upstream cartelists pay to

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[13] The implicit function theorem yields $dw/d\alpha = -\frac{\partial^2 \Pi^U}{\partial w \partial \alpha} / \frac{\partial^2 \Pi^U}{\partial w \partial w}$. By assumption, $\frac{\partial^2 \Pi^U}{\partial w \partial w} < 0$ and $\frac{\partial^2 \Pi^U}{\partial w \partial \alpha} = \pi'(w) < 0$.

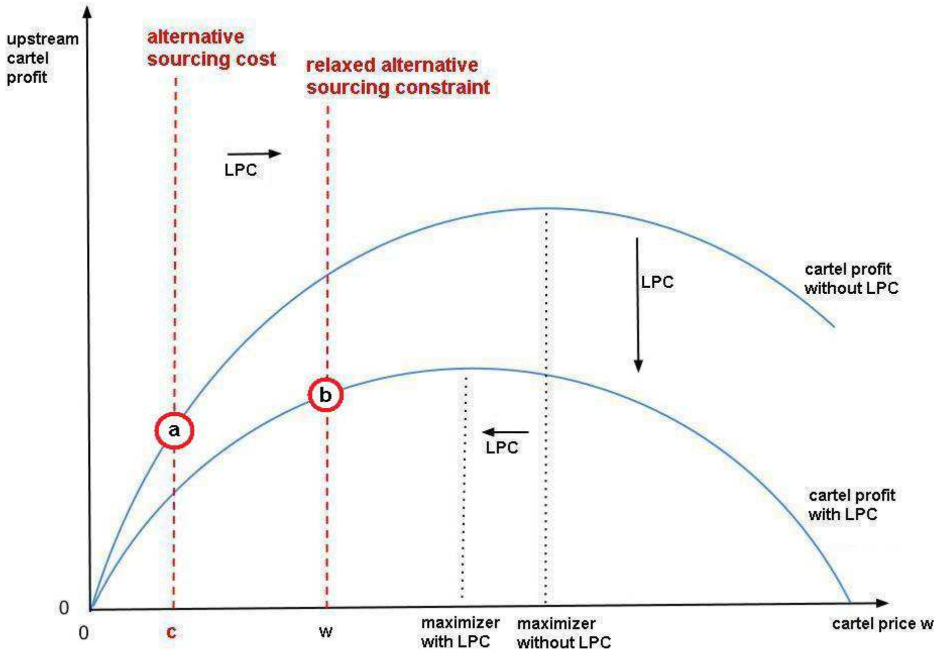

FIGURE 3.4.1. Upstream cartel profits. With a Lost Profit Compensation (LPC) of downstream firms, (marginal) cartel profits are lower, but the fringe constraint is relaxed.

downstream firms. In return, the cartelists can implement higher unit prices w which affect downstream prices and, in turn, industry profits.

Although expected downstream profits are never lower with the LPC than without it, upstream firms can nevertheless benefit in expectation through an increase in industry profits. For this to occur, there must be downstream competition and a relatively efficient fringe, so that without the LPC downstream prices are below the industry profit maximizing level. Using a linear demand specification, one can show that expected upstream cartel profits can indeed increase once downstream competition is sufficiently strong.[14]

PROPOSITION 3.2. *Let the upstream cartel charge linear tariffs and c be sufficiently small. Compared to no compensation rule, with the LPC rule both input and consumer prices are strictly higher; downstream profits are higher for downstream substitutes, and unchanged for independent products; expected cartel profits can be higher.*

See again Figure 3.4.1 for an illustration. With the LPC, a higher cartel price is feasible as the fringe constraint shifts to the right. Although the profit function with the LPC is lower, the maximal expected cartel profits can thus be higher with the LPC than without it. This possibility is illustrated by point b being above point a.

Let us briefly summarize the findings. For the case that the upstream firms can monopolize the input market (c large), Proposition 3.1 states that the LPC rule decreases cartel prices, decreases expected cartel profits and benefits the downstream firms as well as consumers. This is in line with what common sense tells us. Instead, when the upstream cartel does not monopolize the input market, Proposition 3.2 states that essentially the opposite can happen: Cartel and consumer prices increase, expected cartel profits can

[14]Using the specification $q_i = 0.5 - (\beta + \gamma)\, p_i + \gamma\, p_{-i}$, $\beta, \gamma > 0$, for parameter values $\beta = 1$, $\alpha = 0.1, c = 0.05$, the cartelists are in expectation better off once γ exceeds approximately 1.9, i.e., downstream substitutability is sufficiently high.

increase and downstream firms may not benefit from the LPC rule. The reason is that the LPC works like a slotting fee: because in expectation the downstream firms receive a compensation payment, they are still willing to buy from the cartelists at an input price which is above the competitive fringe price of c.

