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**Salvatore Piccolo and Markus Reisinger**

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**Abstract**
This paper highlights the rationale for exclusive territories in a model of repeated interaction between competing supply chains. We show that with observable contracts exclusive territories have two countervailing effects on manufacturers' incentives to sustain tacit collusion. First, granting local monopolies to retailers distributing a given brand softens inter- and intrabrand competition in a one-shot game. Hence, punishment profits are larger, thereby rendering deviation more profitable. Second, exclusive territories stifle deviation profits because retailers of competing brands can adjust their pricing decisions to the wholesale contract offered by a deviant manufacturer, whilst intrabrand competition prevents such `instantaneous reaction'. We show that the latter effect tends to dominate the former, whereby making exclusive territories a more suitable organizational mode to sustain upstream cooperation. These insights carry over when manufacturers voluntarily decide whether to disclose contracts and can change the distribution mode every period; moreover, they strengthen under imperfect intrabrand competition. Finally, we extend the model to allow for retailers' service investments. Here a novel effect emerges under exclusive territories: a retailer of the deviant manufacturer increases its service investment as a response to a lower wholesale price. This renders deviation more profitable, thereby softening the pro-collusive effect of exclusive territories.



**Keywords**: Exclusive territories, supply chains, tacit collusion, information sharing, vertical restraints.

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# 1 Introduction

Distribution networks organized through exclusive territories are widespread in many markets. In industries such as lodging, computer services or maintenance services, upstream firms use franchise contracts that predominantly grant the franchisee an exclusive territorial area in which the franchisor commits not to add competing outlets.[1] Car distribution in the U.S. as well as in Europe, distribution of beverages, and many other retail industries, feature the same pattern.[2] Several existing models rationalize the extensive use of exclusive territories by arguing that they provide retailers with the right incentives to invest in services that would otherwise be eroded by intrabrand competition—see e.g., Mathewson and Winter (1984 and 1994). However, exclusive territories not only affect the way manufacturers and retailers behave within a single supply chain, but they also induce strategic effects on competing brands. As pointed out by Rey and Stiglitz (1995), softening intrabrand competition via exclusive territories also mitigates competition coming from substitute brands through a 'strategic effect': absent intrabrand competition, distributors of a given product can increase their retail prices if competing brands sell at higher wholesale prices. This spurs downstream profits and, therefore, the surplus that manufacturers can extract via franchise fees. Although these effects are crucial to judge the impact of exclusive territories on manufacturers' profits as well as on retail prices, they are relatively unexplored. In particular, to the best of our knowledge, besides Rey and Stiglitz (1995) there is no other paper analyzing the role of exclusive territories in a model of competing supply chains.[3]

In addition, the existing literature has mainly taken a static approach, and has thus neglected the effects that limits on intrabrand competition have on repeated interactions between competing manufacturers. However, exclusive territories appear to be common in industries where few large producers compete for a long time. For example, Coca-Cola Company and PepsiCo, the two leading producers of non-alcoholic beverages, control a very large market share in this segment.[4] Both these producers grant exclusive territories to their bottling companies, who sell and distribute the bottled beverages to final retailers. Another example is the hotel business in which only few big players like InterContinental Hotels Group, Wyndham Hotel Group and Marriott International (the three biggest companies) control a large share of the market in many cities or districts and grant exclusive territories to their franchisees.

Arguably, all these companies do not compete on a purely static perspective, but likely base their pricing behavior on dynamic considerations, that is, lowering their prices today may trigger

[1]For example, Azoulay and Shane (2001) document that more than 80% of franchisors among many different industries adopt exclusive territories.

[2]See, for example, Brenkers and Verboven (2006) for an in-depth study of European car dealerships and Culbertson and Bradford (1991), Jordan and Jaffe (1987) and Sass and Saurman (1993 and 1996) for detailed studies of beer distribution in the U.S..

[3]As we will mention in the literature review, Iyer (1998) considers a model of competition between manufacturers but he focuses on pure interbrand competition, i.e., each retailer has an exclusive territory. Thus, his model does not allow for a comparison of exclusive versus non-exclusive territories.

[4]As reported by Fosfuri and Giarratana (2009), between 1999 and 2003 the two firms controlled more than 75% of the carbonated soft drink market in the U.S..

a price reduction by competitors in the future. For example, Fosfuri and Giarratana (2009) point out that Coca-Cola and Pepsi have often avoided direct price competition and that price adjustments by one brand are usually followed immediately by the other. Taken together, these are telltale things that tacit collusion is relevant in markets with these features.

Building on these considerations, the objective of this paper is to identify the link between restrictions on intra- and interbrand competition and the incentives to achieve cooperative outcomes in a repeated game where manufacturers control the organizational strategies of the supply chain. We are interested in understanding what new trade-offs exclusive territories bring about in a dynamic game. What is the role that the strategic effect plays in a framework where tacit collusion can be enforced through repeated interactions? Do exclusive territories facilitate tacit collusion between upstream firms? What is the role of information sharing agreements among competing vertical chains in such a dynamic setting? How does the interplay between retailers' service provision and strategic price considerations influence collusion incentives?

To address these issues we first set up a simple repeated game extending the static analysis of Rey and Stiglitz (1995): two infinitely-lived manufacturers, each producing a single brand, compete by offering observable two-part tariffs and choose whether to grant exclusive territories or allow for intrabrand competition.[5] Within this framework, we show that exclusive territories have two opposing effects on upstream collusion. On the one hand, the static analysis suggests that cooperative outcomes between manufacturers should be harder to sustain under arrangements that remove intrabrand competition. This is because exclusive territories increase profits along the punishment phase when manufacturers punish deviations with grim-trigger strategies. On the other hand, we demonstrate that a new countervailing effect kicks in with repeated interaction. When both manufacturers impose exclusive territories, retailers of a given brand can react on the deviation of a deviant manufacturer directly in the time period of deviation. They do so by optimally changing their retail price decisions, whereby reducing the spot gain from deviation. This instantaneous 'punishment' mechanism is no longer at work without exclusive territories: retailers cannot tailor their pricing decisions to the wholesale contract offered by the competing manufacturer when facing intrabrand competition. Hence, exclusive territories reduce deviation profits relative to arrangements allowing for intrabrand competition.

Understanding which of these forces dominates is not an obvious question. One might argue that the effect of exclusive territories on the deviation profit is only of second order relative to the impact that these arrangements have on the punishment profit. While the strength of the former effect relies solely on the retailers' reaction to a deviation along the best-reply function,

[5] Public contracts is a somewhat compelling assumption in industries where manufacturers can easily engage into information sharing agreements. For instance, in business-format franchising franchisors must give a 'franchise disclosure document' that includes, among other things, the franchise fee and the royalty rate to a potential franchisee ten business days before signing any contract (see Federal Trade Commission, title 16, chapter 1, subchapter D, part 436). Of course, there are industries where this is not enough to perfectly disclose a franchisee's costs since there are other deals between a franchisor and a franchisee that are not observable to outsiders, e.g., franchisors often sell ingredients and supplies to their franchisees at prices unknown to outsiders. However, even in these cases royalty rates are usually a key determinant of franchisees' costs.

the latter also entails a reaction by the rival manufacturer. Our analysis suggests that this conjecture is incorrect and that the net effect is usually unclear. Moreover, in the standard linear demand model—and more generally when the second-order derivatives of the demand function are small—we show that the deviation effect is invariably stronger than the punishment effect, whereby making collusion easier to sustain when both manufacturers impose exclusive territories.

This result adds to the existing literature on collusion and vertical restraints. In particular, although both effects described above are also present in Nocke and White's (2007) model of collusion and vertical integration, our analysis delivers different predictions relative to theirs. While Nocke and White (2007) find that a single vertical merger suffices to facilitate collusion, in our model the pro-collusive effect of exclusive territories emerges if and only if *all* manufacturers impose this distribution mode. Moreover, we show that in our supply chain set-up, vertical integration does not facilitate collusion over and above intrabrand competition. As a consequence, exclusive territories are predicted to dominate vertical integration for collusive purposes. We also show that the same consideration applies to resale price maintenance.

The results of the baseline model extend to several more complex scenarios. First, the introduction of imperfect intrabrand competition brings in a novel effect of exclusive territories. When retailers dealing with the same manufacturers are differentiated, a deviant manufacturer who distributes by way of exclusive territories gains via larger sales of only one retailer and not of many as would be the case if the manufacturer allowed for intrabrand competition. Thus, distributing via exclusive territories reduces a manufacturer's temptation to deviate from a collusive outcome. Essentially, under imperfect intrabrand competition exclusive territories provide a *commitment device* for manufacturers to keep the deviation profit low. As a consequence, our result that exclusive territories facilitate collusion gets strengthened.

Next, to emphasize the key role of communication in supply chains, we study the incentives for manufacturers to disclose their wholesale contracts. We first show that with non-observable contracts the choice of the distribution channel has no impact on collusion: a *neutrality result* that hinges on the absence of the strategic effect. Then we consider an extended model where the decision of whether to disclose information about wholesale contracts is endogenous and taken at each stage of the repeated game. It turns out that it is in the manufacturers' best interest to exchange information about wholesale contracts: even in the deviation phase upstream firms prefer to make their contracts public in order not to give up the benefits of the strategic effect discussed above. This result shows quite clearly the potential benefits of communication systems among competing supply chains, a feature which seems widespread in many markets. Indeed, consistently with our model, information sharing agreements between competing supply chains, often enforced through suppliers' trade associations, are common in several industries (see, e.g., Briley et al., 1994, or Stern et al., 1996, and the references therein).

To further extend the model and sharpen its predictive value, we also introduce lack of commitment by considering the case where manufacturers can change their distribution and communication strategy at each period of the game.[6] We find that also in this case exclusive territories and communication between producers make cooperative outcomes easier to sustain. In addition, if producers can change their distribution regime, they can threaten to distribute via non-exclusive territories after a deviation, thereby lowering the profit in the punishment phase and render such a deviation even less profitable than under commitment.

Finally, to build a bridge between the literature on retailers' service provision and our repeated game approach to competition between supply chains, we consider a model where, besides setting final prices, retailers also invest into demand enhancing services. This enriched model allows us to identify another novel effect of exclusive territories: when a manufacturer deviates by cutting its wholesale price, his retailer complements this better deal with a higher service level. This renders deviation more profitable because the deviant manufactures enjoys larger sales overall. As a consequence, we find that collusion is now easier to sustain when manufacturers allow for intrabrand competition if problems of service provision are important enough. Otherwise, the pro-collusive effect of exclusive territories carries over. Therefore, we find that two features—competition between supply chains and service provision by retailers—that favor the use of exclusive territories in a static framework lead to novel effects in a dynamic framework that favor intrabrand competition.

The remainder of the paper is organized in the following way. Section 2 relates our contribution to the earlier literature. Section 3 sets up the baseline model. In Section 4 we characterize the equilibrium of the baseline model. Section 5 discusses the differences between exclusive territories and other common vertical restraints. Section 6 extends the baseline model to the case of endogenous disclosure of contracts, lack of commitment of the organizational mode and imperfect intrabrand competition. In Section 7 we analyze investments in service provision by retailers and Section 8 concludes. All proofs are in the Appendix.

## 2 Related Literature

The existing literature on exclusive territories, with the exception of Rey and Stiglitz (1995), focussed exclusively on the case of a monopolistic manufacturer. Mathewson and Winter (1984 and 1994) were the first to show that exclusive territories can create an incentive for retailers to supply desired services—e.g., product demonstrations or non-observable investments in quality. With intrabrand competition, each retailer free-rides on the services provided by competitors, thereby eroding the equilibrium service level. Granting exclusive territories overcomes this free-riding problem. Drawing on Mathewson and Winter, Klein and Murphy (1988) and Alexander and Reiffen (1995) give precise conditions under which a manufacturer can implement his desired service level. Iyer (1998) explores under which conditions a manufacturer optimally offers heterogeneous contracts to retailers in order to provide them with the right incentives to: $(i)$

[6]A prominent example of a company changing its distribution regime is McDonald's who moved from exclusive to non-exclusive territories in 1969.

invest in services, and (*ii*) target different consumer groups. In an extension, he considers competition between manufacturers and shows, with pure interbrand competition, how this affects the coordination between price and non-price downstream competition.[7]

There are several other interesting issues that have been explored in the framework with a single manufacturer. For example, Dutta et al. (1994) compare exclusive and non-exclusive territories when bootlegging is allowed—i.e., even under exclusive territories a retailer can sell into a different geographical area. They show that the optimal intensity of bootlegging is positive and becomes stronger the more important retail services are and the longer the vertical relationship lasts.[8] Desiraju (2004) analyzes the case where retailers are subject to limited liability and demand is stochastic. Therefore, the manufacturer must adapt the fixed fee to extract surplus. In this case non-exclusive territories may be optimal despite of the free-riding problem. Chiang et al. (2003) demonstrate under which conditions it is beneficial for a manufacturer to open an own retail store in competition to the existing retailer although this may involve self-cannibalization. They show that this can even benefit the retailer if wholesale prices decrease.[9]

The issue of competition between manufacturers has been analyzed in the literature dealing with strategic decentralization in supply chains. The seminal paper by McGuire and Staelin (1983) considers a model with competition between two manufacturers that charge linear wholesale prices and can distribute their products either via an independent retailer or via an integrated structure. They show that the equilibrium distribution outcome depends on the level of substitutability between the goods. In particular, both manufacturers choosing to be vertically integrated is always an equilibrium while both choosing decentralization is also an equilibrium if products are close enough substitutes. Coughlan (1985) extends the analysis of McGuire and Staelin (1983) by allowing for general demand functions and provides evidence for the results from the semiconductor industry. Moorthy (1987) explains the intuitions for the results of McGuire and Staelin (1983) in more detail and extends the analysis to non-constant marginal costs and complementarity between products. Bonanno and Vickers (1988) consider two-part tariff wholesale contracts and show that decentralization is the unique equilibrium in this case. In contrast to our paper, these models take a static perspective and do not allow for repeated interaction.

On the empirical side, several studies have documented the main effects of exclusive territories. Using data from manufacturers of industrial machinery and electronic equipment in the U.S., Dutta et al. (1999) demonstrate that the free-riding problem and the degree of upstream competition are highly significant explanatory variables of why manufacturers grant territorial

[7]Rey and Tirole (1986) suggest a different rationale for exclusive territories, namely that distributors may be better informed about local market conditions. If distributors compete with each other, they have no market power and therefore any superior information is lost since the uninformed manufacturer sets the retail price. With exclusivity the informed distributor sets the price which allows for future segmentation of consumers.

[8]Nault and Tyagi (2001) consider the problem when customers in one geographical area may buy in another area but firms' investments only affect the demand of their local consumers. They show under which conditions the optimal agreement between firms involves transfers or shared ownership.

