Buyer Power and Functional Competition for Innovation

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January 2015

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Abstract

Our analysis starts from the observation that with progressive consolidation in retailing and the spread of private labels, retailers increasingly take over functions in the vertical chain. Focusing on innovation, we isolate various reasons for why when a large retailer grows in size, this can lead to an inefficient shift of innovation activity away from manufacturers and to the large retailer. One rationale for this is the retailer's control of access to consumers, which gives rise to a rent-appropriation motive for innovation, next to a hold-up problem. With retail competition, through crowding out the manufacturer's innovative activity, a large retailer obtains a competitive advantage vis-à-vis smaller retailers. We further analyze when inefficiencies are aggravated in case a large retailer's presence threatens the manufacturer with imitation of his innovations.

Keywords: Buyer Power, Innovation, Functional Competition, Imitation

*Inderst and Jovanovic gratefully acknowledge support from the German Science Foundation (DFG) under the Leibniz grant, Jakubovic from the Foundation of German Business (SDW). Part of this research was used in the policy report "The Implications of Buyer Power and Private Labels on 'Vertical Competition' and Innovation" funded by Markenverband.

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1 Introduction

Large retailers have gained impressive buyer power, through organic growth and mergers, and increasingly take over more of the functions in the vertical chain, such as distribution and marketing. In addition, the advent of private labels has resulted in retailers directly competing with manufacturers in certain product segments. As discussed in more detail below, in particular food retailers increasingly compete also with branded products as they move their private labels upmarket, sometimes becoming major innovators. In fact, as we discuss below, in some newly developing up-market segments, such as organic food, their share of the market by now exceeds that of branded products in some countries.

The shift of power and functions to retailers may often be attributable to more fundamental changes, such as changes in shopping habits or technology that, for instance, may render it more efficient if retailers take on a larger role in distribution. The growth and exercise of buyer power, especially when arising from consolidation in the retailing industry, may, however, negatively affect not only horizontal competition but also the efficient allocation of roles and functions in the vertical relationship. Which functions, such as those of innovation, distribution, or marketing, are performed (more) by retailers or by manufacturers is then possibly not only determined by efficiency considerations, but it may be the result of the exercise of buyer power.

In this paper, we focus on one such function, namely that of innovation. We ask in particular whether, as a large retailer increasingly gains in size, the function of innovation will be allocated efficiently between retailers and a branded goods manufacturer. The retailer's size is the key trigger that makes innovation through private labels worthwhile, as the retailer will only find it profitable to undertake these activities himself when he can distribute the respective costs over a sufficiently large number of units. The analysis isolates various forces why, with the growth of large retailers, manufacturers' innovation could be inefficiently crowded out.

Our analysis first focuses on the case where we abstract from retail competition. There, we show how a combination of the following two forces can inefficiently tip innovative activity towards a large retailer: a "rent appropriation" motive for retailers who, where their size permits, may prefer to innovate on their own even if this is less efficient, as this allows them to extract a larger share of the total profits that are created by the product innovation; and a "hold-up" problem for manufacturers, in case they still innovate and must share the proceeds, which is aggravated when there is the threat of copying and imitation by the retailer. We show when either of these two forces can be sufficiently large so as to inefficiently crowd out manufacturer innovation. These two forces (i.e., the hold-up problem and the rent appropriation motive) work only towards inefficiently allocating the innovating role to the large retailer, but not in the opposite direction. The reason for this asymmetry is that the manufacturer must rely on the retailer to have access to consumers ("gatekeeping"), but not vice versa. Hence, a key contribution of this part of our analysis is to show the implications of this asymmetry for dynamic efficiency.

Once the manufacturer has access to different (competing) retailers, we identify another force that may lead to an inefficient and now even potentially anti-competitive substitution of manufacturer innovative activity. Notably, this harms smaller retailers, once the activity of a large retailer crowds out manufacturer innovation. When it dampens or even replaces manufacturer innovation, the large retailer's own innovative activity reduces smaller retailers' access to innovation and puts them at a competitive disadvantage. We show that this is more likely when retail competition intensifies.

While concentration among retailers varies from industry to industry and from country to country, arguably food retailing has become increasingly concentrated in most European countries. This is due to a wave of mergers and acquisitions, organic growth by the largest retailers, and also the formation of buyer groups. For instance, as of 2010 the market shares of the top five firms in the five largest European countries was 73% in France, 75% in Germany, 32% in Italy, 64% in Spain, and 74% in the UK.[1] Taking as an example the German market, the respective figure was still below 60% ten years ago (i.e., more than 15 percentage points lower). The growing concentration directly affects the importance individual retailers have for manufacturers, which will be important for our subsequent analysis.[2]

Our focus in this paper is not on the exercise of buyer power in order to achieve discounts. In fact, our baseline analysis is set up such that, holding all else constant, a larger retailer will not enjoy a discount. Moreover, even when a larger retailer obtains

[1] This is based on Europanel data and taken from British Brands Group (2012). European Commission (2011, Chapter 3) provides more details on the growth of buyer power in European food retail across different countries.

[2] More than ten years ago already, British food suppliers sold on average one third of their UK sales to the biggest British customer and nearly 70% to their top five customers (Competition Commission, 2000).

better terms in some specifications of the model, e.g., with the threat of imitation, the discount will not affect marginal wholesale prices. When they can offer products of the same quality, small retailers will thus not be at a disadvantage. As we noted already, small retailers may, however, suffer when the large retailer's activity crowds out innovation by branded goods manufacturers, which is more likely when retail competition is intense. Then, the larger retailer will enjoy a competitive advantage from his private label products.

A substantial fraction of the aforementioned growth in concentration in some market segments has been fuelled by the spread of private labels. In fact, the market share of private labels in European food retailing has risen significantly, with now more than 40% in some countries such as the UK.[3] From the retailers' perspective, cost savings in production, distribution, and marketing were originally seen as the primary motivation for the introduction of private labels. These "budget private labels" were positioned at the lower end of the quality and price range.[4] Overall, at this stage private label products could basically only replace products with a weak "brand image" (national B-brands). But this has changed recently. As we discuss below when relating our contribution to the extant literature, in contrast to this literature we do not focus on the co-existence of branded goods and private labels on a retailer's shelf but, instead, on the observed tendency towards a substitution.

Though the respective developments have also occurred elsewhere, reportedly in the Netherlands or the UK, we take the example of Germany. There, over recent years growth has taken place, in particular, in the range of "added value" and "premium" private label products.[5] To single out one particular segment, take that of organic food and beverages. This is particularly interesting because, given the rather recent development, established brand manufacturers do have a strong toehold, as in the case of national brands that existed for decades or even for more than a century. The increasing innovative activity of large retailers, which is the focus of this paper, shows itself in the increasing share of private label products in this segment. In fact, by now the private label share in this segment is even greater than that of national brands.[6]

[3] Metro Handelslexikon (2012/2013, p. 61).

[4] Characteristic of this low-price, low-quality strategy were so-called "me too" products, positioned closely to established national brands (see, e.g., Kumar and Steenkamp, 2007).

[5] According to figures from GfK Consumer Scan (2013), the share of these private label products among all products has increased from around 9% in 2007 to almost 13% in 2012.

[6] Again, based on data from the GfK Consumer Scan (2013), the private label share has increased from

Our analysis can thus be brought towards answering the question how antitrust and competition policy should look at these developments. Our analysis isolates effects that suggest that such a shift of innovative activity towards large retailers, as they increase in size, may not always be efficient. Though often there may exist an efficiency rationale, our analysis can inform antitrust and competition policy about possible unwanted consequences of increasing buyer power that results, in particular, from further consolidation in the retailing industry. Even when such concentration does not have immediate horizontal effects, e.g., as the respective acquisitions took place in different local markets, we show, however, that it can have negative implications for competition as well. When only the large retailer innovates, which will especially occur when he becomes sufficiently large and when retail competition is sufficiently intense, this deprives smaller retailers of an equally competitive position. In this case, the advantage of the large retailer, which he enjoys through the innovative (private label) product, comes at a disadvantage to smaller retailers. The causal link is the reduced innovative activity of the branded goods manufacturer.