3.4.2. Overcharge compensation. With the Overcharge Compensation (OCC), a downstream firm is only compensated for the overcharge on each unit bought. Formally, the OCC of downstream firm i is given by

$$OCC_i \equiv (w - w^N)\, q_i(p_i, p_{-i}), \tag{3.4.8}$$

with w denoting the uniform upstream cartel price and w^N the counter-factual competitive price, with $w^N \leq w$.[15]

Salant (1987) and Baker (1988) have shown that the OCC is neutral if there is no competitive fringe (c large). In case of the LPC, however, we have seen that the results crucially depend on whether there is a competitive fringe (c small vs. large). Let us therefore briefly study the OCC for both cases, so that we can compare it with the LPC. Using (3.4.8), the total expected profit of a downstream firm in case of the OCC reduces to

$$\Pi_i \quad = \quad (p_i - w\,(1-\alpha))\, q_i(p_i, p_{-i}).$$

Given w, the (expected) marginal costs of a downstream firm decrease as α increases. The FOC of downstream profits with respect to p_i is

$$q_i + (p_i - w\,(1-\alpha))\,\frac{\partial q_i}{\partial p_i} = 0. \tag{3.4.9}$$

The upstream cartelists anticipate the effect of w on p when maximizing the joint expected profits

$$\sum_i \left[w\, q_i - \alpha\, \mathrm{OCC}_i\right] = w\;(1-\alpha)\, \sum_i q_i \tag{3.4.10}$$

with respect to w. Denote the effective input price by $\hat{w} \equiv w \cdot (1-\alpha)$ and substitute it in (3.4.9) and (3.4.10) to observe that the expressions reduce to the ones without any compensation rule (obtained by setting $\alpha = 0$), only now with $\hat{w}$ instead of w.

No competitive fringe. Without an attractive competitive fringe (i.e. with c sufficiently large), the effective input price that maximizes cartel profits is again given by $\hat{w} = w^M \equiv \arg\max_w w \cdot q(w)$. The resulting consumer prices are given by $p(w^M)$ and equal the equilibrium prices absent any compensation rule.[16] Hence the expected upstream and downstream profits, as well as consumer surplus, are the same under the OCC and no compensation rule.

This neutrality result holds also if α increases in w. An increased probability of a compensation payment lowers the expected input price of a purchaser and raises the

[15]In principle, nothing changes when scaling the OCC by a factor such as 3 for triple damages; see footnote 16 for details.

[16]The optimal "nominal" cartel price w^{OCC} is obtained by solving $w^{OCC} = w^M/(1-\alpha(w^{OCC}))$. The condition has a solution if $\max_w \hat{w}(w) \geq w^M$, i.e., if it is possible to raise the effective input price to the monopoly level. This is clearly the case if $\alpha(w) < 1 \forall w \geq 0$. If $\alpha(w)$ reaches 1 before the previous condition holds, the optimal cartel price is lower and given by $\arg\max_w \hat{w}(w)$ (cf. Salant, 1987). This can in particular be the case if α is not just a probability, but includes a damage multiplier above 1, see footnote 12.

cartelists' expected compensation obligations, but this change is perfectly compensated through an increase in the nominal cartel price.

Competitive fringe. Let us now consider the case that there is an attractive competitive fringe (c sufficiently small). A downstream firm will simply source all inputs where the expected costs are lowest. With no compensation when sourcing from the fringe, the effective cartel price is lower than the alternative sourcing costs if $w\,(1-\alpha(w)) \leq c$. Thus the cartelists will raise w until this condition holds with equality. In turn, the optimal nominal cartel price w^{OCC} is above c, but the effective marginal input costs of downstream firms equal c and consumer prices equal $p(c)$ as without any compensation rule. Hence the neutrality of the OCC is sustained.

PROPOSITION 3.3. *Let the upstream cartel charge linear tariffs. With the OCC rule, both expected input and consumer prices as well as expected up- and downstream profits are as with no compensation rule, i.e., the OCC is neutral, independent of the magnitude of c.*

Whereas the LPC has adverse effects when there is an attractive competitive fringe (c small), but beneficial effects otherwise (c large), the OCC is just neutral in both cases. This finding is interesting because the only difference is in how the damage compensation is calculated: the OCC accounts for the cartel overcharge on each unit bought, whereas the LPC accounts also for losses from foregone sales and pass on.

Towards an intuition, recall that with linear tariffs, up- and downstream firms can write contracts that perfectly counterbalance the OCC as it is linear in quantity. This results in neutrality. Instead, the LPC introduces a non-linearity similar to a slotting fee, which effectively changes the linear to particular non-linear tariffs. Allowing for two-part tariffs indeed neutralizes the effects of the LPC when the cartel monopolizes the input market. Interestingly, we will see in Subsection 3.4.4 that the adverse effects of the LPC persist with two-part tariffs if the competitive fringe is relatively efficient and contracts are non-exclusive.

3.4.3. Non-exclusive linear upstream tariffs. In Subsection 3.4.1 I assumed supply contracts to be exclusive: a buyer had to source all inputs from one supplier. In this subsection I show that Proposition 3.2 on the LPC also holds for non-exclusive linear contracts, with non-exclusive meaning that downstream firms are not restricted in sourcing (additional) inputs from the competitive fringe.

As before, I assume that there is no LPC when sourcing from the fringe (this assumption is relaxed in Subsection 3.4.5). This implies that a downstream firm which sources some inputs alternatively is not compensated for these expenses, although they are above the counter-factual expenses which would result with no upstream cartel. Consequently, the LPC is computed as if the inputs actually sourced from the fringe would have also been sourced from the fringe were there no cartel. Thus the counter-factual downstream profits equal $\pi(w^N) - c\,(1-\beta)\,q_i$, where $(1-\beta)$ denotes the fraction of inputs actually sourced from the fringe, and consequently β the fraction actually sourced from the cartelists.