[9]For a model that analyzes exclusive territories without the free-riding problem and compares price versus quantity competition between retailers, see Matsumura (2003).

exclusivity in these industries.[10] Kalnins (2004) used data from the hotel industry in Texas from 1990 to 1999 to quantify the effects of exclusive territories. He finds that for hotel chains that do not grant exclusive territories, adding a new hotel within the 10 closest hotels is associated with a \$66 loss per room and has highly negative effects on the franchisee's profit. Culbertson and Bradford (1991), Jordan and Jaffe (1987) and Sass and Saurman (1993 and 1996) examine the effects of exclusive territories on beer prices in the U.S.. They find that this use leads to an increase in the wholesale and retail price of beer. In addition, they show that if manufacturers can choose between exclusive or non-exclusive territories, they predominantly use exclusive territories. Finally, Brenkers and Verboven (2006) evaluate the effects of enhanced competition between car dealers due to the removal of exclusive territories and exclusive distribution agreements in the European car market and find that car prices fall. However, they also demonstrate that after the removal almost all car manufacturers chose a distribution system that limits the number of dealers in order to retain some market power with each of them in the respective geographical area. In sum, the empirical studies overwhelmingly demonstrate that exclusive territories have a large impact on retail prices and that competing manufacturers are more likely to choose this distribution system than an upstream monopolistic.

Given its dynamic perspective, our analysis also adds to the recent and growing literature on tacit collusion in vertical relationships. Nocke and White (2007) and Normann (2009) analyze whether vertical integration facilitates tacit collusion by comparing an industry with no integration to one in which one pair of firms is vertically integrated. Both these papers consider perfect Bertrand competition upstream. Nocke and White (2007) show that vertical integration facilitates tacit collusion when upstream firms compete by setting two-part tariffs. Normann (2009), instead, considers linear prices in the upstream market. He shows that even in this case similar results obtain although collusion and deviation profits are different due to double marginalization.[11] The main effects that drive our results in the baseline model are similar to theirs. However, differently from these papers, we are concerned with exclusive territories instead of vertical integration and show that this practice facilitates collusion if and only if both manufacturers distribute via exclusive territories and not just one. In addition, as we show in Section 5, were manufacturers allowed to vertically integrate to sustain collusion, they have no incentive to do so but would prefer to distribute via exclusive territories if this is possible.

Jullien and Rey (2007) study the effects of resale price maintenance (RPM) on tacit collusion in a model with stochastic demand. They find that due to demand uncertainty manufacturers never opt for RPM in a static context but they do so to facilitate collusion. The reason is that RPM reduces the punishment profit and, in addition, it also allows for an easier detection of deviations. Hence, the main difference between our paper and Jullien and Rey (2007) is that while the anticompetitive role of exclusive territories works through the deviation profit, in

[10] Frazier and Lassar (1996) also find for products used in business-to-business markets that distributing via exclusive territories is positively correlated to the degree of competition at the upstream level.

[11] For an experimental investigation of the effects of vertical mergers on final good prices when upstream firms compete for a long but finite time period, see Normann (2007).

their framework RPM renders collusion easier to sustain mainly because it makes detection and punishments more effective. As for vertical integration, we show that also RPM does not improve manufacturers ability to collude over and above non-exclusive territories in our framework.

Finally, in a model without exclusive territories but with public contracts, Schinkel et al. (2008) show that upstream collusion requires low wholesale prices and possibly negative franchise fees when the bargaining power is in the suppliers' hand. By focusing on the polar case of buyer power Piccolo (2010) finds similar results. There is one key difference between these two papers and ours. While we are interested in the interplay between organizational and contractual strategies to sustain cooperative outcomes, they focus mainly on the optimal contracting aspect.

# 3 The Baseline Model

**Players and environment:** Consider a game where two manufacturers, each denoted by $M_i$, $i = 1, 2$, compete by selling imperfect substitute goods (brands) through independent retailers. The downstream technology is one-to-one, and brand $i$'s final demand is $D^i(p_i, p_j)$, which depends on the retail price $p_i$ as well as on the retail price of the competing brand $p_j$. Manufacturers and retailers have linear cost functions with marginal costs normalized to zero. As in Rey and Stiglitz (1995), each manufacturer can organize his distribution network in two alternative manners. He can impose exclusive territories—i.e., grant his retailers exclusivity in the geographical area in which potential consumers reside. Alternatively, the manufacturer can allow for intrabrand competition by letting his retailers compete. Since in this regime dealers of one manufacturer distribute the same brand in a territory, they are in perfect Bertrand competition to each other.

**Contracts and observability:** Manufacturers make take-it-or-leave-it-offers to their retailers and compete by offering two-part tariffs. A contract $C_i = (w_i, T_i)$ specifies a wholesale price $w_i$ charged to all retailers distributing brand $i$ and a franchise fee $T_i$ that these must pay to $M_i$.[12] We assume that contracts are uniform within the same brand, that is, all retailers dealing with $M_i$ get the same contract. This symmetry hypothesis is without loss of generality and is imposed for arbitrage reasons as in Rey and Stiglitz (1995). It reflects the implicit assumption that resale on the downstream market prevents manufacturers from offering different wholesale trade rules to identical retailers. It also rules out non-constant per-unit wholesale prices, whereby justifying our focus on two-part tariffs.

In the baseline model we assume that contracts are observable before the retail competition stage, as is done by e.g., Rey and Stiglitz (1995) and Iyer (1998). This can be the case, for instance, due to mandatory disclosure rules.[13] Nevertheless, there are other industries where

[12] Two-part tariffs are the established praxis in most industries. For example, Lafontaine (1992) and Kalnins (2004) report that around 90% of business format franchising contracts consist of an up-front payment and a royalty rate on sales.

[13] As mentioned, these rules may help manufacturers to draw some inference on the contracts offered by rivals. Also, as Lafontaine and Shaw (1999) report, the prices in franchising contracts appear to be very stable over time, i.e., around 75% of franchisors never changed their royalty rate or franchise fee over a 13-year time period. This

producers have discretion about disclosing their contracts like in automobile distribution. In these instances, manufacturers can make wholesale contracts public, for example via information sharing agreements and/or strategic alliances. In practice, syndicates and suppliers' trade associations may facilitate the dissemination of information among competing supply chains, see, e.g. Stern et al. (1996).[14] In order to capture this feature, in Section 4 we consider private contracts and then extend the baseline model so as to encompass the case where information sharing among competing supply chains is voluntary and taken at every stage of the game.

It is important to note that our results will not hinge on the assumption that franchise fees are observable, but they also hold when only wholesale prices are observable.[15] We explain this in more detail in the next section. For consistency with the earlier literature, in the following we assume that contract observability refers to both wholesale prices and franchise fees.

**Timing:** Consider an infinitely repeated game with discrete time, $\tau = 0, .., +\infty$. Following Nocke and White (2007) and Jullien and Rey (2007), assume that manufacturers are infinitely lived and discount future profits at the same rate $\delta \in (0, 1)$, whereas retailers are short-lived and thus maximize their spot profits. Our analysis extends to the arguably more realistic situation where manufacturers are not able to make long-term commitments and retailers are too short-sighted to collude at their level.

The sequence of events within the stage game unfolds as follows:

**T=1** (**Contracting**)**:** Manufacturers simultaneously offer wholesale contracts. Offers are secret at this stage.

**T=2 (Acceptance):** Retailers (simultaneously) decide whether to accept the received offers without knowing what offer has been made to rival retailers. In case of rejection they enjoy an outside option, which we normalize to zero for simplicity.

**T=3 (Contract disclosure):** Wholesale contracts become common knowledge.

**T=4 (Competition):** Retailers set prices and the market clears—i.e., final demands materialize and input orders are placed. Contract obligations are executed.

This particular timing is standard in the literature—see, e.g., Bonanno and Vickers (1988) or Rey and Stiglitz (1995).[16] It captures those instances where information about actual contracts can be credibly disseminated only after these offers are accepted. In practice, this communication

implies that obtaining such information once may allow to draw good inference on future prices.

[14]An important trend in distribution is the growth of information-intensive channels. These are usually characterized by channel partners who invest in bundles of sophisticated information technology like telecommunication and satellite linkages, bar coding and electronic scanning systems, database management systems etc.

[15]We thank an anonymous referee for pointing this out.

[16]Allowing for a timing where retailers observe the wholesale offer made by the rival manufacturer already at the acceptance stage is unusual in the literature. Such a timing would imply for instance that manufacturers' contracts and retailers' acceptance strategies can in principle be contingent on the rivals' actions. However, this feature contrasts with what is usually done in practice, and drastically complicates the model even in the stage game.

protocol is carried out by external agencies such as trade associations through which firms usually share information about demand and costs (wholesale prices in our model).

**Tacit collusion:** We look for stationary equilibria such that manufacturers maximize their discounted joint profits. For simplicity, we assume that manufacturers sustain tacit collusion through infinite Nash reversion, i.e., a deviation by a manufacturer is followed by an infinitely-repeated play of the equilibrium of the stage game. In contrast, deviations by retailers do not trigger punishments.

As is common in the literature, we will say that exclusive territories facilitate collusion as long as they reduce the critical discount factor above which collusion can be sustained. In particular, the comparison of the different distribution regimes will be based on identifying the regime for which the largest range of discount factors are compatible with the collusive outcome.

**Assumptions and equilibrium concept:** The analysis will be developed under the following simplifying assumptions:

**A1** The inverse demand function for good $i$ is $P^i(q_i, q_j) = \alpha - \beta q_i - \gamma q_j$ for $i = 1, 2$, where $q_i$ is good $i$'s total output.[17] We assume that $\alpha > 0$ and $\beta > \gamma \geq 0$, so that inverting the system of inverse demand functions yields well behaved (symmetric) direct demand functions

$$D^i(p_i, p_j) = \frac{\alpha(\beta - \gamma) - \beta p_i + \gamma p_j}{\beta^2 - \gamma^2} \quad \text{for } i = 1, 2.$$

Linearity is often imposed in models that study repeated interaction between upstream and downstream firms, see, e.g., Schinkel et al. (2008) and Vives (2000). It helps us to make our point in the simplest possible way.

The next assumption allows to focus on equilibria with positive sales.

**A2** Whenever indifferent between accepting a wholesale contract and opting out, retailers accept the contract and secure input supply.

The equilibrium concept that we use in solving the repeated game is subgame-perfect Nash Equilibrium (SPNE).

# 4 Equilibrium Characterization

There are three cases to analyze: (*i*) both manufacturers impose exclusive territories; (*ii*) both allow for intrabrand competition, and (*iii*) one manufacturer imposes exclusive territories while

[17]This demand function can be derived from a representative consumer (or a unit mass of identical consumers) with utility function

$$U(q_1, q_2) = \sum_{i=1}^{2}\left(\alpha q_i - \frac{1}{2}\beta q_i^2\right) - \gamma q_1 q_2 - \sum_{i=1}^{2} p_i q_i + M,$$

where $M$ is the utility from income. Differentiating this utility function with respect to $q_i$, $i = 1, 2$, yields the inverse demand function $P^i(q_i, q_j) = \alpha - \beta q_i - \gamma q_j$.

the other one does not. We will analyze each case in turn.

*Exclusive Territories*

When both manufacturers impose exclusive territories, only interbrand competition matters. Hence, the profit of a retailer distributing brand $i$ is

$$\pi^i(p_i, p_j) = D^i(p_i, p_j)(p_i - w_i) - T_i.$$

Maximizing this function with respect to $p_i$ yields the system of first-order conditions[18]

$$\frac{\partial D^i(p_i, p_j)}{\partial p_i}(p_i - w_i) + D^i(p_i, p_j) = 0, \qquad i = 1, 2. \tag{1}$$

The solution of these equations yields the equilibrium of the retail game, i.e., the price functions $p_i(w_i, w_j)$ $(i = 1, 2)$. It is evident that this equilibrium is unaffected if fixed fees are not observable to retailers since the optimal retail price only depends on own and rival wholesale price.

We can now solve the upstream game. Using backward induction, $M_i$ maximizes the profit

$$\Pi^i(w_i, w_j) = D^i(p_i(w_i, w_j), p_j(w_j, w_i))\, w_i + T_i,$$

subject to the retailer's participation constraint

$$D^i(p_i(w_i, w_j), p_j(w_j, w_i))(p_i(w_i, w_j) - w_i) - T_i \geq 0. \tag{2}$$

Clearly, (2) is satisfied as equality at equilibrium. Hence, $M_i$'s optimization program is

$$\max_{w_i} D^i(p_i(w_i, w_j), p_j(w_i, w_j))\, p_i(w_j, w_i).$$

The symmetric Nash equilibrium of the upstream game, $w_{ET}^N$, is then defined by the following system of first-order conditions:

$$\left(\frac{\partial D^i(.)}{\partial p_i} p_i(.) + D^i(.)\right)\frac{\partial p_i(.)}{\partial w_i} + \underbrace{\frac{\partial D^i(.)}{\partial p_j}\frac{\partial p_j(.)}{\partial w_i}}_{\text{strategic effect}} p_i(.) = 0, \quad i = 1, 2. \tag{3}$$

The first term in (3) is the standard marginal revenue expression, i.e., each manufacturer internalizes the effect that a change in his wholesale price has on the final demand through the retail price, and thus on the sales profit. The second term reflects a *strategic effect*: when choosing the wholesale price, each manufacturer anticipates the competing retailers' reaction in the retail market, and the resulting effect on his own product's demand (see Rey and Stiglitz, 1995).

[18] It is straightforward to verify that these conditions are also sufficient for an optimum with linear demands.

Since prices are strategic complements, the strategic effect of an increase in $w_i$ on $M_i$'s profits is positive.

With linear demand, the equilibrium wholesale price with exclusive territories is

$$w_{ET}^{N} = \frac{\alpha\gamma^2(\beta-\gamma)}{\beta(4\beta^2-\gamma^2-2\beta\gamma)}, \tag{4}$$

which yields the manufacturer's profit

$$\Pi_{ET}^{N} = \frac{2\alpha^2\beta(\beta-\gamma)(2\beta^2-\gamma^2)}{(\beta+\gamma)(4\beta^2-\gamma^2-2\beta\gamma)^2}. \tag{5}$$

When the degree of differentiation between the two brands is minimal, i.e., $\gamma = \beta$, both manufacturers price at marginal costs ($w_{ET}^{N} = 0$) and make zero profits.