Our contribution is related to but different from several contributions that analyze incentives to invest in private label products. Most recently, Chambolle et al. (2014) have analyzed the choice of outsourcing vs. insourcing for a private label product that is stocked next to a branded product. They show various channels through which the resulting innovation activity can then be inefficiently provided, notably as this can affect the subsequent bargaining position of a retailer and a manufacturer. Previous contributions in the same spirit, that is, focusing on the co-existence of private label and branded products and on opportunism in the light of subsequent negotiations, include Bergés-Sennou (2006) (see also Steiner (2004)). In this paper, we abstract fully from such co-existence and focus, instead, on replacement. This is motivated by the preceding observations and seems to capture an increasing tendency in the grocery industry. Abstracting from the joint listing of other products allows us, in addition, to extend and generalize our analysis of "vertical competition" to, for instance, downstream competition, retailers of differing size, or different sharing rules in negotiations.

Other contributions in the recent literature have focused more broadly on the interaction of the exercise of buyer power and manufacturer incentives, without considering thus the issue of "vertical competition" that is the focus of this paper. While Battigalli et

41% in 2007 to 54% in 2012.

al. (2007) focus on the negative ("hold up") effects, Inderst and Wey (2003, 2007) show how buyer power can boost manufacturer incentives (see also Montez (2007)).[7] Chen (2013) provides a framework under which incentives of suppliers can become both weaker or stronger.[8]

The rest of this paper is organized as follows. Section 2 considers the baseline case of a bilateral monopoly. Section 3 introduces competition between a large and smaller retailers. For some of the analysis we first consider a simplified contractual game. Results are then generalized in Section 4. Section 5 offers some concluding remarks. All proofs are collected in the Appendix.

2 Bilateral Monopoly

2.1 Set-up

In this section, we consider a bilateral monopoly. As noted above, the objective of this section is twofold. First, the present analysis provides a baseline case for the subsequent introduction of retail competition in Section 3, which enables us to isolate more clearly the effect of competition on a large retailer's decision whether to innovate or not. Second, the analysis of the bilateral monopoly case is also of interest in itself, as it shows that, regardless of the distribution of bargaining power, there is a strong tendency for the ("gatekeeping") retailer to substitute the manufacturer's innovation even when this is inefficient. Note, however, that the focus on a single retailer does not allow us yet to vary a retailer's size. This will be captured later through the number of outlets that a large retailer, in contrast to small retailers, controls.

Suppose thus for now that a single manufacturer faces a single retailer. Our focus is on the decision to improve the quality of a single product. To bring out the innovative aspect of the considered investment, we suppose that the product's original (quality) characteristics u_0 can, through innovation, be increased to $u_I > u_0$. That is, we consider a non-incremental change in product characteristics. Further, we suppose for simplicity that this leaves the constant marginal cost of production unchanged at $c \geq 0$. As discussed in the introduction,

[7] Abstracting from manufacturer incentives, Chambolle and Villas-Boas (2008) show how a retailer can make use of stocking a differentiated product of lower quality in order to increase his buyer power.

[8] See, for instance, Chen (2007) for a broader discussion of the relevance of buyer power for welfare and efficiency in an antitrust context.

we thus consider the replacement of a single product, rather than a setting where products of lower and higher quality (e.g., branded products and private labels) co-exist.

We abstract from the vertical relationship for a moment and suppose that the manufacturer could directly sell a product with quality u to consumers. Denote the resulting profits by $\Pi(u)$, where $u \in \{u_0, u_I\}$. For the present analysis we need not specify whether firms set prices or quantities at the final (retail) stage. For specificity only, suppose that a price p is chosen, which then gives rise to demand $D(p; u)$. Demand is (where positive) strictly decreasing in p and strictly increasing in u. Maximum profits are

$$\Pi(u) = \max_p \left[(p - c)D(p; u)\right].$$

Return now to the original specification with a vertical relationship. The retailer could procure the basic variant of the product, with quality u_0, from the manufacturer as well as from one of many other manufacturers. That is, the basic variant is supposed to be produced and supplied competitively. In contrast, the enhanced variant with higher quality u_I can only be developed and produced in one of two possible ways. Either the manufacturer innovates or the retailer takes the initiative and innovates (together with one of the competitive manufacturers). In terms of applications, the second variant captures the case in which an innovation is undertaken through a private label product.

When the manufacturer innovates, we suppose that he has to incur costs I_M. When instead the retailer innovates, he bears himself the investment costs, which are then equal to I_R. We do not rule out the possibility that both invest at the same time. (See below for the precise timing.)[9] Clearly, the innovative activity is only strictly profitable if

$$\Delta = \Pi(u_I) - \Pi(u_0) > \min\{I_M, I_R\}, \tag{1}$$

which we assume to be the case in what follows.

The timing of decisions is as follows. In $t = 1$ both the manufacturer and the retailer can decide whether to innovate. As we presently consider a bilateral monopoly, once the retailer has innovated, there is no scope for the manufacturer to sell his product. That is, the retailer acts as a gatekeeper to consumers. When neither has innovated, then only the basic (and competitively provided) variant is on the market, in which case only the

[9] We do not allow the two parties to ex-ante contract on the innovative activity (including the specification of a sharing rule). In fact, such contracting is typical for private-label production, to which we refer to as retailer innovation.

retailer makes positive profits equal to $\Pi(u_0)$. Finally, when only the manufacturer has innovated, then there is scope for mutually beneficial negotiations that would ensure that the superior quality is offered by the retailer. These negotiations take place in $t = 2$.

Note that in $t = 2$, where investment costs are already sunk, the net surplus from successful negotiations is given by Δ, provided that the two sides can rule out double marginalization and, thereby, realize the maximum feasible industry profits. This is the case as we allow for non-linear contracts. To be precise, though this is without loss of generality, we take a two-part tariff wholesale contract with fixed payment F and constant marginal wholesale price w. Beyond this specification, i.e., that of joint profit maximizing wholesale contracts, we are presently agnostic on how Δ is shared and, therefore, suppose that a share α goes to the manufacturer and a share $(1-\alpha)$ to the retailer, where $\alpha \in [0, 1]$. Formally, we could appeal to an application of the axiomatic Nash bargaining solution with respective weights at this stage of the game. Note, however, that we will comment explicitly on the corner cases with $\alpha = 0$ and $\alpha = 1$, where the outcome corresponds to that where either the retailer or the manufacturer makes a take-it-or-leave-it offer.

At the final stage, $t = 3$, the product (of either quality $u = u_I$ or of quality $u = u_0$) is brought to the market.

2.2 Analysis with a Bilateral Monopoly

In what follows, we focus on a characterization of an equilibrium in pure strategies. We start with some immediate observations. Clearly, the manufacturer has only an incentive to innovate when he expects the retailer not to innovate himself. Further, this will only result in non-negative profits when

$$\alpha \geq \alpha^* = I_M/\Delta \tag{2}$$

holds. Consequently, when condition (2) does *not* hold, the manufacturer refrains from innovating. Since the retailer acts as a gatekeeper to consumers, however, he can appropriate the full surplus Δ when he innovates himself.

These two observations already summarize the two forces that will be at work in the presently considered bilateral monopoly case: First, there is a hold-up problem for the manufacturer, as he cannot appropriate the full net surplus from innovation, and which is more severe the lower is the manufacturer's share α;[10] second, when α is higher, so is the incentive of the retailer to innovate himself in order to fully appropriate the respective gains. In other words, as α increases, the hold-up problem is mitigated, but the "rent appropriation" motive for the retailer becomes stronger. Conversely, when α decreases, the hold-up problem becomes more severe, though now the "rent appropriation" motive for the retailer is mitigated. Taken together, these two forces ensure that, regardless of the distribution of bargaining power, the retailer may innovate even when this is inefficient given $I_R > I_M$. (When the converse holds, the retailer will always innovate.)