The actual operational profit of a downstream firm is

$$\pi_i \equiv [p_i - \beta\,w - (1-\beta)\,c]\;q_i. \tag{3.4.11}$$

A downstream firm's expected profit for a positive LPC is[17]

$$\begin{aligned}\Pi_i &= \pi_i + \alpha\left[\pi(w^N) - (1-\beta)\,c\,q_i - \pi_i\right]\\ &= (1-\alpha)\,\pi_i + \alpha\left[\pi(w^N) - (1-\beta)\,c\,q_i\right]\\ &= (1-\alpha)\,\left[p_i - \beta\,w - (1-\beta)\,c\right]\,q_i + \alpha\left[\pi(w^N) - (1-\beta)\,c\,q_i\right]\\ &= (1-\alpha)\left[p_i - \beta\,w - (1-\beta)\,c\frac{1}{1-\alpha}\right]\,q_i + \alpha\,\pi(w^N).\end{aligned}$$

As can be easily seen when differentiating the last line with respect to β and setting $w = c$, downstream profits increase in the fraction β of inputs sourced from the cartelists at equal prices as this lowers expected damages. The cartelists can thus raise w up to $c/(1-\alpha)$ without losing sales to the fringe. The cartelists also have to ensure that a downstream firm does not deviate to source all inputs from the fringe and earn a deviation profit of $\pi(c, w)$, as with exclusive tariffs.[18] Independent of which constraint is stricter, for c sufficiently small, the optimal cartel price is above c, yielding consumer prices above $p(c)$ also with non-exclusive contracts. As a downstream firm can assure itself a profit of $\pi(c, w^K)$ by sourcing all inputs from the fringe, it is better off under the LPC if downstream products are substitutes and not worse off otherwise, similar to the case with exclusive contracts in Subsection 3.4.1.

3.4.4. Two-part tariffs. Assume now that the suppliers $U1$ and $U2$ offer to each downstream firm a two-part tariff with a marginal price w as before and additionally a fixed fee F that needs to be paid upon acceptance of the contract. Maintain the assumption entertained so far that sourcing from the fringe yields no compensation claim.[19] When both downstream firms source inputs from the cartelists, each earns an expected profit of

$$\Pi_i(w, F) = \pi(w, w) - F + \alpha\left[\pi_N - (\pi(w, w) - F)\right], \tag{3.4.12}$$

with π_N denoting the counter-factual downstream profit without an upstream cartel.[20]

If Di accepts a (non-exclusive) contract and sources one more unit of input from the fringe instead of from a cartelist, it has a direct cost saving of $w - c$, but its expected compensation is reduced by $\alpha\,w$ due to the assumption of no compensation for sourcing from the fringe. This is the same logic as with linear tariffs in Subsection 3.4.3. Hence the downstream firm optimally sources all inputs from the cartelists if $w \leq c\,/(1-\alpha)$.

[17]The argument w of α is dropped here for brevity. The results do not depend on whether α' is zero or positive as long as $\alpha > 0$.

[18]Intuitively, if a marginal deviation is not profitable, a discrete deviation, which additionally implies a discrete decrease of the non-linear compensation component, is not profitable either. This logic should be valid at least under strategic complementarity in downstream prices because then not accepting the supply contract of the cartelists and thereby committing to a lower perceived marginal input cost of c should be detrimental. For strategic substitutes, this may though favor the discrete deviation.

[19]The relaxation of this assumption is discussed for linear tariffs in Subsection 3.4.5. A similar logic applies for two-part tariffs.

[20]I do not use the notation $\pi(w^N)$ as the competitive upstream tariffs are potentially also non-linear and downstream profits may thus differ.

The cartelists' problem is to

$$\max_{F,w} \Pi^U = 2\,[w\,q(w) + F] - \alpha \sum_i LPC_i \tag{3.4.13}$$

$$s.t. \quad \Pi_i(w,F) \geq \pi(c,w)\,\forall i, \tag{3.4.14}$$

$$w \leq c/(1-\alpha). \tag{3.4.15}$$

The participation constraints in (3.4.14) clearly have to hold with equality as otherwise the cartelists could profitably raise F. The no arbitrage condition (3.4.15) is relevant in case contracts do not contain exclusivity clauses such that for $w > c\,/(1-\alpha)$ and $F < 0$, purchasers could profitably cash F, but actually source from the fringe.

Substituting for Π_i from (3.4.12) in (3.4.14), imposing equality and solving for F yields

$$\pi(c,w) = \pi(w,w) - F + \alpha\,[\pi_N - (\pi(w,w) - F)]$$

$$\Longrightarrow F = \pi(w,w) + \frac{\alpha\,\pi_N - \pi(c,w)}{(1-\alpha)}. \tag{3.4.16}$$

Substituting in (3.4.13) for LPC_i from the brackets in (3.4.12) and for F from (3.4.16) yields

$$\Pi^U = 2\,[p(w)\,q(w) - \pi(c,w)]\,, \tag{3.4.17}$$

which is independent of α. If contracts are **exclusive,** the no-arbitrage condition (3.4.15) is irrelevant and the problem is thus independent of α. Hence for any c, the LPC has no effect on expected cartel profits and marginal equilibrium prices w^K and p^K.

Instead, if contracts are **non-exclusive**, the no-arbitrage condition (3.4.15) is relevant and downstream firms prefer to source from the fringe once $w > c\,/(1-\alpha)$. Evaluating $\partial\Pi^U/\partial w$ at $w = c$ yields that it is positive for sufficiently small c and downstream substitutes.[21] For $\alpha = 0$, the optimal tariff is thus $\{F^K = 0, w^K = c\}$ and endogenously linear. For $\alpha > 0$, the no-arbitrage constraint is relaxed and a marginal price $w > c$ is feasible and also profitable for the cartelists if $\partial\Pi^U/\partial w > 0$ at $w = c$. Hence without exclusivity clauses, but with downstream price competition and sufficiently small c, marginal prices as well as cartel profits are above the levels which would result without am LPC. The equilibrium downstream profit equals the outside option value $\pi(c, w^K)$ on the right hand side of (3.4.14) and is higher under the LPC as $\partial\pi(c,w)/\partial w > 0$.