Consider now collusion. Recall that retailers always set prices according to (1) for given wholesale prices $w_i$ and $w_j$. Hence, colluding manufacturers maximize joint profits, that is,

$$\max_{(w_1,w_2)} \sum_{i=1,2,j\neq i} D^i\left(p_i\left(w_i,w_j\right),p_j\left(w_j,w_i\right)\right)p_i\left(w_i,w_j\right).$$

The wholesale prices solving this program are determined by the following system of first-order conditions:

$$\sum_{i=1,2,j\neq i} \frac{\partial D^i\left(.\right)}{\partial p_i}\frac{\partial p_i\left(.\right)}{\partial w_i}p_i\left(.\right) + \sum_{i=1,2,j\neq i} \frac{\partial D^i\left(.\right)}{\partial p_j}\frac{\partial p_j\left(.\right)}{\partial w_i}p_i\left(.\right) + \sum_{i=1,2,j\neq i} D^i\left(.\right)\frac{\partial p_i\left(.\right)}{\partial w_i} = 0, \quad i=1,2.$$

With linear demands, this yields the collusive wholesale price

$$w_{ET}^{C} = \frac{\alpha\gamma}{2\beta}.$$

When the degree of differentiation between the two brands is maximal, i.e., $\gamma = 0$, the collusive wholesale price is equal to zero: each manufacturer behaves as a monopolist and extracts the whole downstream surplus by way of the fixed fee. If instead $\gamma > 0$, to induce retailers to set the monopoly price, manufacturers optimally set their wholesale prices above marginal costs due to the strategic effect. Since manufacturers are symmetric, in collusion each receives an equal share of the aggregate profit. Hence,

$$\Pi_{ET}^{C} = \frac{\alpha^2}{4(\beta+\gamma)}. \tag{6}$$

Finally, consider deviation. Suppose that $M_i$ is the deviant manufacturer, i.e., he offers a wholesale price different than $w_{ET}^{C}$, while $M_j$ sticks to $w_{ET}^{C}$. The deviant's maximization program is then

$$\max_{w_i} D^i\left(p_i\left(w_i,w_{ET}^{C}\right),p_j\left(w_{ET}^{C},w_i\right)\right)\, p_i\left(w_i,w_{ET}^{C}\right)\,, \tag{7}$$

which immediately yields the first-order condition

$$\left(\frac{\partial D^i\left(.\right)}{\partial p_i}p_i\left(.\right)+D^i\left(.\right)\right)\frac{\partial p_i\left(.\right)}{\partial w_i}+\frac{\partial D^i\left(.\right)}{\partial p_j}\frac{\partial p_j\left(.\right)}{\partial w_i}p_i\left(.\right)=0,$$

where the arguments of $D^i\left(.\right)$, $p_i\left(.\right)$ and $p_j\left(.\right)$ are the same as in (7). Because contracts are observable before the retail competition stage, $M_i$ anticipates that the retailers distributing the competing brand will react immediately to his deviation, i.e., when observing an unexpected wholesale price $w_i < w_{ET}^C$, they charge a retail price $p_j\left(w_j, w_i\right)$ which is lower than $p_j\left(w_j, w_{ET}^C\right)$. With linear demands, this leads to a deviation wholesale price of

$$w_{ET}^D=\frac{\alpha\gamma^2(4\beta^2-2\beta\gamma-\gamma^2)}{8\beta^2(2\beta^2-\gamma^2)}.$$

It is straightforward to show that $w_{ET}^D$ falls short of the collusive wholesale price, i.e., $w_{ET}^D < w_{ET}^C$. This is because the deviant manufacturer gains from undercutting his competitor to maximize his sales profit. In addition, the deviant's wholesale price exceeds the static Nash price level, $w_{ET}^D > w_{ET}^N$. This is the case because the wholesale price in collusion is larger than the equilibrium wholesale price of the static game, and wholesale prices are strategic complements. The deviant manufacturer gets the profit

$$\Pi_{ET}^D=\frac{\alpha^2(4\beta^2-2\beta\gamma-\gamma^2)^2}{32\beta(\beta+\gamma)(\beta-\gamma)(2\beta^2-\gamma^2)}. \tag{8}$$

Equipped with this characterization, we can now determine the critical discount factor $\underline{\delta}_{ET}$ above which manufacturers can sustain collusion with exclusive territories. The condition that identifies this discount factor is standard: the stream of profits earned by a manufacturer in collusion must exceed the sum of profits in the deviation and punishment phase. Formally,

$$\frac{\Pi_{ET}^C}{1-\delta}\geq\Pi_{ET}^D+\frac{\delta}{1-\delta}\Pi_{ET}^N.$$

The value of $\delta$ which solves this self-enforceability constraint as an equality identifies the lowest critical discount factor above which manufacturers can collude with exclusive territories. Using (5), (6) and (8) we obtain

$$\underline{\delta}_{ET}=\frac{(4\beta^2-2\beta\gamma-\gamma^2)^2}{(32\beta^3-12\gamma^2\beta)(\beta-\gamma)+\gamma^4}. \tag{9}$$

It is easy to show that this discount factor is increasing in $\gamma$, i.e., collusion becomes more difficult to sustain when competition gets more intense (products are closer substitutes). Moreover, $\underline{\delta}_{ET}$ is also decreasing in $\beta$, i.e., demands that are less sensible to own price variations facilitate cooperation.

*Non-exclusive Territories*

Suppose now that both manufacturers distribute by way of non-exclusive territories, i.e., both allow for intrabrand competition. In this case, retailers distributing the same brand are in Bertrand competition. Retail prices are equal to wholesale prices, i.e., $p_i = w_i$ for $i = 1, 2$, and retailers make zero profits irrespective of the contract offered by the rival manufacturer. As a consequence, franchise fees must be zero at equilibrium and manufacturers can make profits only by increasing wholesale prices above their marginal costs which are assumed to be zero.

As before, we first look at the stage game that determines manufacturers' profits along the punishment phase. $M_i$'s objective function is

$$\Pi^i(w_i, w_j) = D^i(w_i, w_j)\, w_i, \qquad i = 1, 2. \tag{10}$$

Optimizing with respect to $w_i$ we get

$$\frac{\partial D^i(w_i, w_j)}{\partial w_i} w_i + D^i(w_i, w_j) = 0, \qquad i = 1, 2. \tag{11}$$

Note that, in contrast to the case where both manufacturers impose exclusive territories, with intrabrand competition there is no strategic effect. Essentially, allowing for intrabrand competition precludes retailers from adjusting their final prices to the competitors' marginal costs. Looking for a symmetric equilibrium in wholesale prices we obtain

$$w^N_{NE} = \frac{\alpha(\beta - \gamma)}{2\beta - \gamma}.$$

As before, when brands' differentiation is minimal ($\gamma = \beta$) manufacturers price at marginal costs. Inserting the equilibrium wholesale price $w^N_{NE}$ into the profit function (10) yields the punishment profit

$$\Pi^N_{NE} = \frac{\alpha^2\beta(\beta - \gamma)}{(\beta + \gamma)(2\beta - \gamma)^2}, \tag{12}$$

where, of course, $\Pi^N_{NE} = 0$ for $\gamma = \beta$.

Consider now collusion. It is straightforward to show that the collusive wholesale price is now $w^C_{NE} = \alpha/2$. Manufacturers' collusive profit is then

$$\Pi^C_{NE} = \frac{\alpha^2}{4(\beta + \gamma)}.$$

Note that collusive profits are the same with exclusive and non-exclusive territories, although wholesale prices differ between the two regimes. This is because, when both manufacturers allow for intrabrand competition, they choose the retail price directly. Differently, when both impose exclusive territories, the wholesale prices are set in such a way to induce retailers to charge the same equilibrium retail price as with non-exclusive territories. Hence, the total 'pie' that manufacturers split does not change.

Turning to the deviation profits, the same logic developed above allows us to calculate the deviation wholesale price and profit. Suppose that $M_i$ is the deviant manufacturer, his optimization program writes as

$$\max_{w_i} D^i(w_i, w_{NE}^C)w_i,$$

whose first-order condition is

$$\frac{\partial D^i(w_i, w_{NE}^C)}{\partial w_i}w_i + D^i(w_i, w_{NE}^C) = 0.$$

With linear demands, we then get

$$w_{NE}^D = \frac{\alpha(2\beta - \gamma)}{4\beta}$$

and

$$\Pi_{NE}^D = \frac{\alpha^2(2\beta - \gamma)^2}{16\beta(\beta - \gamma)(\beta + \gamma)}. \tag{13}$$

The lowest discount factor above which manufacturers collude $\underline{\delta}_{NE}$ is identified by the indifference condition

$$\frac{\Pi_{NE}^C}{1 - \delta} = \Pi_{NE}^D + \frac{\delta}{1 - \delta}\Pi_{NE}^N,$$

whose solution is

$$\underline{\delta}_{NE} = \frac{(2\beta - \gamma)^2}{8\beta(\beta - \gamma) + \gamma^2}.$$

As before, also this critical value increases when competition becomes more intense, as reflected by a larger $\gamma$, and decreases when demand becomes less sensible to own prices, as implied by a larger $\beta$.

*Asymmetric Distribution Channels*

Suppose now that manufacturers have different distribution modes, e.g., $M_i$ imposes exclusive territories while $M_j$ allows for intrabrand competition. In this case, the retailers dealing with $M_j$ set retail prices equal to marginal costs as they face intrabrand competition, i.e., $p_j = w_j$. Differently, those distributing brand $i$ face only interbrand competition and adjust their final prices to the rivals' marginal costs. With linear demands, it is immediate to check that this yields a best reply function of

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

A simple backward induction argument allows to show that the manufacturer imposing exclusive territories sets a wholesale price equal to his marginal costs ($w_i = 0$), so as to maximize his retailers' profits, and then fully extract this surplus through the fixed fee $T_i$. Differently, the manufacturer distributing via non-exclusive territories must charge a wholesale price above his marginal costs to make profits. His optimal wholesale price is given by

$$w_j = \frac{\alpha(2\beta^2 - \beta\gamma - \gamma^2)}{2(2\beta^2 - \gamma^2)}.$$

Upstream profits are then

$$\Pi_i = \Pi^N_{ET,NE} = \frac{\alpha^2(2\beta+\gamma)^2(\beta-\gamma)}{8\beta(\beta+\gamma)(2\beta^2+\gamma^2)}$$

and

$$\Pi_j = \Pi^N_{NE,ET} = \frac{\alpha^2(\beta-\gamma)(4\beta^2 - 2\beta\gamma - \gamma^2)^2}{16\beta(\beta+\gamma)(2\beta^2+\gamma^2)},$$

with $\Pi^N_{ET,NE} = \Pi^N_{NE,ET} = 0$ for $\gamma = \beta$.

Next, consider collusion. Since the distribution networks are asymmetric, we assume that manufacturers share the 'collusive pie' so as to minimize the incentives to deviate. Let $x$ be $M_i$'s share of the manufacturers' joint profits. It is straightforward to verify that the collusive wholesale prices are $w_i^C = \alpha\gamma/(2\beta)$ and $w_j^C = \alpha/2$. Hence, manufacturers' profits in collusion are

$$\Pi_i^C = \Pi^C_{ET,NE}(x) = \frac{x\alpha^2}{2(\beta+\gamma)} \quad \text{and} \quad \Pi_j^C = \Pi^C_{NE,ET}(x) = \frac{(1-x)\alpha^2}{2(\beta+\gamma)}.$$

Finally, consider deviation. Following the logic developed above, the deviation wholesale prices are given by

$$w_i = w^D_{ET,NE} = 0 \quad \text{and} \quad w_j = w^D_{NE,ET} = \frac{\alpha(4\beta^2 - 2\beta\gamma - \gamma^2)}{4(2\beta^2 - \gamma^2)},$$

which yields that manufacturers' profits in deviation are

$$\Pi^D_{ET,NE} = \max_{w_i} D^i(p_i(w_i, w_j^C), w_j^C) p_i(w_i, w_j^C) = \frac{\alpha^2(2\beta - \gamma^2)^2}{16\beta(\beta-\gamma)(\beta+\gamma)},$$

and

$$\Pi^D_{NE,ET} = \max_{w_j} D^j(w_j, p_i(w_i^C, w_j))w_j = \frac{\alpha^2(4\beta^2 - 2\beta\gamma - \gamma^2)^2}{32\beta(\beta-\gamma)(\beta+\gamma)(2\beta^2-\gamma^2)}.$$

In the asymmetric case under consideration there are two different self-enforceability constraints, one for each manufacturer depending on the share $x$. This asymmetry leads to two critical discount factors, that can be determined with the standard procedure described above. Since manufacturers share the collusive pie potentially unevenly, these discount factors will be functions of the sharing rule $x$. Formally,

$$\delta \geq \underline{\delta}_i(x) \equiv \frac{\Pi^D_{ET,NE} - \Pi^C_{ET,NE}(x)}{\Pi^D_{ET,NE} - \Pi^N_{ET,NE}}$$

and

$$\delta \geq \underline{\delta}_j\left(x\right) \equiv \frac{\Pi^D_{NE,ET} - \Pi^C_{NE,ET}\left(x\right)}{\Pi^D_{NE,ET} - \Pi^N_{NE,ET}}.$$

Since our objective is to determine the largest range of discount factors compatible with collusion, it is natural to pick $x$ so as to minimize the maximum between these discount factors, i.e.,

$$x \in \arg\min_{x' \in [0,1]} \left\{\max\left\{\underline{\delta}_i\left(x'\right), \underline{\delta}_j\left(x'\right)\right\}\right\}.$$

The unique solution of this program is obtained by equalizing $\underline{\delta}_i\left(x\right)$ and $\underline{\delta}_j\left(x\right)$, which gives us

$$\underline{\delta}_{AS} = \frac{(2\beta^2 - \gamma^2)(8\beta^2 - 4\beta\gamma - \gamma^2)}{32\beta^4 - 16\beta^3\gamma - 24\beta^2\gamma^2 + 8\gamma^3\beta + 3\gamma^4}.$$

For every discount factor above this threshold, collusion is viable with asymmetric distribution networks.

## 4.1 The Collusive Effect of Exclusive Territories

We can now provide the first result of the paper by ranking the critical discount factors obtained above.

**Proposition 1** *Exclusive territories facilitate collusion if and only if both manufacturers distribute via this organizational mode—i.e.,* $\underline{\delta}_{ET} < \underline{\delta}_{NE} < \underline{\delta}_{AS}$.

Distributing via exclusive territories has two opposing effects on collusion. On the one hand, the stage game profit is larger when both manufacturers impose exclusive territories. This effect hinges on the genuine incentive of manufacturers to raise wholesale prices above marginal costs in the stage game with exclusive territories. This strategic effect was emphasized in the first-order condition (3). Combining (1) with (3), the strategic effect can be written as

$$-\frac{\partial D^i(p_i(w^N_{ET}, w^N_{ET}), p_j(w^N_{ET}, w^N_{ET}))}{\partial p_i}\frac{\partial p_i(w^N_{ET}, w^N_{ET})}{\partial w_i}w^N_{ET}. \tag{14}$$

The larger is this term, the less harsh is the punishment with exclusive territories.