For the characterization in Proposition 1 we now apply in addition the following refinement. Whenever there is a multiplicity of (pure strategy) equilibria, we rule out those equilibria of the innovation stage that are weakly Pareto dominated.

Proposition 1 *In the case of a bilateral monopoly, there is generically a unique equilibrium in pure strategies. Whenever it is (weakly) more efficient that the retailer innovates, as $I_R \leq I_M$, then only this outcome arises in equilibrium. When the converse holds, so that $I_R > I_M$, it would be more efficient that the manufacturer innovates, but this, however, need not be the case, as then either the retailer may innovate instead or even no innovation could take place at all. Precisely, when $I_R > I_M$ we have the following case distinction:*
i) When, in addition, $I_R \geq \Delta$, then the manufacturer innovates in case $\alpha \geq \alpha^*$, while for $\alpha < \alpha^*$ there is no innovation at all (with the exception of $I_R = \Delta$, where also the outcome with retailer innovation is supported).
ii) When, instead, $I_R < \Delta$, then the manufacturer innovates only in case $\alpha^* \leq \alpha \leq \alpha^{**} = I_R/\Delta$, while for both $\alpha < \alpha^*$ and $\alpha > \alpha^{**}$ the retailer innovates.

Proof. See the Appendix. ■

When the innovation would be more efficiently undertaken by the manufacturer, then two types of inefficiencies can arise according to Proposition 1: Either the innovative activity (inefficiently) shifts to the retailer or no innovation is undertaken at all. Clearly, the latter case can only apply when innovation is too expensive for the retailer as $I_R \geq \Delta$ (case i) in Proposition 1). In this case, the source of inefficiency is solely a hold-up problem. Instead, in case ii) of Proposition 1, which applies for $I_M < I_R < \Delta$, both the hold-problem and the rent appropriation incentives of the retailer cause inefficiencies. Though

[10] For a foundation of the hold-up problem see, e.g., Williamson (1979), Klein et al. (1978), and Grossman and Hart (1986).

both effects are always present, that is, unless either $\alpha = 0$ or $\alpha = 1$, somewhat informally speaking, the hold-up problem is the stronger force for low α and the rent appropriation incentive the stronger force for high α. (When $\alpha = 0$ only the hold-up problem is present, while for $\alpha = 1$ there is no longer a hold-up problem, though now the rent appropriation incentives are strongest.) Corollary 1 summarizes the inefficiencies.

Corollary 1 *When in the bilateral monopoly case retailer innovation is less efficient as $I_R > I_M$, two types of inefficiencies can arise:*
i) The hold-up problem leads to a failure of innovation when $\Delta \leq I_R$ and $\alpha < \alpha^*$.
ii) The combination of the hold-up problem and the rent appropriation incentives of the retailer inefficiently shift innovative activity to the retailer when $\Delta > I_R$ and either $\alpha < \alpha^*$ or $\alpha > \alpha^{**}$.

As noted above, both forces can lead to an inefficient outcome and they are both essentially tied to the gatekeeping role of the retailer. That is, the retailer is essential to the manufacturer, which gives rise to the hold-up problem, while the converse does not hold, which gives rise to the rent-appropriation incentives. It is interesting to note that this asymmetry clearly does not exist when one considers an innovation game between two or more manufacturers, each of which then uses prices and product quality to compete for final consumers. This asymmetry thus provides a key novelty of the present analysis.

2.3 Imitation

Maintaining the framework of a bilateral monopoly, we now introduce the following variation. As noted above, large retailers (with a well established line of private labels at their disposal) are sometimes accused by branded goods manufacturers of imitating their innovations and bringing them to market themselves. For instance, in food retailing there may be indeed very limited legal protection against such copying and imitation. In this section, we now allow for such imitation and analyze how it interacts with innovation incentives. Next to providing additional implications also for policy, this analysis further emphasizes the key distinction between an innovation game between manufacturers and retailers, rather than between manufacturers, as (timely) innovation by a large retailer may often be more likely and successful given the contractual interactions between retailers and manufacturers.

We first provide some background. In the process of developing and marketing an innovation, even branded goods manufacturers may have to share information with retailers, which cannot be protected by traditional intellectual property rights. Once a manufacturer has, for instance, tested a new product and generated consumer awareness for it, a retailer could try to produce and market a private-label "look-alike" on its own.[11] Trademark protection often seems not extensive enough to catch the use of such "copycats" and "look-alikes".[12]

Before conducting the analysis, it is also worthwhile noting the difference in imitation incentives between a retailer and, say, another manufacturer. In the presently analyzed case of a bilateral monopoly, an imitating manufacturer would have to compete head-on with the original innovator for the gatekeeping retailer's patronage. Such competition would then shift most, if not all, of the benefits towards the retailer. An imitating retailer, instead, can enjoy the full benefits from his imitation, as he controls access to consumers. Once again it is the gatekeeping function that accounts for this difference. We now analyze what implications the possibility of retailer imitation has on the equilibrium outcome.

Note that we presently consider a single monopolistic retailer of fixed size. Later, we will allow for the possibility that a retailer only has incentives to imitate when he grows sufficiently large in size. For now, however, we simply stipulate that the retailer would have to incur costs K to imitate the manufacturer's innovation. For convenience only, we assume that such imitation is complete, i.e., it delivers quality u_I. Obviously, imitation must occur after $t = 1$. In fact, we suppose that it is at the retailer's disposal right until the final period, $t = 3$. This implies that the retailer still has the option to imitate after negotiations with the manufacturer failed.[13]

[11] In the economics literature, for instance, this has motivated the formal analysis in Allain et al. (2011). The threat of copycats and look-alikes has also been recognised in the UK's grocery inquiry (Competition Commission, 2008). The UK's Competition Commission warns that "the exploitation by retailers of such a position could, in theory, reduce the ability of brand owners to realise a return on product innovation [...]", which would lead to inefficiently low levels of investment into R&D in the future. The European Commission noted in the Kesko/Tuko merger case that "private label development is a key element in the power wielded by retailers vis-à-vis branded daily consumer-goods producers. It enables retailers, who are inevitably privy to commercially sensitive details regarding the branded goods producers' product launches and promotional strategies, to act as competitors as well as key customers of the products. This privileged position increases the leverage enjoyed by retailers over branded-goods producers." (Kesko/Tuko (Case IV/M.784) Commission Decision 97/277/EC[1997] OJ L 110/53 [152]).

[12] In particular, some jurisdictions, such as the UK, require proof of actual misleading.

[13] In fact, as noted above, it may also be precisely in the course of these negotiations that the retailer gathers sufficient information that then enable him to successfully imitate the innovation.

Clearly, imitation will only be of interest when

$$K < \Delta, \tag{3}$$

so that the costs fall short of the surplus that can be extracted from the innovation. Moreover, we specify that

$$K \leq I_R, \tag{4}$$

so that imitating involves (weakly) less resources for the retailer than innovating.

Obviously, the possibility to imitate is of relevance when only the manufacturer has innovated. Taking the retailer's outside option to imitate into account, the net surplus that the manufacturer and the retailer could jointly realize from an agreement is then reduced to K. This is again shared according to the respective fractions α for the manufacturer and $(1-\alpha)$ for the retailer, so that the manufacturer will innovate only if $\alpha \geq I_M/K = \alpha_K^*$. Proposition 2 characterizes the equilibrium when imitation is possible.[14]

Proposition 2 *In the case of a bilateral monopoly, there is a generically unique equilibrium in pure strategies when imitation is possible. Whenever it is (weakly) more efficient that the retailer innovates, as $I_R \leq I_M$, then only this outcome arises in equilibrium. When the converse holds, we have the following case distinction:*
i) When, in addition, $I_R \geq \Delta$, then the manufacturer innovates in case $\alpha \geq \alpha_K^*$, while for $\alpha < \alpha_K^*$ there is no innovation at all (with the exception of $I_R = \Delta$, where also the outcome with retailer innovation is supported).
ii) When, instead, $I_R < \Delta$, then the manufacturer innovates only in case $\alpha \geq \alpha_K^*$, while for $\alpha < \alpha_K^*$ the innovative activity shifts to the retailer.