Proposition 3.4. *Assume that an upstream cartel uses two-part tariffs. Compared to no LPC rule,*

(i) if there is no competitive fringe or downstream products are not substitutable or input contracts are exclusive, the LPC is neutral with respect to marginal prices and expected profits.

(ii) If sourcing from the fringe is sufficiently attractive and input contracts are not exclusive and downstream products are substitutes, marginal prices and both expected upstream cartel and downstream profits increase.

The first part of Proposition 3.4 nicely relates the neutrality of the OCC with linear tariffs (Proposition 3.3): The OCC only imposes a discount that is linear in quantity. Hence linear tariffs are sufficient to neutralize this discount. Instead, the LPC implies

[21] See Proposition 4 in Hunold et al. (2012a). That $\partial\Pi^U/\partial w > 0$ at $w = c$ depends on the assumption of downstream price competition.

a non-linear discount which essentially transforms the linear upstream tariffs into two-part tariffs. This yielded Propositions 3.1 and 3.2. With two-part tariffs, the non-linear discount implied by the LPC can be contracted around again, yielding Proposition 3.4 (i).

Yet, even with two-part tariffs the cartelists are constrained by the competitive fringe in their marginal price setting as the downstream firms' outside options are endogenous (see (3.4.17)). In cases where the cartelists want to set the highest feasible marginal price, the LPC helps them to sustain even higher prices. This is the same result as before with linear tariffs in Subsection 3.4.3 and yields Proposition 3.4 (ii).

3.4.5. Compensation when sourcing from the competitive fringe. Up to here, a firm was assumed to receive compensation with positive probability only if it actually traded with the cartelists. Note that compared to the regime with competitive upstream prices, a damage for a buyer also arises if the upstream cartel prices are so high that it is best for him to source from the less efficient competitive fringe. Although it appears difficult to successfully claim cartel damages without having traded with a cartelist, it is interesting to study the effects of relaxing this assumption. As we will see, the effectiveness of the compensation rule in reducing consumer prices and decreasing cartel profits is increased in this case. Facilitating such claims, if possible, is thus a desirable policy consideration.

Assume that a downstream firm can also claim a LPC if it does not source from the upstream cartelists. Clearly, relaxing the assumption on alternative compensation is only interesting if the competitive fringe is relevant (c sufficiently small), as otherwise sourcing alternatively is not a consideration.

When the linear contracts are exclusive,[22] downstream firm Di prefers to source from the cartelists, given the other firm does so, over sourcing from the fringe if[23]

$$\pi(w,w) + \alpha(w)\,LPC_i \geq \pi(c,w) + \alpha(w)\,LPC_i. \tag{3.4.18}$$

Condition (3.4.18) reduces to

$$\pi(w,w) \geq \pi(c,w), \tag{3.4.19}$$

if LPC_i on the right hand side of (3.4.18) is either conditioned on w or the actual alternative input price of c.[24] Raising w above c violates (3.4.19): each downstream firm then prefers to source from the fringe, so the equilibrium cartel price is $w^K = c$. In turn, downstream prices equal $p(c)$ as without a compensation rule.

As input prices do not counterbalance the LPC, the LPC rule clearly implies a redistribution from upstream cartelists to downstream firms, yielding

Proposition 3.5. *Assume that an upstream cartel charges linear tariffs, there is an attractive competitive fringe (c sufficiently small), and sourcing from the fringe yields the same LPC as sourcing from the cartelists. When compared to no compensation rule, input and consumer prices are unchanged, whereas expected downstream profits increase and cartel profits decrease.*

[22]The same results can easily be obtained for non-exclusive contracts.

[23]The assumption implicit in this statement is that the compensation probability α depends on the cartel price w independently of whether one or both firms actually source from the cartel.

[24]The reduction is straightforward if LPC_i is equal on both sides of (3.4.18). Explicitly conditioning on actual input prices yields $\pi(w,w) + \alpha(w)\,[\pi(0) - \pi(w,w)] \geq \pi(c,w) + \alpha(w)\,[\pi(0) - \pi(c,w)]$ which equivalently reduces to (3.4.19).

Excursion: Overcharge Compensation. If a downstream firm receives the OCC also if it sources from the fringe, it buys from an upstream cartelist only if

$$w - \alpha(w)w \ \leq c - \alpha(w)w.$$

This implies $w \leq c$, yielding an optimal nominal cartel price of $w^K = c$.[25] Interestingly, the effective marginal costs of downstream firms now equal $c\,(1-\alpha(c))$ and are strictly below c for $\alpha > 0$. Hence granting an OCC to downstream firms also when sourcing from the fringe yields lower consumer prices and decreases the upstream cartel profitability compared to no compensation rule.

3.5. Downstream cartel

Assume now that the downstream firms $D1$ and $D2$ fix sales prices to maximize joint profits. To make this meaningful, assume that the downstream products are substitutes: $\partial q_i/\partial p_{-i} > 0$, so downstream firms benefit from a cartel which allows them to internalize the price externalities. Moreover, assume that demand decreases when all prices increase: $\partial q_i/\partial p_i + \partial q_i/\partial p_{-i} < 0$. Maintain the assumption that each supplier can make take-it-or-leave-it offers in the first stage, so the downstream cartelists can still not directly influence input prices.

Upstream firms $U1$ and $U2$ set prices non-cooperatively and are eligible to claim compensation from the downstream cartelists, but no claims accrue to the competitive fringe.[26] To study the effects of a downstream cartel on supplier profits, it is necessary that $U1$ and $U2$ can make positive profits. Assume for simplicity that supplier $U1$ ($U2$) can serve $D1$ ($D2$) at zero marginal costs as before, but that serving the other downstream firm is prohibitively costly.