On the other hand—since contracts are observable—when both manufacturers distribute via exclusive territories, retailers can spot and react to a deviation in the very same time period where such an unexpected offer is made. When a manufacturer undercuts his rival by charging a wholesale price that is lower than expected, the retailers distributing the rival's brand reduce their final prices, thereby stifling the deviation gain of the former manufacturer. The extent of this reaction on the deviant's profits also rests on the strategic effect, i.e.,

$$-\frac{\partial D^i(p_i(w^D_{ET}, w^C_{ET}), p_j(w^C_{ET}, w^D_{ET}))}{\partial p_i}\frac{\partial p_i(w^D_{ET}, w^C_{ET})}{\partial w_i}w^D_{ET}. \tag{15}$$

Once again, the larger is this term, the smaller is the profit that a manufacturer can earn by undercutting his rival when both impose exclusive territories, and the latter charges the collusive wholesale price $w_{ET}^C$.

Which of these two countervailing forces dominates? In general, it is not clear whether (15) is larger than (14). However, with linear demands—and more generally when the second order derivatives of the demand function are small—it turns out that the latter effect is invariably stronger than the former. This is because, due to strategic complementarity, the deviation wholesale price exceeds the Nash level, i.e., $w_{ET}^D > w_{ET}^N$. Since with linear demand the slope of the demand function is constant, (15) is larger than (14).

An important prediction of our model is that exclusive territories facilitate collusion if and only if *both* manufacturers distribute in this manner. As long as only one manufacturer, say $M_i$, imposes exclusive territories, collusion is harder to sustain, i.e., $\underline{\delta}_{AS} > \underline{\delta}_{NE}$. This is because intrabrand competition prevents the retailers dealing with $M_j$ to react on $M_i$'s deviation. Hence, since only the effect of reduced punishment survives in this case, $M_i$'s incentive to undercut his competitor is stronger than in the case where both manufacturers allow for intrabrand competition. This result differs from the ones obtained in the vertical restraints literature. For instance, in Nocke and White (2007) a single vertical merger suffices to facilitate collusion because its main pro-collusive force is to reduce the deviation profits of non-integrated firms. However, as Nocke and White (2007) show, multiple mergers do not necessarily do so.

### 4.2 Endogenous Distribution Modes

So far we have treated each manufacturer's distribution mode as an exogenous feature of the environment. In this subsection we extend the analysis by allowing each manufacturer to make this choice. Suppose that, at the outset of the game, manufacturers simultaneously and independently choose their distribution channels. And, for the sake of crispiness, assume for the moment that these decisions are made once and for all. This feature reflects the idea that distribution systems are not easy to change in practice. For example, Azoulay and Shane (2001) note that in the franchising industry transaction costs of changing the contracts are very large due to mandatory registration and material change laws.

Denote by $\mathcal{G}$ the extended game with the commitment stage. The next proposition shows that manufacturers indeed choose exclusive territories to sustain collusion whenever possible.

**Proposition 2** *With public contracts, game $\mathcal{G}$ has the following properties:*

- *For $\delta < \underline{\delta}_{ET}$, there exists a unique equilibrium where both manufacturers impose exclusive territories but do not collude.*
- *For $\underline{\delta}_{ET} \leq \delta < \underline{\delta}_{NE}$, there exists a unique equilibrium where both manufacturers impose exclusive territories and collude.*

- *For $\underline{\delta}_{NE} \leq \delta < \underline{\delta}_{AS}$, there are two payoff-equivalent symmetric equilibria, one where both manufacturers impose exclusive territories, and another where they both allow for intrabrand competition. In each equilibrium collusion is sustained.*
- *For $\delta \geq \underline{\delta}_{AS}$, there exists a unique equilibrium where both manufacturers impose exclusive territories and collude.*

It should be noted that for $\delta \geq \underline{\delta}_{AS}$ there is a unique equilibrium where both manufacturers impose exclusive territories and collude even if, in this region of parameters, cooperation would be viable with one or both manufacturers allowing for intrabrand competition. This is the case because, when one manufacturer imposes exclusive territories but the other does not, the former receives a larger fraction of the collusive profit since he has a larger incentive to deviate. Hence, for each manufacturer it is strictly dominant to impose exclusive territories. This result is in line with Nocke and White (2007) who note that the distribution of the collusive profit is often asymmetric if upstream firms are asymmetric as well.

As a consequence, a distinctive feature of our model, which we show by going through the entire normal form of the game, is that in equilibrium indeed both manufacturers choose to distribute via exclusive territories for collusive purposes. This prediction appears to fit with the empirical evidence provided by Kalnins (2004) who finds that in 1998 in Texas several hotel chains began to grant territorial exclusivity to its franchisees at the same time.

# 5 Other Vertical Restraints

The analysis pursued so far has revealed that exclusive territories facilitate collusion relative to arrangements allowing for intrabrand competition since the former give retailers freedom in their pricing decisions, thereby allowing them to react instantaneously on a deviation of the rival manufacturer. As pointed out by Nocke and White (2007) this effect is also present in a model of vertical integration—i.e., the integrated firm can react via its downstream unit on a deviation by non-integrated upstream firms, which renders deviation for those firms less profitable. Therefore, an important question is whether in our supply chains set-up manufacturers can use other forms of vertical restraints than exclusive territories to lower the critical discount factor above which collusion is viable. To tackle this issue we consider two prominent examples: vertical integration and resale price maintenance (RPM). As mentioned above, previous papers showed that these restraints can facilitate collusion in different set-ups (see Nocke and White, 2007, and Normann, 2009, for vertical integration, and Jullien and Rey, 2008, for RPM). In this section we show that both these vertical restraints have *no bite* in terms of facilitating collusion in our supply chains framework. To make our point as clear and concise as possible, we focus on the symmetric case in which both manufacturers are either vertically integrated or impose RPM.

*Vertical integration.* Suppose that manufacturers do not distribute via independent retailers but are instead integrated with their retailers in a given territory. In this case, manufacturers compete with each other at the final consumer market. As above, let us first look at the Nash profits. The profit of a manufacturer can be written as

$$\Pi^i(p_i, p_j) = D^i(p_i, p_j)p_i, \quad i = 1, 2,$$

leading to a first-order condition of

$$\frac{\partial D^i(p_i, p_j)}{\partial p_i} p_i + D^i(p_i, p_j) = 0, \quad i = 1, 2.$$

This condition is the same as (11) obtained in the case of non-exclusive territories, since retailers set $p_i = w_i$ in the latter case. Thus, the punishment profit is the same under vertical integration and under non-exclusive territories.

Similarly, since manufacturers set the downstream price directly when being vertically integrated, the downstream prices in collusion with vertical integration, $p^C_{VI}$, are the same as those found with non-exclusive territories—i.e., $p^C_{VI} = w^C_{NE}$. Thus, the collusion profit is also the same.

Finally, turning to the deviation profit, the maximization of a deviant manufacturer is

$$\max_{p_i} D^i(p_i, p^C_{VI})p_i.$$

This leads to a first-order condition of

$$\frac{\partial D^i(p_i, p^C_{VI})}{\partial p_i} p_i + D^i(p_i, p^C_{VI}) = 0.$$

Since $p^C_{VI} = w^C_{NE}$, the deviant manufacturer sets the same downstream price as in case of non-exclusive territories, and so the deviation profit is also the same. Therefore, the critical discount factor above which collusion can be sustained if both manufacturers are vertically integrated is the same as the one under non-exclusive territories. As a consequence, vertical integration does not facilitate collusion over and above intrabrand competition. But this implies that, in the context of our model, exclusive territories dominate vertical integration for collusive purposes.

*Resale price maintenance.* When manufacturers impose RPM, retailers do not make any pricing decision but just decide whether to accept or reject their received offers. Indeed, under RPM, contracts specify downstream prices as well, that is $C_i = (w_i, p_i, F_i)$. This implies that the Nash profit of a manufacturer can again be written as

$$\Pi^i(p_i, p_j) = D^i(p_i, p_j)p_i, \quad i = 1, 2,$$

which leads to the same first-order condition as (11). Thus, the punishment profit with RPM is the same as the one with non-exclusive territories. By the same logic as in the analysis of vertical integration, it is also easy to show that the collusive and the deviation profits do not change with RPM relative to non-exclusive territories. Hence, also RPM does not facilitate collusion.

Taking these insights together, we can summarize the analysis in the following proposition:

**Proposition 3** *If both manufacturers are vertically integrated, or they both impose RPM, the critical discount factor above which collusion is viable is equal to $\underline{\delta}_{NE}$, which is the level found in the case of non-exclusive territories. Hence, exclusive territories are the distribution mode that maximizes the range of discount factors compatible with collusion.*

So, in our supply chains framework, neither vertical integration nor RPM facilitate collusion relative to intrabrand competition. The intuition is as follows: Under vertical integration the retail unit of a supply chain belongs to the manufacturer. Therefore, manufacturers compete directly in the retail market, which implies that a cheating manufacturer deviates by lowering the final consumer price. But this means that the rival manufacturer cannot react on this deviation in the very same period. Hence, the deviation profit cannot be diminished compared to the case of non-exclusive territories. In addition, since there is only one layer of competition, there is no strategic effect whatsoever, implying that also the punishment profit is the same with vertical integration and with non-exclusive territories.[19]

In contrast to vertical integration, RPM eliminates competition not at the wholesale but at the retail level. However, the consequence is that again an instantaneous reaction on a deviation is not feasible which implies that vertical price fixing cannot help making collusion easier to sustain relative to non-exclusive territories. It is important to note that both these results hold for general demand functions.

In summary, neither vertical integration nor resale price maintenance have bite in our supply chains model. This is because under these forms of vertical restraints there is no instantaneous reaction effect while exclusive territories bring about this pro-collusive force. This result can be contrasted with the one obtained in Nocke and White (2007) and Normann (2009). They show that vertical integration facilitates collusion in a setting in which upstream firms are in perfect competition to each other and compete to sell to all downstream firms. By contrast, we demonstrate that in a framework of supply chain competition manufacturers prefer exclusive territories over vertical integration to sustain collusion. As for RPM, while Jullien and Rey (2007) showed that vertical price control facilitates collusion between supply chains under uncertain final demands due to the detection effect, we argue that without uncertainty exclusive territories are a better collusive tool relative to RPM.

## 6 Extensions of the Baseline Model

Up until now, the baseline model has been developed under the hypotheses that: (*i*) contracts are observable, (*ii*) manufacturers are committed to the distribution mode, and that (*iii*) intrabrand competition is perfect. In this section we extend the model so as to allow for these possibilities.

[19]The absence of the strategic effect was also demonstrated by Bonanno and Vickers (1998) in a static model. They show that due to this effect firms have an incentive to stay unintegrated.

The objective is to show that the main insights do not change, first, when manufacturers voluntarily decide whether to share information about wholesale contracts, and, second, when, in addition, they can change the distribution mode every period. Moreover, we also demonstrate that our results are reinforced when intrabrand competition is not perfect.

### 6.1 Private Contracts

We first study the case of private contracts, i.e., each manufacturer's offer cannot be observed by the retailers distributing the competing brand before the retail competition stage. This assumption captures the idea that in some instances manufacturers lack commitment power because they can recontract and/or offer secret discounts. In line with the earlier literature—e.g., Hart and Tirole (1990), Katz (1991), McAfee and Schwartz (1994) and White (2007)—we assume that the equilibrium concept is perfect Bayesian Equilibrium (PBE) with the added passive beliefs refinement: when a retailer is offered a contract different than the one he expects in a candidate equilibrium, he does not revise its beliefs about the contract offered to the rival retailers. It should be noted that, although contracts are not observable, a manufacturer can infer if his rival deviated from collusion because he observes the input order of his retailers in each period. If this order is an out-of-equilibrium one, the manufacturer will play infinite Nash-reversion from the next period onwards.

The next proposition shows that in this case a *neutrality result* obtains:

**Proposition 4** *With private contracts, the critical discount factor above which collusion can be sustained is independent of the distribution modes chosen by manufacturers and is equal to* $\underline{\delta}_{NE}$.

The intuition is as follows. Since the retailers' choice of downstream prices is unaffected by unobserved changes in the input prices to rival retailers, each manufacturer acts as if he was integrated with his retailers and faces a given residual downstream demand. Profit maximization then involves setting the input price equal to the manufacturers' marginal cost.[20] Hence, private contracting intensifies upstream competition relative to the case of contract observability. Essentially, although the distribution choice is public, with secret contracts, manufacturers cannot credibly influence the behavior of rival retailers. Interestingly, this neutrality result holds for general demand functions—see the Appendix.

### 6.2 Endogenous Disclosure

In this subsection we consider the case where the management of a supply chain decides whether to make wholesale contracts observable to third parties, e.g., by joining a trade association—see Briley et al. (1994). To account for this possibility, we extend the baseline model by allowing manufacturers to choose at each stage of the game between making contracts observable or

[20] As observed by McAfee and Schwartz (1994), this result is quite general: it does not hinge on the nature of downstream production (fixed versus variable proportions) or of downstream competition (strategic substitutes or strategic complements).

keeping them secret. For obvious reasons, we assume that when manufacturers decide to communicate, it must be feasible for them to credibly disclose their contracts to rivals—i.e., if disclosed, contracts are hard information.[21] This assumption has been made in the information sharing literature[22] and it seems reasonable in all circumstances where, to be legally binding, contracts need to be recorded in a 'Public Registry' or require verifiable legal certifications. The following result then obtains:

**Proposition 5** *With endogenous disclosure, manufacturers always make their contracts observable to third parties in equilibrium and the critical discount factors are the same as those characterized in Proposition 1. Hence, exclusive territories facilitate collusion.*

An interesting feature of this result is that a manufacturer who imposes exclusive territories always gains by making his contract public. This is because with exclusive territories disclosing the wholesale price generates the strategic effect which is beneficial to manufacturers. Differently, when a manufacturer allows for intrabrand competition, he is indifferent between making his offer public or keeping it secret. This is because intrabrand competition forces retailers of the same brand to price at wholesale prices. Summing up, if manufacturers have the choice between information sharing or not, they decide to make the contract public under exclusive territories to be able to sustain cooperative outcomes for a larger range of parameters.

### 6.3 Lack of Commitment

So far, we assumed that the distribution mode of each supply chain is chosen once and for all at the outset of the game. This hypothesis seems natural when the transaction costs associated with changes in the form of distribution networks are very large. However, when such costs are relatively small, the distribution channel of each manufacturer is endogenous and results as the equilibrium outcome of a game where upstream firms decide their organizational strategies along with their wholesale contracts at each stage of the game. To account for this possibility we now extend the game by allowing manufacturers to decide about their distribution modes period after period.

Manufacturers' actions have three components at each stage, i.e., (*i*) a distribution mode (exclusive *vs* non-exclusive territories), (*ii*) a disclosure decision (public *vs* private contracting), and (*iii*) a wholesale contract. We obtain the following result:

**Proposition 6** *If manufacturers can change their mode of distribution in every period, manufacturers collude via exclusive territories, and the range of discount factors for which collusion is viable is larger than in case of commitment to the distribution mode.*

[21]Hard information is quantitative, easy to store and transmit in impersonal ways, and its content is independent of the collection process. In this sense, a legal contract indicating the wholesale price and franchise fee can be interpreted as hard information.