Proof. See the Appendix. ■

As is immediate, the possibility of imitation makes the hold-up problem that the manufacturer faces more severe. It is further aggravated when imitation becomes less expensive for lower values of K. In this case, welfare will be reduced either through a shift of the innovative activity to the retailer or when both parties refrain from innovating altogether.

[14] In our framework, imitation does not occur in equilibrium, as in, e.g., Gallini (1992), who analyzes the optimal patent length without, however, considering a vertical structure. Imitation rather constrains the manufacturer's rents and thus affects his innovative activity, as in Tandon (1982) and Gilbert and Shapiro (1990).

Interestingly, however, the possibility of imitation reduces the retailer's incentives to innovate solely because of a rent appropriation motive.

Corollary 2 *When in the bilateral monopoly case retailer innovation is less efficient as $I_R > I_M$, the possibility of imitation has the following impact. It aggravates the hold-up problem as $\alpha^* < \alpha_K^*$ holds, so that for a larger range of values α there is now either an inefficient shift of the innovative activity to the retailer (whenever $\Delta \geq I_R$) or no innovation takes place at all (whenever $\Delta < I_R$). On the other hand, as the rent appropriation motive disappears, the manufacturer will efficiently innovate for all higher values of α, where his bargaining power is sufficiently large.*

3 Small vs. Large Retailers and Retail Competition

3.1 Set-up and Auxiliary Results

Suppose that there are now $N \geq 2$ independent, local markets indexed by $n = 1, .., N$. In each market, two retail outlets compete for final consumers. Further, suppose that there is one large retailer who owns n_L outlets, while the remaining $2N - n_L$ outlets are owned by small retailers. We restrict the latter to own each exactly one outlet. We consider, in particular, a comparative analysis of n_L. While the consideration of only a single large retailer may often represent a far abstraction from reality, it serves to isolate the implications of differences in size, which are the focus of this section.

To abstract fully from horizontal effects, i.e., monopolization issues, we suppose that each of the large retailer's n_L outlets is located in a different market. Note that this implies the restriction $1 < n_L \leq N$. That is, even at his maximum size, the large retailer only controls one half of all outlets.[15] This implies that even when the large retailer stocks private labels, i.e., he decides to perform the innovative activity himself, the manufacturer can still sell at least through the same number of outlets. Note that, in contrast to the bilateral monopoly case, the existence of small retailers thus prevents the large retailer to act as a full gatekeeper to final consumers. We show that, despite this being the case, it may still occur that only the large retailer innovates; in particular, when there is strong retail competition.

[15] See Inderst and Wey (2011) and Inderst and Valletti (2011) for a corresponding setup.

To bring this out most clearly, we now stipulate that $I_M = I_R = I$. That is, both the manufacturer and the large retailer are now assumed to be equally efficient when performing the innovative activity. This also allows us to focus on a change in the large retailer's size n_L. Our qualitative results would, however, not be affected by including also different investment costs for retailers and the manufacturer.

The timing of the game remains unchanged: Innovation can take place in $t = 1$, where both the manufacturer and retailers can simultaneously decide whether to innovate or not. Provided that a given retailer does not use his own product (i.e., after innovating himself), in $t = 2$ negotiations take place with the manufacturer. Finally, in $t = 3$ products are sold to final consumers. We now flesh out the respective strategies in detail.

At the final stage, we specify that firms set prices (albeit the choice of price competition is inconsequential for our results). Suppose that in a given market the two outlets set prices p_i and that the respective qualities of their products are u_i, with $i = 1, 2$. Then, demand for outlet i in this market is given by $D(p_i, p_j; u_i, u_j)$, with $i \neq j$. When this is positive, it is strictly increasing in own quality and strictly decreasing in own price. The extent to which demand increases with the rival outlet's price p_j and decreases with the rival outlet's quality u_j will depend on the intensity of competition. We provide an illustrative example below.

Turn now to negotiations in $t = 2$. In the subsequent section, we will again allow for an arbitrary sharing rule of net surplus in each bilateral negotiation. There, we will also allow for differences between the large retailer's and the small retailer's share. For this we will then combine again an axiomatic (Nash) bargaining solution with our noncooperative investment game. However, to first simplify the exposition of the main results we presently consider the case where there is a take-it-or-leave-it offer by the manufacturer to all retailers that did not innovate themselves. (This will exactly correspond, as previously, to the case where in the generalized bargaining case the manufacturer's share of net surplus is equal to one, i.e., $\alpha = 1$.)

We again allow for non-linear wholesale contracts and specify a fixed fee F and a constant marginal wholesale price w. Now with competing retailers, we make the assumption that wholesale contracts between the manufacturer and each retailer are private information. To move on, we make use of the following well-known result.

Lemma 1 *As we consider non-observable, non-linear (precisely, two-part tariff) whole-*

sale contracts, the following result obtains for negotiations in $t = 2$ between an innovating manufacturer and any retailer that does not innovate. When retailers hold passive beliefs with regards to other retailers' contracts, which is what we assume to hold, then the respective marginal wholesale price is equal to marginal cost of production, $w = c$.

Passive beliefs are commonly assumed in the literature and prescribe that any given retailer does not change his beliefs about other retailers' contracts when he receives, in the presently analyzed take-it-or-leave-it offer game, a non-anticipated offer from the manufacturer.[16] We assume that an equilibrium with passive beliefs exists.[17] Given Lemma 1, wholesale contracting is basically restricted to the determination of the fixed part. For the presently analyzed take-it-or-leave-it offer game, in equilibrium the choice of the fixed part of the contract will make the respective retailer just indifferent between acceptance and rejection.[18]

Note also that non-observability of contracts also rules out the possibility that the manufacturer could serve only one retailer, thereby dampening downstream competition. From Lemma 1 we can now already use that in $t = 3$ the two retailers in any given market will, next to observing the respective qualities u_1 and u_2, also know the respective marginal costs of the competitor (i.e., wholesale prices, as we abstract from additional costs of handling). While we explicitly derive the respective equilibrium prices for the Hotelling case below, for now it is sufficient to work with equilibrium profits. Thus, we only need to assume that these are uniquely determined. Then, substituting out equilibrium prices, the profits of outlet 1 and outlet 2 in a given market will depend on own quality and their rival's quality and are denoted by $\pi(u_1, u_2)$ and $\pi(u_2, u_1)$, respectively, with $u_1, u_2 \in \{u_0, u_I\}$. (Note that these are gross of the fixed part of the wholesale contract.) That is, if, in a given market n, outlet 1 has access to quality u_I, whereas its rival only

[16] See Hart and Tirole (1990), McAfee and Schwartz (1994), and O'Brien and Shaffer (1994). Note, however, that, similar to our generalized approach in the following section, O'Brien and Shaffer (1994) use an axiomatic Nash bargaining approach with bilateral negotiations and wholesale contracts that are private information, rather than simultaneous take-it-or-leave-it offers.

[17] For the case of Bertrand competition it needs to hold that the cross elasticity of demand is strictly smaller than half of the elasticity of demand for an equilibrium with passive beliefs to exist (Rey and Vergé, 2004, Proposition 2).