The joint downstream profits when sourcing all input from $U1$ and $U2$ at w^1 and w^2 are given by

$$\Pi_D(p_i, p_{-i}) \ \ \equiv \sum_{i \in \{1,2\}} \left\{ \left(p_i - w^i\right) q_i(p_i, p_{-i}) - \alpha\, LPC^i \right\}.$$

Let π^N denote the equilibrium profit of a supplier when both up- and downstream prices are set non-cooperatively. The LPC claim of supplier Ui if selling to Di is

$$LPC^{\text{i}} \ = \max\left[0, \pi^N - w^i\, q_i(p_i, p_{-i})\right].$$

For $LPC^{\text{i}} \ > 0$, downstream profits are

$$\Pi_D(p_1, p_2) \ = \sum_{i \in \{1,2\}} \left\{ \left(p_i - w^i\,(1-\alpha)\right) q_i(p_i, p_{-i}) - \alpha\, \pi^N \right\}. \tag{3.5.1}$$

The profit of supplier Ui is

$$\Pi^i = (1-\alpha)\, w^i\, q_i + \alpha\, \pi^N. \tag{3.5.2}$$

[25]Note that also if the purchaser is compensated with c instead of w^K when sourcing from the fringe, the same results obtain.

[26]For example, because the fringe firms make zero profits or because the downstream firm's alternative is to produce in-house.

No competitive fringe. Without a competitive fringe (c sufficiently large), each supplier is the monopolist of its downstream firm. The suppliers still influence each other indirectly through the effects of input prices on sales prices and thus input sales.

For now assume that the probability of a due payment is completely exogenous, i.e., α does not depend on the cartel prices.[27] Let $\tilde{w}^i \equiv w^i (1-\alpha)$ and substitute in (3.5.1) and (3.5.2) to observe that given $\tilde{w}^i$, the marginal profits with respect to the corresponding prices do not depend on α. Hence the effective equilibrium upstream price, denoted by $\tilde{w}^*$, is not a function of α, whereas the nominal price solves $w^* = \tilde{w}^* / (1-\alpha(w^*))$. The equilibrium downstream cartel price, denoted by p^K, is not affected by the LPC. A supplier's expected profit,

$$\Pi^i = \tilde{w}^* q_i(p^K, p^K) + \alpha \pi^N,$$

increases in α by the second term. As p^K is invariant in α, downstream cartel profits must decrease in α.

PROPOSITION 3.6. *Assume that there is a downstream cartel, supplier Ui, $i \in \{1,2\}$, is a monopolist for firm Di using linear tariffs (c sufficiently large), and α is exogenous. Compared to no compensation rule, the LPC has no effect on consumer prices, benefits suppliers and decreases cartel profits.*

Competitive fringe. Assume now that the fringe price c is sufficiently small such that absent any compensation rule, it is optimal for each supplier to charge c both in case of a downstream cartel and downstream competition.[28] At equal input prices, the downstream cartel markup is above the competitive markup. Hence the quantity sold is lower with a cartel and upstream profits are smaller.

With the LPC, the cartelists' choice between buying inputs for Di from the efficient supplier Ui and sourcing from the fringe depends not simply on whether input price w^i is below or above c, but also on the expected damage payments.

Recall the assumption that a LPC claim is valid only if trade with the cartelists takes place. If $w^i = c$ and $LPC^i > 0$, the cartelists prefer sourcing from the fringe as they pay the same input price and avoid the damage payment. Hence the upstream firms have to lower their prices below c to remain attractive.[29]

For $LPC^i > 0$, the cartel profit from sourcing all inputs from $U1$ and $U2$ at uniform prices of $w^1 = w^2 = w$ is defined by (3.5.1). The cartel profit from sourcing input for $D1$ from the fringe and input for $D2$ from $U2$ at w is

$$\text{(3.5.3)} \quad \Pi_D^{ALT}(p_1, p_2|w) \equiv (p_1 - c)\, q_1(p_1,p_2) + (p_2 - w\,(1-\alpha))\, q_2(p_2,p_1) - \alpha \pi^N.$$

The value of sourcing from $U1$ depends on the input price for product $U2$. In equilibrium, it must be that

[27]This simplifies the exposition as otherwise one needs to explain how upstream firms account for how their input prices affect downstream cartel margins and in turn the detection probability. That distracts from the main point.

[28]This assumption is not completely innocuous. Intuitively, a downstream cartel puts additional pressure on input prices. In particular, with homogenous downstream products the equilibrium upstream prices equal 0 in case of joint downstream profit maximization because it does not matter which producer's product is sold more, except for the input price. Instead, upstream prices are positive in case of downstream competition a la Cournot.

[29]Note that this logic also applies if the LPC is not payable to the suppliers, but instead to the competition authority. This decoupling has been suggested by Polinsky and Che (1991) to avoid excessive lawsuits (recall the discussion in the Introduction).

$$\max_{p_1,p_2} \Pi_D(p_1,p_2|w^1 = w^2 = w) = \max_{p_1,p_2} \Pi_D^{ALT}(p_1,p_2|w^2 = w), \tag{3.5.4}$$

i.e., for any price larger w charged by supplier Ui, the cartelists prefer to source the inputs for Di from the fringe at price c and adjust sales prices accordingly.