[22]See, e.g., Gal-Or (1985) and Raith (1996) for information sharing in oligopoly or Jappelli and Pagano (1993) for a model of information sharing in the banking literature.

The intuition is as follows. By imposing exclusive territories a manufacturer enables his retailers to react to an unexpected offer by the rival manufacturer in the period where such an offer is observed. Hence, with exclusive territories, the deviation profit is the lowest among all distribution modes. Thus, manufacturers choose to sustain tacit collusion via exclusive territories.

In addition, with lack of commitment, the stage game has two symmetric equilibria. The first type of equilibrium is such that both manufacturers choose exclusive territories and make their contracts observable to third parties. The second type of equilibrium is such that both manufacturers choose non-exclusive territories and either disclose or not disclose their contracts. Clearly, in the latter type of equilibrium manufacturers obtain lower profits than in the former. However, the latter combination is an equilibrium, since, given that $M_j$ chooses non-exclusive territories, the profit of $M_i$ is the same independent of his regime choice. This is because, due to intrabrand competition, retailers dealing with $M_j$ have no discretion in setting prices and always set $p_j = w_j$. Thus, $M_i$ is indifferent between the distribution regimes and finds it optimal to distribute via non-exclusive territories, thereby rendering the choice of $M_j$ to also distribute via non-exclusive-territories optimal. The implication for the infinitely repeated game is then that the critical discount factor is minimized if this equilibrium is played as a punishment in the periods after a deviation.

As a consequence, we obtain that exclusive territories facilitate collusion in the extreme cases when manufacturers are committed to the organizational mode and when they can change it at no costs. But this implies that even in less extreme cases, i.e., when changing the organizational mode involves finite costs or can only be changed every $t > 1$ periods, the result applies as well.

### 6.4 Imperfect Intrabrand Competition

In this section we show that the qualitative insights of the baseline model survive, and are even strengthened, in the case of imperfect intrabrand competition. To this purpose, we consider the simplest case in which each manufacturer can either allow for intrabrand competition between two retailers selling differentiated products or grant territorial exclusivity to only one of them. So while under exclusivity a manufacturer is selling only one product, under non-exclusivity he sells two different products via his retailers. Hence, ceteris paribus, the total demand of a manufacturer's good expands under non-exclusive territories relative to the exclusivity regime.[23]

Naturally, the products of the two retailers distributing the same brand are less differentiated than the products of the competing brand. This can expressed in the following way. If both manufacturers distribute by way of non-exclusive territories, the inverse demand function of retailer 1 distributing manufacturer $i$'s product is

$$D^{i1}(q_{i1}, q_{i2}, q_{j1}, q_{j2}) = \alpha - \beta q_{i1} - \sigma\beta q_{i2} - \gamma(q_{j1} + q_{j2}),$$

[23] For example, this is meant to capture a situation in which retailers of the same brand are located at different geographical points in the market. To see this, consider the market for soft drinks or hotels. In the first case a soft drink producer sells more bottles via two retailers located at different points of a street than with only one, while in the second case a hotel franchisor gets more customers with two hotels in a neighborhood than with only one.

with $\sigma \in [\gamma/\beta, 1]$. Here $q_{i1}$ and $q_{i2}$ are the quantities of the two retailers of manufacturer $i$, while $q_{j1}$ and $q_{j2}$ are those of the retailers of manufacturer $j$. The parameter $\sigma$ measures the degree of differentiation between two retailers distributing the same brand. If $\sigma = 1$, we are back to the previous analysis with perfect intrabrand competition. Assuming $\sigma \geq \gamma/\beta$ ensures that the products of retailers of the same brands are closer substitutes than those of competing brands. Again we will look for the distribution mode that allows manufacturers to sustain collusion for the largest range of discount factors.

There is one main difference between this framework and the one analyzed above. Of course, under exclusive territories nothing changes because each brand is sold by only one retailer. However, with imperfect intrabrand competition, the profits of manufacturers in collusion, deviation and punishment under non-exclusive territories scale up relative to the case of perfect competition between retailers of the same brand. This is because allowing for intrabrand competition now has a demand enhancing effect. Hence, while the critical discount factor does not change with exclusive territories and is still equal to $\underline{\delta}_{ET}$ , the one with non-exclusive territories, denote it by $\hat{\underline{\delta}}_{NE}$, is different to the one obtained under perfect intrabrand competition. In principle, the effect of this difference on collusion is not obvious. However, the next proposition shows that in the linear set-up at hand the result is clear-cut.

**Proposition 7** *Exclusive territories facilitate collusion even with imperfect intrabrand competition, i.e.,* $\underline{\delta}_{ET} < \hat{\underline{\delta}}_{NE}$. *Moreover, the pro-collusive effect of exclusive territories becomes larger the less intense intrabrand competition is, i.e., the difference* $\hat{\underline{\delta}}_{NE} - \underline{\delta}_{ET}$ *expands as* $\sigma$ *becomes smaller.*[24]

The economic intuition for why the pro-collusive effect of exclusive territories becomes larger when intrabrand competition becomes less intense hinges on the effect that a change in $\sigma$ has on $\hat{\underline{\delta}}_{NE}$ and is as follows. Collusion, deviation and punishment profits are higher for lower values of $\sigma$. However, the gain from deviation is particularly large because a deviating manufacturer can now gain on two products. As a consequence, the sum of the increase in the deviation and punishment profit overturns the increase in the collusive profit in our linear framework.

This also explains why exclusive territories facilitate collusion even with imperfect intrabrand competition. In addition to the instantaneous reaction effect described above, distributing via exclusive territories now also reduces the temptation of a manufacturer to deviate simply because by cutting its wholesale price he can gain via larger sales of only one retailer and not of both as under intrabrand competition. In summary, exclusive territories provide a *commitment device* for manufacturers to keep the deviation profit low enough to render collusion sustainable.

Finally, it should be noted that with imperfect intrabrand competition collusive profits under non-exclusive territories are higher than under exclusivity. Hence, the comparison of discount factors performed above is not made for equal profits. For simplicity, we do not address the

[24] For the sake of simplicity we do not consider the case of asymmetric distribution regimes. However, it is possible to show that $\underline{\delta}_{ET}$ is also smaller than the discount factor obtained with an asymmetric distribution regime.

issue of endogenous distribution modes here—an analysis that would be cumbersome due to the multiplicity of cases to analyze (see Normann, 2009, for a similar approach). In summary, the prediction of our result is that there exists a range of discount factor in which manufacturers imposing exclusive territories are in collusion, while those who allow for intrabrand competition are not.

# 7 Service Incentives

So far we neglected investment problems on the retailers' side. However, the provision of the right incentives to invest into promotional services or spend advertising effort is an important issue in several markets. In the existing literature the standard explanation for territorial exclusivity is indeed to avoid the well-known free-riding problem between retailers whose investment into services would be eroded under intrabrand competition. The goal of this section is to analyze the interplay between these incentives and the economic forces highlighted in the previous analysis. To the best of our knowledge, this analysis is the first to combine both upstream competition and downstream service investment in a model of exclusive territories.

We incorporate service provision by retailers in a natural way. In the last stage of our game retailers now not only set final prices but also provide costly demand enhancing effort. In particular, denote the sum of efforts of manufacturer $i$'s retailers by $e_i$. Then, the inverse demand function can be written as $P^i(q_i, q_j, e_i) = \alpha + e_i - \beta q_i - \gamma q_j,\ i, j = 1, 2,\ i \neq j$. Inverting this system one obtains the following direct demand functions

$$D^i(q_i, q_j, e_i, e_j) = \frac{\alpha(\beta - \gamma) + \beta e_i - \gamma e_j - \beta p_i + \gamma p_j}{\beta^2 - \gamma^2} \quad \text{for} \quad i = 1, 2.$$

Effort costs of a retailer $\ell$ dealing with manufacturer $i$ who sets an effort level of $e_{\ell i}$ are $C(e_{\ell i}) = (k/2)e_{\ell i}^2$. Such a quadratic cost function is common in previous research (see, e.g., Mussa and Rosen, 1978, or Iyer, 1998). Nevertheless, the insights of the analysis are valid for any increasing and strictly convex cost function. Here, $k$ measures how costly it is to provide effort relative to the demand expansion, and it can be interpreted as the importance of service provision. For example, if $k \to \infty$, effort provision plays no role, which implies that $e_i = 0$. In this case we are back in our baseline model. Thus, this new analysis includes our baseline model as a special case.

Finally, to guarantee interior solutions, we impose that the cost function is convex enough so that a finite level of effort is optimal for retailers:

$$k \geq \frac{4\beta^2 - \gamma^2 + \sqrt{\gamma^2(8\beta^2 + \gamma^2)}}{8\beta(\beta^2 - \gamma^2)} \equiv \bar{k} > 0. \tag{16}$$

This guarantees that second-order conditions of the retailers' and manufacturers' maximization problems are satisfied.

Two main effects will drive our results. One effect is straightforward and it implies that collusive profits are higher with exclusive territories simply because in this regime retailers provide positive effort. This clearly goes in the direction of making collusion easier to sustain when preventing intrabrand competition. On the other hand, in this enriched framework the instantaneous reaction effect becomes more complex since retailers not only change their pricing decisions as a response to a deviation, but they also change their effort levels. In particular, following a price cut the retailer of a deviant manufacturer increases its effort, thereby raising the gain from deviation under exclusive territories. The following result shows that the parameter $k$ shapes the trade-off between these effects:

**Proposition 8** *There exists a threshold $k_1 > \bar{k}$, such that:*

- *For $k > k_1$, collusion is easiest to sustain if both manufacturers distribute by way of exclusive territories, that is, $\underline{\delta}_{ET}$ is smaller than $\underline{\delta}_{NE}$ and $\underline{\delta}_{AS}$.*
- *For $k < k_1$, collusion is easiest to sustain if both manufacturers distribute by way of non-exclusive territories, that is, $\underline{\delta}_{NE}$ is smaller than $\underline{\delta}_{ET}$ and $\underline{\delta}_{AS}$.*

The result shows that if service problems are important enough, i.e., $k < k_1$, collusion is easier to sustain if manufacturers allow for intrabrand competition. The reason is that, with exclusive territories, a deviation of one manufacturer makes it more profitable for his retailers to invest into services. This is the case because the retailers face a lower wholesale price and, therefore, benefit to a larger extent from an enhanced demand. But, since effort levels of competing retailers are strategic substitutes, the retailer of the non-deviating manufacturer optimally reduces its effort level. As a consequence, a deviation becomes very profitable if investment in services is important enough. By contrast, if manufacturers distribute through non-exclusive territories, retailers spend no effort because of the free-riding problem. Thus, the critical discount factor remains unchanged. So we find that if effort provision by retailers is very important, the effect that retailers of a deviating manufacturer provide higher effort dominates, whereby making non-exclusive territories a more suitable mode for collusion purposes.

In summary, combining the analysis of manufacturer competition with retailers' service investments allows us to identify a novel effect that has not been identified in the literature so far: retailers of a deviating manufacturer have stronger incentives to provide demand enhancing services, thereby making deviation more profitable. In this respect, our analysis demonstrates that, while in a static context exclusive territories raise manufacturers' profits both via the strategic effect and the removal of the free-riding problem, in a dynamic game the interplay between these two effects generates a novel force that favors non-exclusive territories.

# 8 Conclusion

We analyzed the use of exclusive territories in a model of repeated interaction between competing manufacturers. Our results show that there is a genuine tension between static and dynamic incentives that shapes manufacturers' scope for limiting intrabrand competition. While in the static analysis manufacturers unambiguously benefit from exclusive territories, because this allows retailers to price above marginal costs, in a repeated framework this effect makes collusion more difficult to sustain as it increases profits in the punishment phase. Nevertheless, with repeated interaction, a countervailing effect through deviation profits comes into play that tends to make cooperative outcomes easier to sustain with exclusive territories. When both manufacturers prevent intrabrand competition, retailers adapt their pricing decisions to the wholesale contract offered by the competing manufacturer. This 'instantaneous reaction' mechanism facilitates collusion with exclusive territories because it stifles manufacturers' (spot) gains from deviation. With linear demands, it turns out that the latter effect completely offsets the former, whereby making exclusive territories the more suitable organizational mode to sustain cooperative outcomes. This result is robust to extensions concerning the disclosure and commitment rules. Moreover, it gets strengthened with imperfect intrabrand competition since manufacturers can commit to sell only through one retailer, and this attenuates their gains from deviation. Finally, we extend the our analysis to allow for retailers' investments into demand enhancing services. Here we show that a new effect emerges under exclusive territories which is that the retailers of a deviating manufacturer have higher investment incentives. As a result, we obtain that if service investments are important enough, this new effect can dominate the instantaneous reaction effect. Interestingly, this latter analysis shows that while manufacturer competition and retailer investments favor the use of exclusive territories in a static context, they bring about a novel force in a dynamic context that favors the use of intrabrand competition.

The paper provides novel implications on the benefits of vertical restraints in supply chains: First, the pro-collusive effect of exclusive territories emerges only if *all* manufacturers distribute via this mode. Second, vertical integration as well as vertical price control do *not* facilitate collusion over and above intrabrand competition. Finally, the pro-collusive effect of exclusive territories can be *undermined* in a model where retailers also invest into demand enhancing services if the provision of these services is important enough.

Our results have implications both for supply chain managers and for policy makers. For supply chain managers one of our most interesting results is that exclusive territories make it easier to sustain cooperative outcomes in competition between rival supply chains. This result applies since retailers have discretion over their final good prices, which gives them the power to react instantaneously to deviations by competing supply chains. Moreover, it is important for supply chain managers to note that other instruments like vertical integration or vertical price controls cannot achieve this goal and therefore have no bite in facilitating collusion. In addition, we show that the pro-collusive effect works only if rival supply chains also compete by way of exclusive territories. Therefore, the implication for a supply chain manager is that it can be profitable to change the distribution system to exclusive territories if rival chains have done so as well to sustain cooperation, a result in line with the evidence found in Kalnins (2004).

It is also of importance for the manager of a supply chain to understand that the above mentioned instantaneous reaction effect only works if there is some form of information sharing agreement with rivals. However, pure information sharing alone is not beneficial to supply chains if they do not give retailers the freedom to select the downstream prices. Only contract disclosure *coupled* with territorial exclusivity helps to sustain cooperative outcomes between supply chains.

Finally, supply chain managers must be aware of the effect that service provision by retailers may undermines this pro-collusive force of exclusive territories. This is the case because retailers of a deviating manufacturer increase their service investments due to the lower wholesale price thereby rendering a deviation more profitable. Thus, although exclusive territories lead to a larger investment level than intrabrand competition, they may hinder collusion if service provision is important enough.