[18] Note also that the assumption of unobservable contracts allows us to abstract from any role that the manufacturer could play to dampen competition, i.e., even without an innovation, namely by raising rivals' marginal costs and distributing the gains from monopolization through adjusting the fixed part. Also note that there is no commitment as to the number and identity of supplied retailers, which is why an innovating manufacturer will end up supplying all non-innovating retailers. (When competition is not too intense, this would also indeed maximize total industry profits.)

offers the basic variant u_0, then outlet 1's and outlet 2's profits become $\pi(u_I, u_0)$ and $\pi(u_0, u_I)$, respectively.

An increase in the own product's quality increases profits, while a higher quality of the rival's product (weakly) reduces an outlet's profit: $\pi_1 > 0$ and $\pi_2 \leq 0$, where the latter holds strictly in case of competition. As is standard, we further assume that $\pi_{11} > 0$ and $\pi_{12} < 0$: innovations are strategic substitutes. That this holds for most commonly used oligopoly models, including the subsequently analyzed Hotelling model, has been shown by Athey and Schmutzler (2001). For our case with a discrete choice between the basic variant and innovation this implies[19]

$$\pi(u_0, u_I) < \pi(u_0, u_0) \leq \pi(u_I, u_I) < \pi(u_I, u_0) \tag{5}$$

and

$$\pi(u_I, u_0) - \pi(u_0, u_0) \geq \pi(u_I, u_I) - \pi(u_0, u_I), \tag{6}$$

which again hold strictly with competition.

Define $\Delta_h = \pi(u_I, u_0) - \pi(u_0, u_0)$ and $\Delta_l = \pi(u_I, u_I) - \pi(u_0, u_I)$, where $\Delta_h > \Delta_l$ follows immediately from (6). Without retail competition Δ_h and Δ_l are identical, as there is no difference between pioneering and catching-up with a single outlet per market n, i.e., an outlet can only benefit from having access to the higher quality but not from, e.g., gaining a competitive advantage vis-à-vis the rival.

By assuming that

$$\Delta_h < I < N\Delta_h \tag{7}$$

a small retailer will never want to innovate, while a large retailer may want to innovate when he becomes sufficiently large (at least, when owning an outlet in each of the N independent markets). This allows us to restrict attention to the interesting case where the large retailer's size can make a difference to innovation incentives.

3.2 Equilibrium for the Innovation Game

We first present some immediate results on the large retailer's and the manufacturer's incentives to innovate. Recall that we presently consider the case where the manufacturer

[19] Notice that when $\pi(u_0, u_0) = \pi(u_I, u_I)$ holds, then in the symmetric case all benefits from the higher-quality products would be competed away to the benefit of final consumers. This is especially true for the Hotelling model.

can make take-it-or-leave-it offers (see, however, Section 4 for a generalization). Thus, when only the manufacturer innovates, he can extract the difference Δ_l from each outlet (i.e., exactly Δ_l from each small retailer and $n_L\Delta_l$ from the large retailer). Note for this that the alternative at each outlet is that it offers only the basic variant, while its rival offers the innovative variant.

The manufacturer's incentives to innovate will be lower when he expects that his innovation will only be bought by $2N - n_L$ outlets, as the large retailer innovates as well. Turning to the large retailer's incentives, these depend on the anticipated choice of the manufacturer's strategy only when there is competition (so that $\Delta_h > \Delta_l$). With competition the large retailer's incentives are strictly larger when he expects the manufacturer not to innovate. Calculating explicitly the respective profits, we obtain the following result.

Lemma 2 *The manufacturer will always innovate when he expects that no one else innovates. Instead, when he expects the large retailer to innovate, he (weakly) prefers to innovate only when*

$$n_L \leq 2N - I/\Delta_l = n_M^{**}.$$

Further, while small retailers will never innovate, the large retailer's incentives to innovate are as follows: He (weakly) prefers to innovate when

$$n_L \geq I/\Delta_h = n_R^*$$

in case he expects the manufacturer not to innovate and when

$$n_L \geq I/\Delta_l = n_R^{**}$$

in case he expects the manufacturer to innovate.

Now, we are in the position to characterize the equilibrium in the case of retail competition. Proposition 3 summarizes our results.

Proposition 3 *Suppose that the large retailer owns an outlet in n_L of N markets, while in each market another outlet is owned by a small retailer. Innovation comes at cost I to either the manufacturer or a retailer. Presently, the innovating manufacturer can make take-it-or-leave-it offers to retailers. The innovation game has then the following equilibrium outcome:*

i) When $N\Delta_l \geq I$, then both the large retailer and the manufacturer innovate if $n_L > n_R^{**}$ (duplication), while for $n_L \leq n_R^{**}$ only the manufacturer innovates.
ii) When $N\Delta_l < I$, then there are multiple equilibria, where either the large retailer or the manufacturer innovates if both $n_L \geq n_M^{**}$ and $n_L \geq n_R^{*}$, while, otherwise, only the manufacturer innovates.

Proof. See the Appendix. ■

Our findings in Proposition 3 are illustrated in Figure 1.

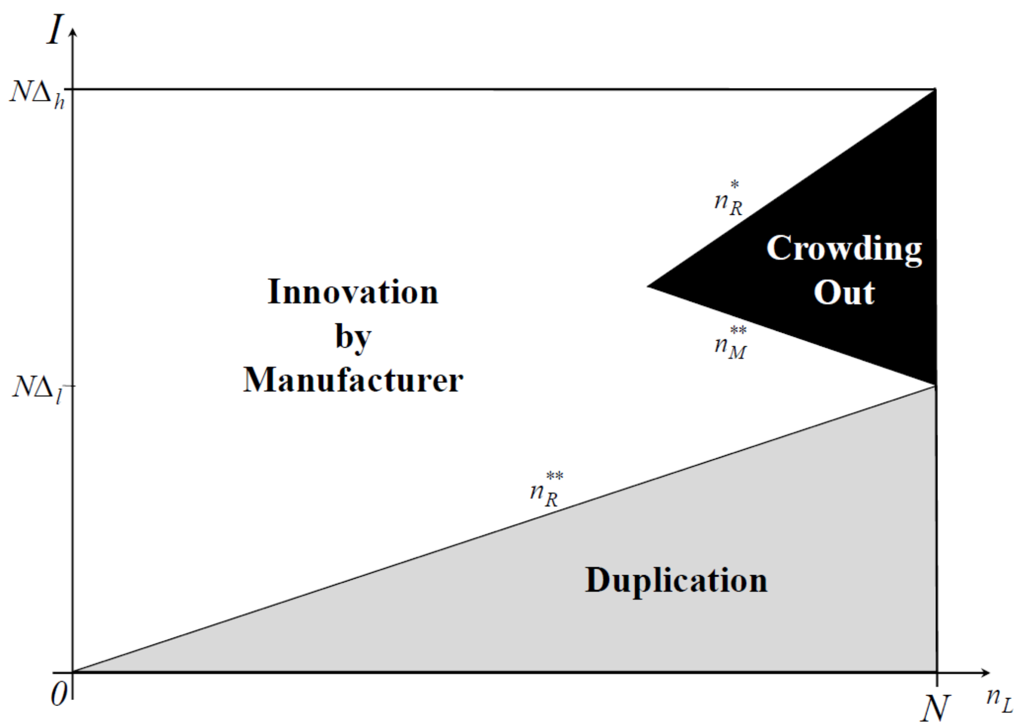

Figure 1: Equilibrium of the Innovation Game in the Case of Retail Competition and Take-It-Or-Leave-It Offers.

In order to disentangle the impact of retail competition, we consider first the case where there is no retail competition implying $\Delta_h = \Delta_l$. In Figure 1, the black triangle would then disappear. There is duplication for $n_L > n_R^{**}$ and, otherwise, innovation by the manufacturer only. Thus, the only inefficiency is due to duplication, which follows from the large retailer's rent appropriation incentives. Further, note that duplication becomes more likely the more outlets n_L the large retailer owns, as this makes innovation more beneficial for him. Presently, a hold-up problem does not emerge due to the assumption that the manufacturer can extract the entire net surplus when negotiating with non-innovating retailers (see, however, Section 4).