Recall that without compensation and c sufficiently small, the equilibrium input prices equal c. Hence there is no gain for the downstream cartelists from adjusting sales prices when turning to the competitive fringe for one product. Instead, with the LPC and input prices below c, the cartelists can profitably adjust prices:[30] When deviating to source inputs for $D1$ alternatively at price c, while continuing to source inputs for $D2$ at a price $w < c$, the downstream cartelists under standard conditions (as with linear demand) optimally raise the sales price on the high cost product of $D1$ and thus make a higher profit on the low cost product of $D2$. Hence the attractiveness of the cartelists' outside option is higher once $w < c$. Intuitively, the more substitutable the downstream products are, the more attractive this option becomes.

This logic yields a striking possibility: With the LPC in place, the expected profit of a supplier may be lower than that earned without a compensation rule. This intuition can be confirmed using the linear demand specification $q_i = 1/2 - (\beta + \gamma)\, p_i + \gamma\, p_{-i}$. For large parameter ranges with a sufficiently high substitution intensity γ, the optimal input prices without a compensation rule equal c and suppliers are worse off under the LPC, whereas cartelists are better off. See Table 1 for the parametric results.

γ	Upstream price (w)	$\Pi^{U1}(\alpha = 1/2)/\Pi^{U1}(\alpha = 0)$	$\Pi_D(\alpha = 1/2)/\Pi_D(\alpha = 0)$
0.5	0.04	104%	100%
1.65	0.02	100%	101%
4	0	83%	105%
5	−0.02	69%	108%

TABLE 1. Results for $\alpha = 0.5$, $\beta = 1$, $c = 0.05$ and increasing degrees of downstream competition (γ). Column 3 presents the supplier profit with the LPC relative to no LPC, Column 4 the ratio of downstream cartel profits.

PROPOSITION 3.7. *Assume that there is a downstream cartel, each supplier Ui, $i \in \{1,2\}$, can only supply downstream firm Di using linear tariffs, and the competitive fringe is attractive (c sufficiently small). Compared to no compensation rule, the LPC decreases consumer prices, but may increase cartel profits and hurt suppliers.*

Intuitively, with two-part tariffs a supplier can make its offer more attractive by lowering the fixed fee and at the same time still offer optimal marginal price. In consequence, the rent shift between supplier and customer that is imposed by the LPC is simply counteracted through the fixed fees and the LPC is neutral.

PROPOSITION 3.8. *Assume that there is a downstream cartel and each supplier Ui, $i \in \{1,2\}$, can only supply downstream firm Di; two-part tariffs are feasible. If there is no competitive fringe or it yields no LPC and α is exogenous, the LPC does not affect consumer prices and expected profits, when compared to no compensation rule.*

PROOF. See Appendix. □

[30] Even at prices of c and the LPC in place, in case of a deviation a price adjustment is profitable as the effective input price when sourcing from a supplier Ui is $c\,(1-\alpha)$ instead of c.

3.5.1. Compensation when sourcing from the competitive fringe. Assume again that upstream tariffs are linear and, furthermore, that supplier Ui is compensated with

$$\max\left[0, \left(\pi^N - \beta\, w^i\, q_i\right)\right],$$

where β denotes the fraction of inputs for Di which the cartelists purchase from Ui, and $1-\beta$ the fraction of inputs for Di which the cartelists purchase from the fringe. In case of a positive expected compensation (assumed henceforth), sourcing one unit from the fringe decreases cartel profits by c, whereas sourcing one unit from Ui decreases (expected) profits by $w^i - \alpha\, w^i$. The downstream cartelists are indifferent at $w^i = c/(1-\alpha)$, so supplier Ui can raise price above c, yielding equilibrium upstream prices of $w^* = c/(1-\alpha) > c$ for c sufficiently small. The expected supplier profit equals

$$w^* q_i + \alpha\left[\pi^N - w^* q_i\right] \;= c\, q_i + \alpha\, \pi^N.$$

For the cartelists, the effective input prices equal c as without any compensation rule. Downstream cartelists are worse off compared to no compensation rule because they additionally pay $\alpha\, \pi^N$ in expectation to the suppliers.

If α is independent of the cartel prices, i.e. $\alpha'(w) = 0$, the resulting downstream prices and quantities are as with no compensation rule. If α increases in the cartel markup, i.e. $\alpha'(w) > 0$, marginal cartel profits are lower, cartel prices lower and quantities higher.[31] This benefits both consumers and suppliers. As analyzed in Subsection 3.4.5 for upstream cartels, compensating for cartel damages even if no trade with the cartelists has taken place is beneficial for consumers.

PROPOSITION 3.9. *Assume that there is a downstream cartel and each supplier Ui, $i \in \{1,2\}$, can only supply downstream firm Di using linear tariffs. If there is an attractive competitive fringe (c sufficiently small) and sourcing from also yields the LPC, the LPC benefits suppliers and hurts the cartelists. Consumer prices decrease only if α increases in the cartel mark-up and are unchanged otherwise.*

3.6. Extensions

3.6.1. Asymmetric information about the probability of compensation. So far I have assumed that all firms know the detection probability α and are aware of its public nature. This simplifies the exposition, but is not necessarily realistic. The opposite extreme case considered by Block et al. (1981) is that purchasers of upstream cartelists are agnostic about the possibility of a damage compensation, i.e., assess α with zero, and cartelists are aware of this. Block et al. have shown that this can be beneficial for the purchasers who than – incorrectly – take the nominal input price to be the effective one. Hence, the cartelists cannot increase prices to neutralize the rebate, and in turn the cartel profitability decreases also with the overcharge compensation, whereas purchasers benefit.