Our results are also of interest from an antitrust perspective. As argued in the introduction, dynamic considerations are very likely to be of strong relevance in several industries in which manufacturers engage in exclusive territories. Therefore, it is of importance for antitrust authorities if exclusive territories are pro- or anticompetitive. In particular, this is the case since exclusive territories are treated differently in the U.S. and in Europe, and also the treatment in the U.S. had undergone several changes. For example, in the 1970's exclusive territories were illegal per se in the U.S. but in 1977 the Supreme Court overruled this decision and they are currently viewed under a rule-of-reason principle.[25] To the contrary the European commission consistently opposed the praxis of exclusive territories. Our paper shows that due to the 'instantaneous reaction' mechanism exclusive territories may facilitate tacit collusion between manufacturers and are therefore likely to be anticompetitive if manufacturers compete repeatedly. Our analysis also shows that from a collusive point of view exclusive territories should be viewed more suspiciously than other vertical restraints, like RPM, that are also illegal in many countries.[26]

An assumption we made throughout the analysis is that cheated upstream firms punish deviations with infinite Nash reversion. This begs the question if the pro-collusive effect of exclusive territories would still hold when optimal punishment is in place.[27] One can easily argue that this is the case in the context of our model, because were manufacturers able to punish deviations according to an optimal penal code, the difference between the punishment profits

[25] See Sass and Saurman (1993) for a history of the treatment of exclusive territories, and the current praxis in different states.

[26] For example, in Europe RPM is generally illegal. In the U.S. the Supreme Court has recently struck down a law that would prohibit RPM completely and instead concluded that RPM should be judged on a case-by-case basis.

[27] Characterizing optimal penal codes is somewhat tricky in models with differentiated products—see, e.g., Wernerfelt (1989) or Häckner (1996)—because manufacturers receive positive profits even in the punishment phase since prices cannot be negative. Thus, determining the punishment profit involves the calculation of the optimal punishment length which is usually not possible in closed form.

with and without exclusive territories would shrink since optimal punishment involves returning to collusion after some time. However, the instantaneous reaction of competing retailers after a deviation is still possible only under exclusive territories. So this effect becomes relatively stronger under optimal penal codes, whereby unambiguously increasing the pro-collusive value of exclusive territories.[28] We also supposed that retailers are short-lived, i.e., they are basically passive in the repeated interaction not only with their competitors but also vis-à-vis manufacturers. This assumption is standard and has been made in the earlier literature dealing with related issues (see, e.g., Jullien and Rey, 2007, and Schinkel et al., 2008). In future research we hope to extend our analysis of collusion between competing supply chains so as to relax this hypothesis.

[28]We thank Patrick Rey for pointing this out to us.

# Appendix

**Proof of Proposition 1.** Using the expressions for the discount factors we have

$$\underline{\delta}_{ET} - \underline{\delta}_{NE} = -\frac{4\beta^3\gamma^4(\beta-\gamma)(4\beta-3\gamma)}{(8\beta(\beta-\gamma)+\gamma^2)((32\beta-12\beta\gamma^2)(\beta-\gamma)+\gamma^4)},$$

and

$$\underline{\delta}_{NE} - \underline{\delta}_{AS} = -\frac{2\gamma^3(\beta-\gamma)(4\beta^2-\beta\gamma-\gamma^2)}{(8\beta(\beta-\gamma)+\gamma^2)(32\beta^4-16\beta^3\gamma^-24\beta^2\gamma^2+8\beta\gamma^3+3\gamma^4)}.$$

It is immediate to verify that $\underline{\delta}_{ET} < \underline{\delta}_{NE} < \underline{\delta}_{AS}$. Hence, there is a range of $\delta$ in which collusion can be sustained if both manufacturers impose exclusive territories, but not if one or both allow for intrabrand competition. ■

**Proof of Proposition 2.** Consider first $\delta < \underline{\delta}_{ET}$. In this range collusion can never be sustained. Hence, each manufacturer chooses the distribution mode that yields the largest stage game profit (given the rival's distribution mode). Since $\Pi^N_{ET} > \Pi^N_{NE,ET}$ and $\Pi^N_{ET,NE} > \Pi^N_{NE}$, it is a dominant action for each manufacturer to impose exclusive territories.

Next, suppose that $\delta \in [\underline{\delta}_{ET}, \underline{\delta}_{NE})$. In this range collusion can be sustained only when both manufacturers impose exclusive territories. No manufacturer wants to deviate from this strategy because $\Pi^C_{ET} > \Pi^N_{NE,ET}$. Moreover, since $\Pi^N_{ET,NE} > \Pi^N_{NE}$, imposing exclusive territories is again a dominant action for each manufacturer.

Suppose now that $\delta \in (\underline{\delta}_{NE}, \underline{\delta}_{AS})$. We know that $\Pi^C_{ET} > \Pi^N_{NE,ET}$, hence there exists an equilibrium where both manufacturers impose exclusive territories. But, since in this range collusion can also be sustained if both manufacturers allow for intrabrand competition, and $\Pi^C_{NE} > \Pi^N_{ET,NE}$ there exists also an equilibrium where both manufacturers do not impose exclusive territories.

Finally, suppose that $\delta \geq \underline{\delta}_{AS}$. In this range any pair of organizational modes sustains collusion. If both manufacturers choose the same distribution network, each one gets half of the collusive profit, while if $M_i$ chooses exclusive territories and $M_j$ chooses non-exclusive territories, $M_i$ receives a share $x$ of the collusive profit. Calculating $x$ so as to minimize the discount factor in the asymmetric case yields

$$x = \frac{256\beta^7 - 128\beta^6\gamma - 320\beta^5\gamma^2 + 160\beta^4\gamma^3 + 104\beta^3\gamma^4 - 56\beta^2\gamma^5 - 3\beta\gamma^6 + 3\gamma^7}{8\beta(2\beta^2-\gamma^2)(32\beta^4 - 16\beta^3\gamma - 24\beta^2\gamma^2 + 8\gamma^3\beta + 3\gamma^4)}.$$

It is easy to check that

$$x - \frac{1}{2} = \frac{\gamma^3(32\beta^4 - 16\beta^3\gamma - 24\beta^2\gamma^2 + 9\gamma^3\beta + 3\gamma^4)}{8\beta(2\beta^2-\gamma^2)(32\beta^4 - 16\beta^3\gamma - 24\beta^2\gamma^2 + 8\gamma^3\beta + 3\gamma^4)} > 0.$$

Therefore, $M_i$ receives a larger fraction of the collusive profit than $M_j$, and we have that $\Pi^C_{ET,NE} > \Pi^C_{NE}$ and $\Pi^C_{ET} > \Pi^C_{NE,ET}$. It then follows that for each manufacturer it is a dominant strategy to impose exclusive territories. ■

**Proof of Proposition 3.** The proof follows from the text. ■

**Proof of Proposition 4.** We start with the Nash equilibrium of the stage game. In case both manufacturers have non-exclusive territories, we have $p_i = w_i$ because of intrabrand competition. Therefore, the optimization problem of a manufacturer is the same irrespective of the contract observability regime, i.e., public vs. private, and the equilibrium wholesale prices are implicitly defined by

$$\frac{\partial D^i(w_i, w_j)}{\partial w_i} w_i + D^i(w_i, w_j) = 0, \quad i = 1, 2. \tag{A1}$$

Suppose now that both manufacturers distribute via exclusive territories. Since contracts are unobservable, here we need to specify off-equilibrium beliefs. Denote by $\tilde{p}_j^i$ the expectation about brand $j$'s retail price of the retailers distributing brand $i$. We assumed passive beliefs; hence, given any equilibrium candidate where final outputs are expected to be sold at the retail prices $\left(p_i^e, p_j^e\right)$, one has $\tilde{p}_j^i = p_j^e$ and $\tilde{p}_i^j = p_i^e$. This implies that for any pair $(w_i, w_j)$ of wholesale prices offered at the contracting stage, the equilibrium retail prices in the downstream market are defined by

$$\frac{\partial D^i(p_i, p_j^e)}{\partial p_i}(p_i - w_i) + D^i(p_i, p_j^e) = 0 \quad i = 1, 2. \tag{A2}$$

Accordingly, denote by $p_i\left(w_i, p_j^e\right) \equiv p_i^e$ for $i = 1, 2$ the solution to $p_i$ of the system of first-order conditions (A2). Since $M_i$ can extract retailers' profits via the fixed fee, his profit is given by

$$\Pi^i(w_i, w_j) = D^i(p_i(w_i, p_j^e), p_j^e) p_i(w_i, p_j^e),$$

which gives the system of first-order conditions

$$\left(\frac{\partial D^i(p_i(w_i, p_j^e), p_j^e)}{\partial p_i} p_i(w_i, p_j^e) + D^i(p_i(w_i, p_j^e), p_j^e)\right) \frac{\partial p_i(w_i, p_j^e)}{\partial w_i} = 0, \quad i = 1, 2.$$

So, in a symmetric equilibrium where both manufacturers offer the same wholesale contract $C^e = (T^e, w^e)$, $w^e$ must satisfy

$$\frac{\partial D^i(p(w^e), p(w^e))}{\partial p_i} p(w^e) + D^i(p(w^e), p(w^e)) = 0, \quad i = 1, 2. \tag{A3}$$

It is immediate to verify by comparing equation (A1) with equation (A3), that, given the (symmetric) equilibrium wholesale price $w^e$, the equilibrium retail price $p^e \equiv p(w^e)$ is the same as the one obtained in the case of non-exclusive territories. However, since wholesale prices in both regimes satisfy the same downstream first-order conditions, and manufacturers' marginal costs are zero in our model, with private contracts manufacturers set $w^e = 0$. This implies that upstream profits are the same in the two regimes where both manufacturers choose exclusive territories and where they both allow for intrabrand competition.

Suppose now that one manufacturer imposes exclusive territories ($M_i$) while the other ($M_j$) does not. It is straightforward to verify that the equilibrium first-order condition for $M_i$ is given by (A3), while that of $M_j$ is given by (A1). Therefore, the equilibrium outcome in such an asymmetric case is again the same as in the two cases above: upstream profits are also the same irrespective of the distribution mode.

Next, consider collusion. With non-exclusive territories $p_i = w_i$ for $i = 1, 2$. Hence, $w_i$ is chosen to maximize

$$\sum_{i=1,2} \Pi^i(w_i, w_j) = D^i(w_i, w_j) w_i + D^j(w_j, w_i) w_j,$$

which yields first-order conditions

$$D^i(w_i, w_j) + \frac{\partial D^i(w_i, w_j)}{\partial w_i} w_i + \frac{\partial D^j(w_j, w_i)}{\partial w_i} w_j = 0, \qquad i = 1, 2. \tag{A4}$$

With exclusive territories, instead, we have

$$\sum_{i=1,2} \Pi^i(w_i, w_j) = D^i(p_i(w_i), p_j(w_j))p_i(w_i) + D^j(p_j(w_j), p_i(w_i))p_j(w_j),$$

where $p_i(w_i)$ is again given by (A2). For each $i = 1, 2$ the optimality condition for $w_i$ is then

$$D^i(p_i(w_i), p_j(w_j)) + \frac{\partial D^i(p_i(w_i), p_j(w_j))}{\partial p_i} p_i(w_i) + \frac{\partial D^j(p_j(w_j), p_i(w_i))}{\partial p_i} p_j(w_j) = 0. \tag{A5}$$

Using the same argument as above, one can show that condition (A5) implies the same retail prices as in (A4), and that the same trivially holds for the case of asymmetric distribution networks.

We can then turn to deviation. When both manufacturers allow for intrabrand competition, the optimal deviation price is given by

$$\frac{\partial D^i\left(w_i, w_{NE}^C\right)}{\partial w_i} w_i + D^i\left(w_i, w_{NE}^C\right) = 0, \qquad i = 1, 2,$$

where $w_{NE}^C$ is the collusive wholesale price that solves the system of equations (A4).

Next, suppose that both manufacturers distribute via exclusive territories. The optimal deviation wholesale price is defined by

$$\frac{\partial D^i\left(p_i(w_i), p_j(w_{ET}^C)\right)}{\partial p_i} p_i(w_i) + D^i\left(p_j(w_{ET}^C), p_i(w_i)\right) = 0, \qquad i = 1, 2,$$

where $w_{ET}^C$ is the solution to the system of equations (A5). From above we know that the collusive retail prices are the same irrespective of manufacturers' distribution modes—i.e., $p_j(w_{ET}^C) = w_{NE}^C$. This implies that the optimal deviation wholesale price is also the same irrespective of the pair of distribution modes chosen by manufacturers at equilibrium. Hence, collusion, deviation and punishment profits are the same in all three regimes. This implies in turn that with private contracts the critical discount factor above which upstream collusion is viable is unique and is independent of the equilibrium distribution modes. Finally, since any equilibrium of the game with private contracts yields the same wholesale prices, retail prices and upstream profits as those obtained with public contracts and non-exclusive territories, this discount factor must be equal to $\underline{\delta}_{NE}$. ■

**Proof of Proposition 5.** We start with the case in which both manufacturers distribute via non-exclusive territories. We know already that in this case it is not important if the contract is observable to rivals or not because due to intrabrand competition retailers set $p_i = w_i$ anyway. Thus, manufacturers are indifferent between making their contracts observable or not. The critical discount factor is the same as the one calculated in Section 4 and is given by

$$\underline{\delta}_{NE} = \frac{(2\beta - \gamma)^2}{8\beta(\beta - \gamma) + \gamma^2}.$$

Next, consider the case where both manufacturers impose exclusive territories. We first look at the stage game. Consider an equilibrium candidate where $M_i$ charges a wholesale price $w_i^e$ and each brand $i$ is sold at the retail price $p_i^e$ (for $i = 1, 2$). The profit function of a retailer distributing brand $i$ is then given by

$$\frac{\alpha(\beta - \gamma) - \beta p_i + \gamma p_j^e}{\beta^2 - \gamma^2}(p_i - w_i).$$

Here, $p_j^e$ means that, in case $M_j$ decides not to disclose his contract, retailers of the competing brand conjecture that their rivals still charge the equilibrium price since they hold passive beliefs.

Maximizing the profit function yields that the equilibrium in the game of retailers is given by

$$p_i(w_i, w_j^e) = \frac{\alpha(2\beta^2 - \gamma^2 - \beta\gamma) + \beta(2\beta w_i + \gamma w_j^e)}{4\beta^2 - \gamma^2}, \quad i = 1, 2. \tag{A6}$$

Now we can turn to the first stage which determines manufacturers' wholesale contracts. In principle, three outcomes can occur depending on each manufacturer's decision to disclose his contract or not: (*i*) either both manufacturers do not make their contracts observable, (*ii*) both manufacturers make them observable, and (*iii*) one keeps its contract secret, while the other makes it observable.