With retail competition, the large retailer has an additional incentive to innovate when he has exclusive access to the innovation: He can realize a competitive advantage over his smaller rivals, which grants him pioneering gains $\Delta_h > \Delta_l$. Graphically, this gives rise to the black triangle in Figure 1. In this parameter region, we know from Proposition 3 that there are two equilibrium outcomes: one where only the large retailer innovates and one where only the manufacturer innovates. In each case, the anticipation that the other party innovates makes an additional investment unprofitable, while such an innovation becomes profitable when it is anticipated that the other party does not innovate. Interestingly, in contrast to the bilateral monopoly case, this multiplicity is no longer ruled out by application of Pareto dominance. In particular, when only the large retailer innovates, then this now deprives other retailers of an access to the innovative product, given that the anticipated innovation of the large retailer essentially crowds out the manufacturer's innovation. This gives the large retailer a competitive advantage in the retail market vis-à-vis smaller retailers, who rely on the manufacturer's innovation. Clearly, to repeat this only happens when there is indeed competition, as only then it holds that $\Delta_h > \Delta_l$. Further below we will analyze how intensity of competition affects these differences more gradually, thereby making such "crowding out" more likely.

Corollary 3 *Suppose that the innovating manufacturer can make take-it-or-leave-it offers to non-innovating retailers. Then, with retail competition there are two possible inefficiencies that arise when the large retailer owns sufficiently many outlets (high n_L). First, there can be duplication of investment, as both the large retailer and the manufacturer innovate, in which case the high-quality product is offered both as a private label and as a branded product; second, the large retailer's anticipated innovation can even crowd out the manufacturer's innovation, so that only the large retailer offers a (private label) high-quality product, whereas small retailers do not.*

Clearly, the welfare loss from duplication is exactly equal to the respective costs I, which are incurred twice. Consider now the case of "crowding out". Compared to the case where only the manufacturer, instead of only the large retailer, innovates, the same investment costs are incurred, namely exactly I. Welfare is, however, strictly lower when only the large retailer innovates. Precisely, the respective loss in welfare is made up as follows. There is first a direct effect that arises from the crowding out of manufacturer innovation: The respective consumers at small retailers' outlets can no longer enjoy the high-quality product (and the respective small retailers will no longer be able to make higher profits from this offering). An additional effect arises as some consumers will now, compared to the symmetric outcome, no longer shop at their preferred (small retailers') outlets but instead switch to an outlet controlled by the large retailer. They will thus no longer shop at the outlet for which they would otherwise have the strongest "horizontal preference", e.g., in terms of lower transportation costs as in the Hotelling model that we analyze next.

Hotelling Model We now consider a Hotelling model with linear transportation costs and a mass one of uniformly distributed consumers over the unit interval. Outlets are located at both ends of the unit interval. If a consumer, whose location is x, shops at outlet 1 (2) which is located at 0 (1), then his net utility is given by $U = u_1 - p_1 - \tau x$ ($U = u_2 - p_2 - \tau(1-x)$), where u_1 and u_2 represent a consumer's gross utility from purchasing the respective product, with $u_1, u_2 \in \{u_0; u_I\}$. This implies that the mass $x^* = 1/2 + \left[(p_2 - p_1) + (u_1 - u_2)\right]/2\tau$ shops at outlet 1.

Based on this model, we can immediately derive

$$\Delta_l = \frac{(u_I - u_0)\left[\tau - (u_I - u_0)/6\right]}{3\tau} \tag{8}$$

and

$$\Delta_h = \frac{(u_I - u_0)\left[\tau + (u_I - u_0)/6\right]}{3\tau}. \tag{9}$$

Further, note that $\partial \Delta_l / \partial \tau > 0$ and $\partial \Delta_h / \partial \tau < 0$. That is, increased competition lowers (*catch-up gains*) Δ_l, while it increases (*pioneering gains*) Δ_h.

This provides the following implications for duplication and "crowding out". As competition intensifies, duplication becomes less likely. This is quite intuitive as more intense competition reduces the large retailer's gains in case of duplication, $n_L \Delta_l$. This effect is illustrated by a downward rotation of the line that depicts n_R^{**} in Figure 1. Consider next the area of "crowding out". Here, note that both n_M^{**} and n_R^{*} decrease when competition intensifies. In particular, while the manufacturer's incentives to innovate in case he expects the large retailer to innovate are stifled, the large retailer's incentives to innovate in case he expects the manufacturer not to innovate increase. Thus, the outcome occurs for a wider range of values of n_L and I, which graphically corresponds to a widening of the black triangle in Figure 1.

In the following corollary, we summarize the effects of increased competitive pressure on the prevalence of duplication and "crowding out".

Corollary 4 *Increased competitive pressure, measured by a reduction of the horizontal product differentiation parameter τ for the Hotelling model, has the following effects: It makes duplication less likely but makes it more likely that only the large retailer innovates.*

For completeness we end this section with an explicit calculation of welfare. After substituting out equilibrium prices, producer surplus in a given local market n equals

$$PS(u_1, u_2) = \frac{(u_1 - u_2)^2}{9\tau} + \tau \tag{10}$$

and, after substituting for the critical type x^*, consumer surplus equals

$$\begin{aligned} CS(u_1, u_2) &= \int_0^{x^*} [u_1 - p_1 - \tau x] dx + \int_{x^*}^{1} [u_2 - p_2 - \tau(1 - x)] dx \\ &= \frac{(u_1 + u_2 - 2c)}{2} + \frac{(u_1 - u_2)^2}{36\tau} - \frac{5\tau}{4}. \end{aligned} \tag{11}$$

Summing up, welfare (gross of investment costs) that is generated in a local market is then

$$\omega(u_1, u_2) = \frac{(u_1 + u_2 - 2c)}{2} + \frac{5(u_1 - u_2)^2}{36\tau} - \frac{\tau}{4}. \tag{12}$$

When u_L is the equilibrium quality of the large retailer and u_S that of small retailers, aggregate welfare (gross of investment costs) is thus

$$\Omega = n_L \omega(u_L, u_S) + (N - n_L)\omega(u_S, u_S), \tag{13}$$

so that in case of "crowding out" the resulting welfare loss equals

$$\begin{aligned} & n_L [\omega(u_I, u_I) - \omega(u_I, u_0)] - (N - n_L) [\omega(u_I, u_I) - \omega(u_0, u_0)] \\ = \;& (u_I - u_0) \left[N - \frac{n_L}{2} - \frac{5n_L}{36\tau}(u_I - u_0) \right]. \end{aligned}$$

3.3 Imitation

The large retailer's size, whenever sufficiently large, also provides incentives to imitate the manufacturer's innovation. We again stipulate that a retailer incurs fixed imitation costs K. Additionally, we specify that $K \leq I$, so that imitation is less costly for the retailer than innovating. From

$$K > \pi(u_I, u_I) - \pi(u_0, u_I) = \Delta_l$$

a small retailer would never have sufficient incentives to imitate an innovation (nor to innovate himself, as $K \leq I$). However, the large retailer has sufficient incentives to imitate when the number of his outlets is sufficiently large, as

$$n_L \geq \frac{K}{\Delta_l} = n_K^*. \tag{14}$$

An immediate observation is now that when $n_L < n_K^*$ the threat of imitation is not credible and the previous characterization still holds. There is a second immediate case. Recall that for $n_L < n_M^{**}$ the manufacturer (strictly) prefers to innovate even when the large retailer innovates as well. The interesting difference with imitation is now that in this case we need no longer distinguish whether the large retailer indeed innovates or not. The by assumption "cheaper" possibility of imitation (or, more precisely, the credible threat of imitation) ensures that the large retailer would not want to duplicate the manufacturer's innovation.