Besanko and Spulber (1990) have shown that the full neutrality of the overcharge compensation derived by Baker (1988) and Salant (1987) can fail if the cartelists' costs are private knowledge: the purchasers are no more sure about the effective input, i.e. whether it is due to high cost or a cartel overcharge. In turn cartelists have incentives to moderate the price.

[31]Note that the marginal profit of $\Pi_D(p_1,p_2) = \sum_{i\in\{1,2\}} \left\{\left(p_i - w^i\right) q_i - \alpha \max\left[0, \left(\pi^N - \beta\, w^i\, q_i\right)\right]\right\}$ with respect to p_i is lower if $\partial\alpha/\partial p_i > 0$ and the supplier has a loss due to the cartel.

Yet, the major results presented in the present paper can be obtained also in case of asymmetric information. To illustrate this, let us consider a simple example: The cartelists know the true probability α of a compensation payment when there is a cartel, whereas customers do not know whether collusion is implicit (read: legal, no compensation claims) or explicit (a cartel, compensation claims). Suppose that it is common knowledge that collusion is explicit with probability $\gamma > 0$. The customers thus expect a compensation payment with probability $\alpha\gamma$. Suppose further that the suppliers $U1$ and $U2$ collude and there is an attractive competitive fringe (c sufficiently small), but there is no compensation in case of alternative sourcing. If both $U1$ and $U2$ charge a (linear) input price of c, the customers strictly prefer to source from $U1$ or $U2$ over sourcing from the fringe: Only if they source from $U1$ or $U2$, they receive compensations with a positive probability. Hence, the (linear) equilibrium price charged by the colluding suppliers is above w, both in case of explicit and implicit collusion. Similarly, also the other adverse effects stated in Subsection 3.4.1 hold for γ sufficiently large. Note that the compensation rule consequently also has adverse effects in case that collusion is indeed implicit. The implicit colluders thus benefit from the umbrella of private enforcement of the cartel prohibition.

Overall, it appears plausible that the trade partners of cartelists have at least some knowledge (say, suspicion) of collusive behavior, and that the cartelists are aware of this. Moreover, recall that the results of this paper also apply for a dominant firm that charges excessive prices. For dominant firms it appears even more likely that their trade partners are aware of excessive pricing, though there may be common uncertainty about whether this can be proved in court (which is captured by α).

3.6.2. Cartel stability. Private enforcement may cause substantial damage obligations to accumulate over time. Eventually, the motive of avoiding discovery of evidence and by that avoiding paying the damage obligations may thus become the dominating objective of the cartelists. If the continuation of the cartel yields the highest discovery probability, there are thus incentives for a cartel breakdown. A cartel breakdown may, however, facilitate cartel detection because it causes price jumps which are suspicious for trade partners or the competition authorities. In this case private enforcement can even stabilize the cartel as defection from a cartel may become highly unprofitable. Yet, this logic also applies to public fines, see Harrington (2004).[32]

A further investigation of cartel stability in the context of private enforcement is out of the scope of this paper, but appears worthwhile for future research.

3.6.3. Endogenous detection. Recall that α denotes the probability of a damage compensation. This probability may increase in the cartel price for several reasons. For example, providing convincing evidence of a damage due a cartel may be easier when the markup is higher, so that lawsuits tend to be more successful and more frequent than in case of low markups.

Moreover, the detection probability may increase with the cartel price. In a dynamic setting, an increase in the cartel price today thus reduces expected future cartel profits. Purchasers of the cartelists may though not perceive that as a discount on their sales

[32]Straightforward is the argument that private damage compensation claims can reduce the incentives for leniency applications, in particular if the applicant's information is disclosed to private parties, making it an easy target.

of today. Whinston (2006) shows that the neutrality result of Baker (1988) and Salant (1987) for the case of OCC and monopolistic suppliers fails in this case.

The alleviating effect of an increase in the detection probability generally also applies for the LPC studied in this paper, but the results are more robust than in the OCC case for at least two reasons. First, the LPC is not just neutral, but the LPC can strictly decrease allocative efficiency, benefit both upstream and downstream cartelists and hurt suppliers. Hence, endogenizing the detection probability in a dynamic setting may weaken, but does not necessarily overturn the result of strictly adverse effects. The second reason is slightly more technical: The aforementioned results (in particular Propositions 2 and 4) occur in case alternative sourcing is attractive. This involves corner solutions in the pricing problems which persist when the marginal profits are slightly perturbed.

3.7. Conclusion

By establishing private damage compensation claims, the EU-Commission aims at increasing the effectiveness of cartel deterrence, improving corrective justice by compensating those who suffered losses, and increasing efficiency. I show that compensating actual losses (i.e., the Lost Profit Compensation) by means of private lawsuits can counteract the pursuit of the Commission's goals: Private damage claims can increase cartel profits as well as consumer prices, and hurt suppliers of cartelists when entitled to compensation claims. The mechanism at work is that if anticipated, the expected compensation payments from the cartelists to their trade partners are counterbalanced through prices that are more favorable to the cartelists. The same logic applies to excessive pricing of dominant firms.

Forcing infringers to pay claimants the profit lost due to the infringement is the ex-post measure that achieves full compensation. Indeed, European courts have stated that compensating lost profits is the norm and also the EU-Commission has indicated to aim at full compensation. Moreover, Han et al. (2008) have shown by means of an oligopoly model that the Overcharge Compensation can be far away from actual losses due to a cartel. This favors the Lost Profit Compensation, although it is harder to compute than the Overcharge Compensation.