Consider first the case in which both choose not to disclose. Inserting (A6) into the quantities yields

$$q_i(w_i, w_i^e, w_j^e) = \frac{\beta(\alpha(2\beta^2 - \gamma^2 - \beta\gamma) + \beta\gamma(w_j^e) - 2\beta^2 w_i + \gamma^2 w_i^e)}{(2\beta - \gamma)(2\beta + \gamma)(\beta + \gamma)(\beta - \gamma)}, \quad i = 1, 2. \tag{A7}$$

As a consequence, the profit of a retailer of manufacturer $i$ is $\pi_i = q_i(p_i - w_i)$, where $p_i$ and $q_i$ are defined in (A6) and (A7). Since manufacturer $i$ can extract everything via the fixed fee, he maximizes $\Pi_i = p_i q_i$ with respect to $w_i$. Calculating equilibrium prices yields $w_i^e = 0$ which gives a profit of

$$\Pi_{ET}^{nob} = \frac{\alpha^2\beta(\beta - \gamma)}{(2\beta - \gamma)^2(\beta + \gamma)}.$$

We have to check whether manufacturer $i$ can gain by making his contract observable whilst manufacturer $j$ keeps his contract secret. Calculating the optimal $w_i$ for this case yields

$$w_i = \frac{\alpha\gamma^2(2\beta^2 - \gamma^2 - \beta\gamma)}{4\beta^2(2\beta^2 - \gamma^2)},$$

and a profit of

$$\Pi_{ET}^{ob,nob} = \frac{\alpha^2(\beta - \gamma)(2\beta + \gamma)}{8\beta(\beta + \gamma)(2\beta^2 - \gamma^2)}.$$

It is readily checked that $\Pi_{ET}^{ob,nob} > \Pi_{ET}^{nob}$. Therefore, the equilibrium of the stage game cannot entail both manufacturers hiding their contracts.

By the same token, one can check that it in equilibrium it can never happen that manufacturers behave asymmetrically, i.e., $M_i$ discloses his contract while $M_j$ does not.

Finally consider the case where both manufacturers make the contract observable to the rival. From Subsection 4.1 we know that profits in this case are

$$\Pi_{ET}^{ob} = \frac{2\alpha^2\beta(\beta - \gamma)(2\beta^2 - \gamma^2)}{(\beta + \gamma)(4\beta^2 - \gamma^2 - 2\beta\gamma)^2}.$$

Deviation to secret contracting by $M_i$ would yield $w_i = 0$ and a profit of

$$\Pi_{ET}^{nob,ob} = \frac{16\alpha^2\beta^3(\beta-\gamma)(2\beta^2-\gamma^2)}{(\beta+\gamma)(2\beta+\gamma)^2(2\beta-\gamma)^2(4\beta^2-\gamma^2-2\beta\gamma)^2}$$

which is lower than $\Pi_{ET}^{ob}$. Thus, the stage game profit is given by $\Pi_{ET}^{ob}$.

Consider now the dynamic game. We begin with collusion. Maximizing manufacturers' joint profits yields $w_C = \gamma\alpha/2\beta$ irrespective of whether contracts are observable or not. Each manufacturer then gets the profit

$$\Pi_{ET}^{C} = \frac{\alpha^2}{2(\beta+\gamma)}.$$

The observability regime is nevertheless important to determine the deviation profit. In equilibrium, manufacturers collude in such a way that deviation profits are minimized in order to achieve cooperative outcomes for the largest range of discount factors.

We know already that when both manufacturers collude via observable contracts, and one of them deviates by keeping his contract public but changes the wholesale tariff, the deviation profit is given by

$$\Pi_{ET}^{D,ob} = \frac{\alpha^2(4\beta^2-\gamma^2-2\beta\gamma)^2}{32\beta(\beta+\gamma)(\beta-\gamma)(2\beta^2-\gamma^2)}.$$

On the other hand, if $M_i$ deviates by hiding his contract, retailers distributing brand $j$ spot such a deviation since they can no longer observe $M_i$'s contract. $M_i$'s deviation then entails $w_i = 0$ with a corresponding profit of

$$\Pi_{ET}^{D,nob} = \frac{\alpha^2\beta(4\beta^2-\gamma^2-2\beta\gamma)^2}{4\beta(\beta+\gamma)(\beta-\gamma)(2\beta-\gamma)^2(2\beta+\gamma)^2},$$

which is lower than $\Pi_{ET}^{D,ob}$. By the same token, one can easily check that if collusion is organized in such a way that at least one manufacturer hides his contract, the deviation profit of this firm is always larger than $\Pi_{ET}^{D,ob}$. Thus, the deviation profit is given by $\Pi_{ET}^{D,ob}$.

As a consequence, both manufacturers optimally choose public contracting, and so the critical discount factor is again given by

$$\underline{\delta}_{ET} = \frac{(4\beta^2-\gamma^2-2\beta\gamma)^2}{32\beta^3(\beta-\gamma)-12\beta\gamma^2(\beta-\gamma)+\gamma^4}.$$

Finally, suppose that $M_i$ distributes via exclusive territories, while $M_j$ does not. We can then perform the same analysis as in the case in which both distribute via exclusive territories. It is readily shown that $M_i$—the manufacturer distributing via exclusive territories—chooses to make his contract public in the stage game, in the collusive phase and also when deviating. Instead, $M_j$—the manufacturer allowing for intrabrand competition—is indifferent in any phase. Hence, the critical discount factor in this case is the same as that determined in Section 4, i.e.,

$$\underline{\delta}_{AS} = \frac{(2\beta^2-\gamma^2)(8\beta^2-4\beta\gamma-\gamma^2)}{32\beta^4-16\beta^3\gamma-24\beta^2\gamma^2+8\beta\gamma^3+3\gamma^4}.$$

Therefore, the statement of the proposition follows directly from the proof of Proposition 1. ■

**Proof of Proposition 6.** We start with the stage game. In the case of lack of commitment manufacturers have three different choice variables, i.e., the mode of distribution—exclusive or non-exclusive territories—whether to make the contract observable or not, and the wholesale contracts $(w_i, T_i)$.

Suppose first that both manufacturers impose exclusive territories and disclose their contracts. The profit of a manufacturer in this case is given by (5). Moreover, from the proof of Proposition 5, we know that deviating to secret contracting is not profitable. However, a manufacturer can now deviate by choosing non-exclusive territories. Suppose that $M_i$ does so and chooses to make his contract observable. Given the pair of wholesale prices $(w_i, w_j)$, from the analysis of the asymmetric case studied in Section 4 we know that retail prices are

$$p_i = w_i \quad \text{and} \quad p_j\left(w_i, w_j\right) = \frac{\alpha(\beta-\gamma)+\beta w_i+\gamma w_j}{2\beta}.$$

Since $M_j$ does not deviate, he sets a per-unit wholesale price of

$$w_j = \frac{\alpha\gamma^2(\beta-\gamma)}{\beta(4\beta^2-\gamma^2-2\beta\gamma)},$$

that was given by (4). After calculating the retail quantities we can write the profit function of manufacturer $i$ as

$$\Pi_i\left(w_i\right) = \frac{w_i(2\beta^2-\gamma^2(4\alpha\beta(\beta-\gamma)-w_i(4\beta^2-\gamma^2-2\beta\gamma)))}{2\beta(4\beta^2-\gamma^2-2\beta\gamma)(\beta+\gamma)(\beta-\gamma)}. \tag{A8}$$

Maximizing this with respect to $w_i$ yields

$$w_i = \frac{2\alpha\beta(\beta-\gamma)}{4\beta^2-\gamma^2-2\beta\gamma}.$$

Inserting this price into (A8) yields a profit that is the same as the one in (5). Thus, by deviating to non-exclusive territories and observable contracts, a manufacturer does as well as with sticking to exclusive territories and observable contracts. Hence, he has no incentive to deviate.

By the same token, we can check whether a manufacturer can gain by deviating to non-exclusive territories and non-observable contracts. Doing so yields a profit of

$$\frac{16\alpha^2\beta^3(2\beta^2-\gamma^2)^2(\beta-\gamma)}{(4\beta^2-\gamma^2-2\beta\gamma)^2(\beta+\gamma)(2\beta-\gamma)^2(2\beta+\gamma)^2},$$

which is strictly lower than (5). Hence, this deviation is not optimal and there exists an equilibrium of the stage game where both manufacturers impose exclusive territories and disclose their contracts. As mentioned in the proof of Proposition 4, there cannot exist a stage game equilibrium where one or both manufacturers chooses exclusive territories and keep their contracts secret. This is because opting for a public contract yields larger profits.

Next, consider the case where both manufacturers distribute via non-exclusive territories and make their contracts public. The profit in this case is given by (12). We know that deviating to private contracts yields the same profit in this case. Suppose now that $M_i$ deviates and chooses to distribute via exclusive territories. Here it does not matter if he makes the wholesale contract observable or not because the retailers distributing brand $j$ set $p_j = w_j$. We know that $M_j$ sets a wholesale price of $w_j = \alpha(\beta-\gamma)/(2\beta+\gamma)$. Calculating the optimal deviation wholesale price then yields $w_i = 0$ with associated profit

$$\Pi_{NE}^{D,ET} = \frac{\alpha^2\beta(\beta-\gamma)}{(2\beta-\gamma)^2(\beta+\gamma)},$$

which is the same as the one given by expression (12). Thus, no manufacturer can gain by deviating which implies that there also exists an equilibrium of the stage game in which manufacturers allow for intrabrand competition and disclose their contracts. By the same logic we obtain that both manufacturers imposing non-exclusive territories and both or just one of them make the contract not observable is also a Nash equilibrium of the stage game yielding the same profit as in (12).

Finally, one can show that there does not exist an asymmetric equilibrium of the stage game where manufacturers distribute with different distribution channels. This is because, as seen above, the manufacturer who allows for intrabrand competition can gain by imposing exclusive territories.

Summing up, the stage game with lack of commitment features two equilibria: one in which both manufacturers impose exclusive territories and disclose their contracts, and one where both allow for intrabrand competition and either make contracts public or private. The upstream profit in the first type of equilibrium is given by (5), in the second type of equilibrium it is given by (12). The difference between (5) and (12) is given by

$$\frac{\alpha^2\beta(\beta-\gamma)(32\beta^3(\beta-\gamma)+12\beta\gamma^3-8\beta^2\gamma^2-\gamma^4)}{(4\beta^2-\gamma^2-2\beta\gamma)^2(\beta+\gamma)(2\beta-\gamma)^2(\beta+\gamma)}$$

which is positive since $\beta > \gamma$. Thus, the harsher punishment is the one in which firms play non-exclusive territories in the stage game.

Next, consider collusion. In the analysis in Section 4 we have seen that if manufacturers collude via exclusive territories and observable contracts, they set a per-unit price of $w_i = \alpha\gamma/(2\beta)$ for $i = 1, 2$. Moreover, from the proof of Proposition 5 we also know that if a manufacturer sticks to exclusive territories, he optimally deviates by making the contract observable, with a corresponding profit of

$$\Pi_{ET}^{D,ET} = \frac{\alpha^2(4\beta^2-\gamma^2-2\beta\gamma)^2}{32\beta(\beta+\gamma)(\beta-\gamma)(2\beta^2-\gamma^2)}. \tag{A9}$$

Suppose instead that the manufacturer deviates by setting non-exclusive territories and public contracts. His optimal deviation wholesale price in this case is given by

$$w_i = \frac{\alpha(4\beta^2-\gamma^2-2\beta\gamma)}{4(2\beta-\gamma^2)}$$

leading also to a deviation profit of (A9). One can easily check that the deviation profit with non-exclusive territories and private contracts is strictly lower. Thus, in this case the largest deviation profit is given by (A9).

Now suppose that both manufacturers distribute via non-exclusive territories. From Proposition 3 we know that in this case it does not matter if contracts are public or private. Therefore, the profit that the deviant manufacturer earns when he keeps allowing for intrabrand competition in the period of deviation is given by (13), that is

$$\Pi_{ET}^{D,NE} = \frac{\alpha^2(2\beta-\gamma)^2}{16\beta(\beta-\gamma)(\beta+\gamma)}.$$

Subtracting $\Pi_{ET}^{D,ET}$ from $\Pi_{NE}^{D,NE}$ yields

$$\Pi_{NE}^{D,NE} - \Pi_{ET}^{D,ET} = \frac{\alpha^2\gamma^3(4\beta - 3\gamma)}{32\beta(\beta+\gamma)(\beta-\gamma)(2\beta^2-\gamma^2)} > 0.$$

Thus, the deviation profit if both manufacturers distribute via non-exclusive territories is larger and so it cannot be optimal that both manufacturers choose this mode of distribution.

Finally, when manufacturers choose asymmetric distribution networks, one can show that the deviation profit of the manufacturer imposing exclusive territories is larger than $\Pi_{ET}^{D,ET}$. Hence, manufacturers optimally collude by way of exclusive territories and public contracts.

We can now calculate the critical discount factor $\underline{\delta}$ above which collusion can be sustained if manufacturers are not committed to their distribution mode. This critical discount factor solves the standard indifference condition used throughout the paper:

$$\frac{\underline{\delta}}{1-\underline{\delta}}\frac{\alpha^2}{4(\beta+\gamma)} = \frac{\alpha^2(4\beta^2-\gamma^2-2\beta\gamma)^2}{32\beta(\beta+\gamma)(\beta-\gamma)(2\beta^2-\gamma^2)} + \frac{\underline{\delta}}{1-\underline{\delta}}\frac{\alpha^2\beta(\beta-\gamma)}{(2\beta-\gamma)^2(\beta+\gamma)},$$

yielding

$$\underline{\delta} = \frac{(2\beta-\gamma)^4}{16\beta^2(2\beta-\gamma)(\beta-\gamma)+\gamma^4}.$$

Comparing this discount factor with $\underline{\delta}_{ET}$ yields

$$\underline{\delta}_{ET} - \underline{\delta} = \frac{(32\beta^2\gamma(4\beta-3\gamma)(2\beta^2-\gamma^2)(\beta-\gamma)^2}{(4\beta(\beta-\gamma)(8\beta^2-3\gamma^2)(\beta-\gamma)+\gamma^4)(16\beta^2(2\beta-\gamma)(\beta-\gamma)+\gamma^4)} > 0.$$

Therefore, with lack of commitment collusion is easier sustain relative to the case where distribution modes are chosen once and for all. ■

**Proof of Proposition 7.** The proof follows the same lines as the analysis developed with perfect intrabrand competition. First, if both manufacturers distribute by way of exclusive territories, the analysis remains unchanged since there is no intrabrand competition. Thus, the critical discount factor is still equal to $\underline{\delta}_{ET}$ derived in (9).