We next discuss the case where the large retailer is sufficiently large, so that both $n_L \geq n_K^*$ and $n_L \geq n_M^{**}$. As we show now, with retail competition the hold-up problem, that is induced by the threat of imitation, can exacerbate the shift of innovative activity away from the manufacturer to the large retailer.

Suppose first that only the manufacturer innovates and subsequently negotiates with retailers. When (14) is satisfied, the manufacturer realizes altogether the surplus K from the large retailer, while he obtains the surplus $(2N - n_L)\Delta_l$ from small retailers. Thus, if the threat of imitation is credible, then with every outlet that the large retailer acquires, the manufacturer loses exactly the respective profits Δ_l, so that all joint profits beyond K, which are given by $n_L\Delta_l - K$, are left to the large retailer. This loss is particularly large as we presently consider a take-it-or-leave-it offer by the manufacturer, so that there is no hold-up problem vis-à-vis small retailers. It follows that the manufacturer will only innovate when

$$n_L \leq n_M^* = 2N - (I - K)/\Delta_l.$$

If the large retailer's own innovation incentives are not yet sufficiently high, then the threat of imitation can now lead to a failure of innovation. Intuitively, this is the case when the respective costs of imitation K are sufficiently low, as they bound the manufacturer's own profits from imitation.

The threat of imitation makes it also more likely that only the large retailer innovates, so that the aforementioned "crowding out" deprives smaller competitors of the innovative product. While without imitation this occurred only for parameter values where there was also an equilibrium with only manufacturer innovation, we show that the threat of imitation leads to an outcome where the unique equilibrium prescribes that only the large retailer innovates. This additionally tilts the equilibrium outcome inefficiently away from manufacturer innovation, where also smaller retailers could offer the innovative product.

To streamline the subsequent exposition of the equilibrium, we now invoke a parameter restriction. Recall that with competition (and without imitation) in case of multiple equilibria, where either the manufacturer or the large retailer innovated, none of these was Pareto dominated.[20] As we already observed, the threat of imitation grants a non-innovating large retailer higher profits. This is especially true when compared to the low profits under the presently considered case of a take-it-or-leave-it offer by the manufacturer when the threat of imitation is not credible. Still, with competition the benefits of innovating compared to those of imitating stem from a competitive advantage that the large retailer enjoys over his smaller rivals (through pioneering gains) in case the manufacturer abstains from innovation. These benefits are larger when the retailer owns more outlets but also when competition is more intense. We find (cf. the proof of Proposition 4) that the large retailer would never want to "give up" the position as the sole innovator if

$$n_L > \frac{I - K}{\widetilde{\Delta}}, \tag{15}$$

with $\widetilde{\Delta} = \pi(u_I, u_0) - \pi(u_I, u_I)$. That is, whenever imitation pays and the large retailer owns sufficiently many outlets such that (15) holds, he will never benefit from giving up his pioneering role in favor of manufacturer innovation. One observation regarding $\widetilde{\Delta}$

[20] This was different in the case without competition, where we could thereby eliminate the outcome where only the large retailer innovated.

is particularly noteworthy. When in case of symmetry, all the benefits from innovation are competed away to the benefit of final consumers, so that $\pi(u_I, u_I) = \pi(u_0, u_0)$, then $\widetilde{\Delta} = \Delta_h$, in which case condition (15) is always satisfied.[21] This is especially true for the Hotelling model.

Proposition 4 *Consider the case of retail competition where the innovating manufacturer can make take-it-or-leave-it offers to retailers and where imitation is possible. When $n_L < n_K^*$, then, even for the large retailer, imitation is not credible and does not affect the equilibrium outcome as characterized in Proposition 3. Further, when $n_L < n_M^{**}$, then only the manufacturer innovates. When instead the large retailer is sufficiently large so that both $n_L \geq n_K^*$ and $n_L \geq n_M^{**}$, then the threat of imitation leads to the following equilibrium outcome:*
i) $K \geq N(\Delta_h - \Delta_l)$ (relatively high imitation costs): If the large retailer is still sufficiently small so that $n_L < n_R^*$, then only the manufacturer innovates. Otherwise, for $n_L \geq n_R^*$ there are multiple equilibria where either the large retailer or the manufacturer innovates.
ii) $K < N(\Delta_h - \Delta_l)$ (relatively low imitation costs): If the large retailer is sufficiently small so that $n_L \leq n_M^*$, then the equilibrium outcome is identical with the previous case where $K \geq N(\Delta_h - \Delta_l)$. If, however, $n_L > n_M^*$, then there is now a failure of innovation in case of $n_L < n_R^*$, while for $n_L \geq n_R^*$ only the large retailer innovates.

Proof. See the Appendix. ■

Recall that, whenever credible, the threat of imitation creates a hold-up problem vis-à-vis the large retailer, as the manufacturer realizes only K instead of the entire net surplus $n_L\Delta_l$. However, this does not inevitably lead to inefficiencies when compared with the case where imitation is not possible or not credible. Additionally, fixed imitation costs must be sufficiently low, as $K < N(\Delta_h - \Delta_l)$. Then, efficient manufacturer innovation is crowded out by the large retailer. This results in "crowding out", as the small retailers are deprived of the high-quality product. If, however, the large retailer's number of outlets is still low, then neither him nor the manufacturer performs the innovative activity, so that there is a failure of innovation. It is straightforward that both types of inefficiencies become more severe when imitation becomes cheaper, as K decreases.[22]

[21] For a more detailed discussion see the Proof of Proposition 4 in the Appendix.
[22] This follows from two observations. First, the manufacturer's innovation incentives are stifled, i.e.,

Finally, notice that the threat of imitation also has positive effects from a welfare perspective. As in the case of a bilateral monopoly, imitation eliminates the large retailer's rent appropriation motives, so that duplication never constitutes an equilibrium outcome.

Corollary 5 *In the case of retail competition, where the innovating manufacturer can make take-it-or-leave-it offers to retailers, the credible threat of imitation has the following welfare implications. When the large retailer is sufficiently large ($n_L > n_M^*$) and fixed imitation costs are relatively low ($K < N(\Delta_h - \Delta_l)$), then the hold-up problem leads to a failure of innovation if the large retailer is not too large ($n_L < n_R^*$), while, otherwise, it induces only the large retailer to offer a (private label) high-quality product. Both types of inefficiencies are exacerbated when imitation becomes cheaper. Imitation also eliminates the large retailer's rent appropriation incentives, so that inefficient duplication never occurs in equilibrium.*

Notice that, in general, the impact of increased competitive pressure on the prevalence of inefficiencies appears to be ambiguous. The same is true when explicitly referring to the Hotelling model. However, we can at least isolate the effects of increased competitive pressure and thereby stress the trade-offs from a welfare perspective. First, recall that increased competitive pressure, measured by a reduction of the horizontal product differentiation parameter τ, increases pioneering gains Δ_h. It follows that the large retailer's incentive to innovate if he expects the manufacturer not to innovate is boosted, i.e., n_R^* decreases. Further, catch-up gains Δ_l decrease at the same time, which negatively affects both the manufacturer's incentive to innovate when he expects the large retailer to refrain from innovation and the large retailer's incentive to imitate, i.e., n_M^* decreases, while n_K^* increases. Taken altogether, on the one hand, these three effects relax the restriction $K < N(\Delta_h - \Delta_l)$ so that the range of values K for which the hold-up problem is accompanied by inefficiencies becomes larger. On the other hand, as imitation becomes less beneficial for the large retailer, the threat of imitation is less likely to be credible which reduces the range of values K for which the hold-up problem indeed leads to inefficiencies.

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n_M^* decreases as the surplus that he can appropriate from the large retailer is reduced. Second, the large retailer's incentive to imitate the manufacturer's innovation increases, i.e., n_K^* decreases, as imitation becomes even more favorable when K falls.