Investigating ex-ante incentives, I show in this paper that Lost Profit Compensation claims of customers can have completely undesirable allocative effects. These effects arise if there is fringe competition upstream in spite of the cartel, e.g., due to imports or in-house production. If the cartel monopolizes the input market, instead, the Lost Profit Compensation tends to provide socially desirable incentives and tends to perform better than the Overcharge Compensation. The latter has already been studied by Baker (1988) and Salant (1987) in a less general framework and has been confirmed to be at worst neutral in terms of expected profits and consumer prices. As a policy implication, the Overcharge Compensation is likely to be more desirable than the Lost Profit Compensation in terms of ex-ante incentives if cartels and dominant firms are expected to be unable to fully monopolize the market in most cases.

In the US, suppliers have been recognized as antitrust victims in some, but were denied standing in other cases (Han et al., 2008). The legal treatment in the EU is still open. I have pointed out that facilitating supplier claims can also have undesirable effects. Most strikingly, in some cases it does not hurt, and in others it even benefits suppliers to *not* have standing. In other words: Facilitating supplier damage claims may be intended to benefit suppliers, but it may turn out to be a curse for them.

The arguments provided in this paper can be used to structure and stimulate the policy discussion about ex-ante incentives of private compensation claims in case of competition law infringements, in particular cartels and abuses of dominant positions. One should, however, bear in mind that the adverse results are derived under two central assumptions. The first is that damages can only be claimed if trade with the cartelists took place, so that sourcing from the competitive fringe does not trigger compensation. This appears to be realistic. Even if legally possible, it is highly likely that it is effectively much harder or even infeasible to claim a commercial damage if one did not actually trade with the cartelists. The second assumption is that the cartelists and their trade partners rationally anticipate the compensation payments when trading. Informally speaking, this means that there needs to be at least some suspicion in the industry that there could be a cartel or an abuse of a dominant position and that damage claims have a chance to succeed. This also appears plausible, and at the same time an interesting avenue for empirical research.

Appendix

Proof of Proposition 3.9. Let π^N denote a supplier's profit in case of downstream competition. When sourcing from supplier Ui, the downstream cartelists face a damage claim of $LPC^i = \max\left\{0,\, \pi^N - [w^i\, q_i(p_i, p_{-i}) + F^i]\right\}$. For $LPC^i > 0$, the profit of supplier Ui is

$$\Pi^i = \left(w^i\, q_i + F^i\right)\,(1-\alpha) + \alpha\,\pi^N. \tag{3.7.1}$$

Downstream cartel profits when sourcing from $U1$ and $U2$ become

$$\Pi_D(p_1, p_2) \;=\; \sum_{i\in\{1,2\}} \left\{\left(p_i - w^i\,(1-\alpha)\right) q_i - F^i\,(1-\alpha) - \alpha\,\pi^N\right\}. \tag{3.7.2}$$

The cartelists' profit when sourcing from Ui for Di and from the fringe for $D-i$ is

$$\Pi_D^{ALT}(p_i, p_{-i}) \;=\; \left(p_i - w^i\,(1-\alpha)\right) q_i - F^i\,(1-\alpha) - \alpha\,\pi^N + (p_{-i} - c)\, q_{-i}.$$

The cartelists are indifferent between the latter and sourcing both from $U1$ and $U2$ if

$$\max_{p_1,p_2} \Pi_D^{ALT}(p_1, p_2) \;=\; \max_{p_1,p_2} \Pi_D(p_1, p_2). \tag{3.7.3}$$

To simplify this exposition, assume that α is exogenous. Let $\{p_i^*, p_{-i}^*\} = \max_{p_1,p_2}\Pi_D$ to reduce (3.7.3) to

$$F^i\,(1-\alpha) = (p_i^* - w^i\,(1+\alpha))\, q_i + (p_{-i}^* - w^{-i}\,(1+\alpha))\, q_{-i} - F^{-i}\,(1-\alpha) - 2\alpha\,\pi^N - \max_{p_1,p_2} \Pi_D^{ALT}.$$

Substituting F^i in (3.7.1) yields

$$\Pi^i = p_i^* q_i + (p_{-i}^* - w^{-i}\,(1+\alpha))\, q_{-i} - F^{-i}\,(1-\alpha) - \alpha\,\pi^N - \max_{p_1,p_2} \Pi_D^{ALT}. \tag{3.7.4}$$

The profit is maximized when the downstream cartelists face the true input costs. Observe in (3.7.4) that for $w^{-i} = 0$, it is profit maximizing to set $w^i = 0$. Hence marginal upstream prices of 0 are mutually best responses, independent of the value of α. Under symmetric upstream tariffs with $w^1 = w^2 = 0$, the indifference condition (3.7.3) reduces to

$$F\ (1-\alpha) = \max_{p_1,p_2} \sum_{i\in\{1,2\}} \{p_i\, q_i\} - \max_{p_1,p_2} \{p_i\, q_i + (p_{-i} - c)\ q_{-i}\} - \alpha\, \pi^N$$

and

$$\Pi^i = \max_{p_1,p_2} \sum_{i\in\{1,2\}} \{p_i\, q_i\} - \max_{p_1,p_2} \{p_i\, q_i + (p_{-i} - c)\ q_{-i}\}\,, \tag{3.7.5}$$

which is independent of α. Hence the LPC is neutral in terms of consumer prices and expected profits. □

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Eidesstattliche Erklärung

Hiermit erkläre ich, die vorliegende Dissertation selbständig angefertigt und mich keiner anderen als der in ihr angegebenen Hilfsmittel bedient zu haben. Insbesondere sind sämtliche Zitate aus anderen Quellen als solche gekennzeichnet und mit Quellenangaben versehen.

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