However, if both manufacturers have two retailers, the analysis changes. In this case calculating the Nash-profit of a manufacturer in the stage game, i.e., the punishment profit that follows a deviation, we obtain

$$\Pi_{NE}^{N} = \frac{\alpha^2\beta(\beta(1+\sigma)-2\gamma)(\beta^2(2+\sigma-\sigma^2)-2\gamma^2)(\beta^2(2+3\sigma-\sigma^3)-2\gamma^2(3-\sigma))}{2(\beta(1+\sigma)+2\gamma)\left(\beta^3(2+3\sigma-\sigma^3)-\beta^2\gamma(2+\sigma-\sigma^2)-2\gamma^2(2\beta-\gamma)\right)^2}.$$

Determining the individual collusive profit yields

$$\Pi_{NE}^{C} = \frac{\alpha^2}{2(\beta(1+\sigma)+2\gamma)}.$$

Finally, calculating the deviation profit yields

$$\Pi_{NE}^{D} = \frac{\alpha^2\left(\beta^3(2+3\sigma-\sigma^3)-\beta^2\gamma(2+\sigma-\sigma^2)-2\gamma^2(2\beta-\gamma)\right)^2}{2\beta(\beta(1+\sigma)+2\gamma)(\beta(1+\sigma)-2\gamma)(\beta^2(2+\sigma-\sigma^2)-3\gamma^2)(\beta^2(2+3\sigma-\sigma^3)-2\gamma^2(3-\sigma))}.$$

So, the critical discount factor $\underline{\delta}_{NE}$ can be written as

$$\hat{\underline{\delta}}_{NE} = \frac{\left(\beta^3(2+3\sigma-\sigma^3) - \beta^2\gamma(2+\sigma-\sigma^2) - 2\gamma^2(2\beta-\gamma)\right)^2}{\eta\left(\sigma,\beta,\gamma\right)}.$$

with

$$\eta\left(\sigma,\beta,\gamma\right) \equiv 2\beta^5(2-\sigma)^2(1+\sigma)^3\left(\beta(1+\sigma)-2\gamma\right) -$$
$$-\beta^3\gamma^2(2-\sigma)(1+\sigma)\left(\beta(1+\sigma)(14+\sigma)-4\gamma(7+\sigma)\right) + 4\gamma^4\beta(\beta(5+\sigma)-2\gamma(5-\sigma)) + 4\gamma^6.$$

It is easy to check that for $\sigma = 1$ the critical discount factor is the same as the one obtained in our previous analysis, i.e., $\hat{\underline{\delta}}_{NE} = \delta_{NE} = (2\beta-\gamma)^2/(8\beta(\beta-\gamma)+\gamma^2)$. We can now compare $\hat{\underline{\delta}}_{NE}$ with $\underline{\delta}_{ET}$. We know from the previous analysis that for $\sigma = 1$ the difference between $\hat{\underline{\delta}}_{NE}$ and $\underline{\delta}_{ET}$ is positive. Now, evaluating this difference at the lower-bound $\sigma = \gamma/\beta$ we obtain

$$\hat{\underline{\delta}}_{NE} - \underline{\delta}_{ET} = \frac{\gamma^2(\beta-\gamma)(4\beta^2+3\gamma^2)(12\beta^3-4\beta^2\gamma-11\beta\gamma^2+\gamma^3)}{(8\beta^4+24\beta^3\gamma-2\beta^2\gamma^2-28\beta\gamma^3+7\gamma^4)(32\beta^4-32\beta^3\gamma-12\beta^2\gamma^2+12\beta\gamma^3+\gamma^4)} > 0.$$

Thus, also in this case collusion is easier to sustain under exclusive territories. Differentiating the above difference with respect to $\sigma$ we obtain

$$\operatorname{sign}\left\{\frac{\partial(\hat{\underline{\delta}}_{NE} - \underline{\delta}_{ET})}{\partial\sigma}\right\} = -\operatorname{sign}\left\{\varphi\left(\beta,\sigma,\gamma\right)\right\},$$

with $\varphi\left(\beta,\sigma,\gamma\right)$ being equal to

$$\left(\beta^2(2+\sigma(1-\sigma)) - 2\gamma(\beta(1-\sigma)+\gamma)\right)\left(\beta^3(2+\sigma(3-\sigma^2)) - \beta^2\gamma(2+\sigma(1-\sigma)) - 2\gamma^2(2\beta+\gamma)\right).$$

One can then readily check that $\partial(\hat{\underline{\delta}}_{NE} - \underline{\delta}_{ET})/\partial\sigma < 0$ for all $\sigma \in (\gamma/\beta, 1]$. Hence, exclusive territories facilitate collusion. Moreover, this also implies that the pro-collusive effect of exclusive territories becomes larger the less intense intrabrand competition is. ■

**Proof of Proposition 8.** We first look at the case in which both manufacturers distribute via exclusive territories. In the downstream stage the profit of a retailer distributing brand $i$ is

$$\pi^i(q_i,q_j,e_i,e_j) = (p_i - w_i)\left(\frac{\alpha(\beta-\gamma)+\beta e_i-\gamma e_j-\beta p_i+\gamma p_j}{\beta^2-\gamma^2}\right) - T_i - \frac{1}{2}ke_i^2, \quad i,j=1,2, i\neq j.$$

Maximizing this expression with respect to $p_i$ and $e_i$ for both retailers, solving for the optimal price and effort levels, and inserting it back into the profit function, we obtain that the (net) profit and quantity of retailer $i$ is given by

$$\pi^i(w_i,w_j) = \frac{\beta k(\beta(2\beta k-1)-2\gamma^2 k)\left(k(2\beta^2-\gamma^2)(\alpha-w_i)-\beta(\alpha-w_i+\gamma k(\alpha-w_j))\right)^2}{2(\beta(2\beta k-1)-\gamma k(\beta+\gamma))^2(\beta(2\beta k-1)+\gamma k(\beta-\gamma))^2} - T_i \tag{A10}$$

and

$$q_i(w_i,w_j) = \frac{\beta k\left(k(2\beta^2-\gamma^2)(\alpha-w_i)-\beta(\alpha-w_i+\gamma k(\alpha-w_j))\right)}{(\beta(2\beta k-1)-\gamma k(\beta+\gamma))(\beta(2\beta k-1)+\gamma k(\beta-\gamma))}, \tag{A11}$$

respectively.[29] Manufacturer $i$'s problem can then be written as

$$\Pi^i(w_i, w_j) = w_i q_i(w_i, w_j) + \pi^i(w_i, w_j),$$

where $\pi^i(w_i, w_j)$ and $q_i(w_i, w_j)$ are given by (A10) and (A11), respectively. Maximizing this with respect to $w_i$ and using symmetry, we obtain that the Nash equilibrium wholesale price under exclusive territories is given by[30]

$$w_{ET}^N = \frac{\alpha k \gamma^2 (\beta(\beta k - 1) - \gamma^2 k)}{\beta \left(4\beta^3 k - 2\beta^2 k(2 - \gamma k) + \beta(1 - \gamma k(1 + 3\gamma k)) + \gamma^2 k(1 - \gamma k)\right)}.$$

This gives a manufacturer's profit of

$$\Pi_{ET}^N = \frac{\alpha^2 k(\beta(\beta k - 1) - \gamma^2 k)(4\beta^2 k(\beta k - 1) + \beta(1 - 4\gamma^2 k^2) + \gamma^2 k)}{2\left(4\beta^3 k - 2\beta^2 k(2 - \gamma k) + \beta(1 - \gamma k(1 + 3\gamma k)) + \gamma^2 k(1 - \gamma k)\right)^2}.$$

Turning to the case of collusion we can calculate the collusive wholesale price and the collusive profit of each manufacturer in the same way as above. This yields

$$w_{ET}^C = \frac{\alpha k \gamma(\beta + \gamma)}{\beta(2k(\beta + \gamma) - 1)} \tag{A12}$$

for the collusive wholesale price and

$$\Pi_{ET}^C = \frac{\alpha^2 k}{2(2k(\beta + \gamma) - 1)}. \tag{A13}$$

for the collusive profit of a manufacturer.

To determine the deviation profit we insert $w_j = w_C^N$ given by (A12) into the profit function of manufacturer $i$. Maximizing $\Pi_i$ with respect to $w_i$ then yields

$$w_{ET}^D = \frac{\alpha\gamma^2 k(\beta(\beta k - 1) - \gamma^2 k)\left(4\beta^3 k^2 - 2\beta^2 k(2 - \gamma k) + \beta(1 - \gamma k(1 + 3\gamma k)) + \gamma^2 k(1 - \gamma k)\right)}{\beta(\beta(2\beta k - 1) - \gamma^2 k)(2k(\beta + \gamma) - 1)\left(4\beta^2 k(\beta k - 1) + \beta(1 - 4\gamma^2 k^2) + \gamma^2 k\right)}$$

leading to a deviation profit of

$$\Pi_{ET}^D = \frac{\alpha^2 k\left(4\beta^3 k^2 - 2\beta^2 k(2 - \gamma k) + \beta(1 - \gamma k(1 + 3\gamma k)) + \gamma^2 k(1 - \gamma k)\right)^2}{2(\beta(2\beta k - 1) - \gamma^2 k)(2k(\beta + \gamma) - 1)^2\left(4\beta^2 k(\beta k - 1) + \beta(1 - 4\gamma^2 k^2) + \gamma^2 k\right)}.$$

We can now determine the critical discount factor above which collusion can be sustained if both manufacturers distribute by way of exclusive territories. Proceeding in the same way as above gives us

$$\underline{\tilde{\delta}}_{ET} = \frac{\left(4\beta^3 k^2 - 2\beta^2 k(2 - \gamma k) + \beta(1 - \gamma k(1 + 3\gamma k)) + \gamma^2 k(1 - \gamma k)\right)^2}{\xi},$$

[29] Due to our assumption on $k$ given by (16) the Hessian matrix of a retailer's problem is negative definite. Thus, we indeed calculated a maximum.

[30] Since $k > \bar{k}$, the second-order conditions are fulfilled here as well.

with

$$\xi \equiv 32\beta^5 k^3(k(\beta+\gamma)-2)+4\beta^4k^2(12(1-\gamma k)-11\gamma^2k^2)-4\beta^3k(4-\gamma k(6+15\gamma k-11\gamma^2k^2))+$$

$$+\beta^2(2-\gamma k(4+27\gamma k-38\gamma^2k^2-13\gamma^3k^3))+\beta\gamma^2k(1-\gamma k)(2(1-\gamma k)-7\gamma^2k^2)+\gamma^4k(2-2\gamma k(2-\gamma k)).$$

It is easy to check that in the limiting case as $k \to \infty$, this discount factor approaches $(4\beta^2 - 2\beta\gamma - \gamma^2)^2/((32\beta^3 - 12\gamma^2\beta)(\beta-\gamma)+\gamma^4)$, which is the critical discount factor without effort provision.

Consider now the case in which both manufacturers distribute via non-exclusive territories. Since retailers price at marginal costs and make zero profits, it is evident that the free-riding problem prevents retailers from exerting any effort in this case. As a consequence, all profits are the same as in the case in which effort plays no role. Thus, the critical discount factor is the same as well and is given by

$$\underline{\delta}_{NE} = \frac{(2\beta-\gamma)^2}{8\beta(\beta-\gamma)+\gamma^2}.$$

Finally, consider the asymmetric regime. In the same way as above we can determine the optimal effort level of the retailer whose brand is distributed via exclusive territories, and the resulting prices and profit levels under collusion, deviation and punishment for both manufacturers. Here we obtain that the lowest discount factor above which collusion can be sustained is given by

$$\tilde{\underline{\delta}}_{AS} = \frac{(\beta(2\beta k-1)-\gamma^2k)(2\beta(4\beta k-1-2\gamma k)-\gamma^2k)}{8\beta^3k(2k(2\beta-\gamma)-3)+4\beta^2(1+2\gamma k(1-3\gamma k))+\beta\gamma^2k(7+8\gamma k)+3\gamma^4k^2}.$$

We can now compare the three discount factors with each other. We start with a comparison of $\underline{\delta}_{NE}$ and $\tilde{\underline{\delta}}_{ET}$. Solving $\underline{\delta}_{NE} - \tilde{\underline{\delta}}_{ET} = 0$ for $k$ we obtain that there are four roots for $k$ which are given by

$$k_1 = \frac{2\beta^2-\gamma^2+2\beta\gamma+\sqrt{4\beta^4+\gamma^4+4\beta\gamma^3}}{4\gamma(\beta^2-\gamma^2)}, \quad k_2 = \frac{2\beta^2-\gamma^2+2\beta\gamma-\sqrt{4\beta^4+\gamma^4+4\beta\gamma^3}}{4\gamma(\beta^2-\gamma^2)},$$

$$k_3 = \frac{6\beta^2-\gamma^2+\sqrt{4\beta^4+\gamma^4+12\beta^2\gamma^2-8\gamma\beta^3}}{4(4\beta^3-3\beta\gamma^2+2\beta^2\gamma)} \quad \text{and} \quad k_4 = \frac{6\beta^2-\gamma^2+\sqrt{4\beta^4+\gamma^4+12\beta^2\gamma^2-8\gamma\beta^3}}{4(4\beta^3-3\beta\gamma^2+2\beta^2\gamma)}.$$

Comparing each of these roots with $\bar{k}$, it is easy to check, that only $k_1$ is larger than $\bar{k}$. Thus, the other three roots are not valid for the parameter range under consideration. Hence, we can ignore them. Since we know that $\tilde{\underline{\delta}}_{ET} < \underline{\delta}_{NE}$ for $k \to \infty$ and there is only one solution to the equation $\underline{\delta}_{NE} - \tilde{\underline{\delta}}_{ET} = 0$ for $k \in (\bar{k}, \infty)$, we know that for $k > (<) k_1$, $\tilde{\underline{\delta}}_{ET} < (>) \underline{\delta}_{NE}$.

Pursuing a similar analysis for the comparison between $\underline{\delta}_{NE}$ and $\tilde{\underline{\delta}}_{AS}$, we obtain

$$\underline{\delta}_{NE} \gtreqless \tilde{\underline{\delta}}_{AS} \quad \text{if} \quad k \gtreqless \frac{\beta}{\gamma(\beta-\gamma)}.$$

It is easy to see that $\beta/\gamma(\beta-\gamma) > k_1$. Thus, it follows that for all $k < k_1$, the critical discount factor in case where both firms distribute via non-exclusive territories is the lowest one.

Finally, comparing $\tilde{\underline{\delta}}_{ET}$ with $\tilde{\underline{\delta}}_{AS}$ we know that for $k$ between $\beta/\gamma(\beta-\gamma)$ and $k_1$ one has $\tilde{\underline{\delta}}_{ET} < \tilde{\underline{\delta}}_{AS}$. This is the case because in this region $\tilde{\underline{\delta}}_{ET} < \underline{\delta}_{NE}$, but $\tilde{\underline{\delta}}_{AS} > \underline{\delta}_{NE}$. Now differentiating $\tilde{\underline{\delta}}_{ET} - \tilde{\underline{\delta}}_{AS}$ with respect to $k$, one can check that for all $k > k_1$ this difference is strictly decreasing in $k$. But since $\tilde{\underline{\delta}}_{ET} < \tilde{\underline{\delta}}_{AS}$ at $k = k_1$, it follows that for all $k > k_1$, $\tilde{\underline{\delta}}_{ET} < \tilde{\underline{\delta}}_{AS}$ also holds. ■

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