4 Generalization of the Analysis with Coexistence of Small and Large Retailers

In this section, we consider a more general distribution of bargaining power in the case of retail competition.[23] Recall that in the bilateral monopoly case we took an axiomatic Nash bargaining approach and specified that the manufacturer receives the fraction α of the net surplus (leaving the retailer with the fraction $1-\alpha$).[24] To additionally account for possible differences between the large and small retailers in terms of bargaining power, we now allow for two different sharing rules, given by $\alpha_S \geq \alpha_L$, with $\alpha_S, \alpha_L \in [0,1]$.[25] That is, when bilateral negotiations take place, the large retailer may be in a position to extract a larger share from the net surplus than small retailers (albeit we also allow for the symmetric case). Otherwise, we maintain all the assumptions made in Section 3.

An immediate observation is that the more general distribution of bargaining power again gives rise to a hold-up problem, as the manufacturer cannot appropriate the entire net surplus from innovation when $1 > \alpha_S \geq \alpha_L$. He only extracts $\alpha_S(2N - n_L)\Delta_l$ from the small retailers and $\alpha_L n_L \Delta_l$ from the large retailer, respectively. It follows that, in contrast to the case where he could make take-it-or-leave-it offers, the manufacturer will only innovate when

$$n_L \leq n_M^* = \alpha_S 2N/(\alpha_S - \alpha_L) - I/\Delta_l[(\alpha_S - \alpha_L)]$$

in case he expects the large retailer not to innovate. This is similar to Section 3 when imitation was analyzed, except that, now, it is the retailers' bargaining power (whenever $1 > \alpha_S \geq \alpha_L$) which diminishes the manufacturer's innovation incentives, rather than the (credible) threat of imitation by the large retailer. Overall and correspondent to the effects of imitation, when the large retailer owns sufficiently many outlets, the hold-up problem may lead either to a failure of innovation or to a unique equilibrium where only the large

[23]Note that in contrast to Inderst and Wey (2011) and Inderst and Valletti (2011), who also consider a setup with retail competition, we additionally account for possible differences between small and large retailers in terms of bargaining power.

[24]Notice that in this respect our approach resembles O'Brien and Shaffer's (1994) work, which also combines a non-cooperative setting with an axiomatic (Nash) bargaining solution. However, O'Brien and Shaffer (1994) do not consider (noncooperative) investment decisions preceding bilateral negotiations, which is rather the focus of our paper.

[25]See, e.g., Marx and Shaffer (1999), who, in a setup with two (monopoly) sellers using a common (monopoly) retailer, also consider a more general distribution of bargainig power. However, they are not concerned with buyer power and thus do not invoke an assumption resembling $\alpha_S \geq \alpha_L$.

retailer innovates. In the latter case, manufacturer innovation is crowded out for sure, so that small retailers are deprived of the innovative product.

The more general distribution of bargaining power has a further implication whenever the large retailer is able to extract a larger share of the net surplus than small retailers, as $\alpha_S > \alpha_L$. In that case, the manufacturer looses $(\alpha_S - \alpha_L)\Delta_l$ per outlet when the large retailer grows in size. Hence, whenever $1 > \alpha_S > \alpha_L$ the hold-up problem is aggravated if the large retailer grows in size. Note at this point that in our analysis the difference in the behavior and payoff of retailers is obtained endogenously from a difference in size. While this is outside the scope of the model, one could also conjecture that, even without the threat of imitation, the share of surplus that the manufacturer can extract from a smaller retailer is larger, $\alpha_S > \alpha_L$, e.g., as it pays for the larger retailer to employ more experienced negotiators. Our subsequent characterization of outcomes is however independent of this assumption. In Lemma 3 we first present the manufacturer's and the large retailer's innovation incentives.

Lemma 3 *The manufacturer (weakly) prefers to innovate only when $n_L \leq n_M^* = \alpha_S 2N/(\alpha_S - \alpha_L) - I/\Delta_l[(\alpha_S - \alpha_L)]$ in case he expects that no one else innovates and when $n_L \leq n_M^{**} = 2N - I/\alpha_S\Delta_l < n_M^*$ in case he expects the large retailer to innovate. Further, while small retailers will never innovate, the large retailer's incentives to innovate are as follows: He (weakly) prefers to innovate only when $n_L \geq n_R^* = I/\Delta_h$ in case he expects the manufacturer not to innovate and when $n_L \geq n_R^{**} = I/\alpha_L\Delta_l > n_R^*$ in case he expects the manufacturer to innovate.*

Using Lemma 3 we can next characterize the equilibrium at the innovation stage. Before doing so, in order to restrict case distinctions, we invoke an assumption similar to (15). Again, this ensures that we do not have to distinguish between cases where we can rule out multiplicity by appealing to Pareto dominance and where this can not be done. Precisely, specifying that

$$n_L > \frac{I}{\widetilde{\Delta} + \alpha_L\Delta_l}, \tag{16}$$

guarantees that the large retailer will always prefer to innovate alone (and thus to realize pioneering gains) rather than letting the manufacturer innovate instead. Again, in analogy to condition (15), this is satisfied in particular when $\pi(u_I, u_I) = \pi(u_0, u_0)$ holds, as in the

Hotelling model. Further, this restriction seems justified, as our key interest is to analyze the implications of the presence and further growth of a large retailer.

Proposition 5 *Suppose that the large retailer owns an outlet in n_L of N markets, while in each market another outlet is owned by a small retailer. Innovation comes at cost I to either the manufacturer or a retailer and the manufacturer receives α_S and α_L of the net surplus when negotiating with a small retailer and the larger retailer, respectively. The innovation game has then the following outcome:*

i) When $\alpha_L N \Delta_l \geq I$, then both the large retailer and the manufacturer innovate if $n_L > n_R^{**}$ (duplication), while for $n_L \leq n_R^{**}$ only the manufacturer innovates.

ii) When $\alpha_L N \Delta_l < I$, we need to distinguish two cases: If $\alpha_S + \alpha_L > \Delta_h/\Delta_l$, then there are multiple equilibria where either the large retailer or the manufacturer innovates when $n_L \geq n_M^{**}$ and $n_L \geq n_R^{*}$ simultaneously hold, while, otherwise, only the manufacturer innovates. If, however, $\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$, then we additionally obtain for $n_L \geq n_M^{*}$ that the large retailer innovates alone whenever also $n_L \geq n_R^{*}$, while, otherwise, there is no innovation at all (though for $n_L = n_M^{*}$ as well as for $n_L = n_R^{*}$ both outcomes with and without investment can be supported).

Proof. See the Appendix. ■

Our findings in Proposition 5 are illustrated by Figure 2 (a), which depicts the equilibrium in case of $\alpha_S + \alpha_L > \Delta_h/\Delta_l$, and by Figure 2 (b), which depicts the equilibrium in case of $\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$.

For ease of exposition, the black triangle in Figure 2 (b) representing "crowding out" covers both multiplicity as well as the case where only the large retailer innovates in equilibrium. However, notice that the crucial difference between those two outcomes is that the former *may* lead to "crowding out", while the latter leads to this for sure.

As previously, we again consider separately the implications for welfare. By allowing for a more general distribution of bargaining power we have the following (additional) effects in terms of welfare. First, when retailers extract a share of the manufacturer's innovation, even without the threat of imitation, then this stifles the large retailer's rent appropriation incentives and thus makes duplication less likely. Graphically, this implies that the range of values n_L and I for which duplication constitutes an equilibrium, i.e., the light grey area in Figures 2 (a) and 2 (b), becomes smaller as α_L decreases (notably compared to $\alpha_L = 1$ under the take-it-or-leave-it offer of the manufacturer). This follows from the large retailer being now able to extract the share $(1 - \alpha_L)$ from the net surplus of each of his outlets when negotiating with the manufacturer.

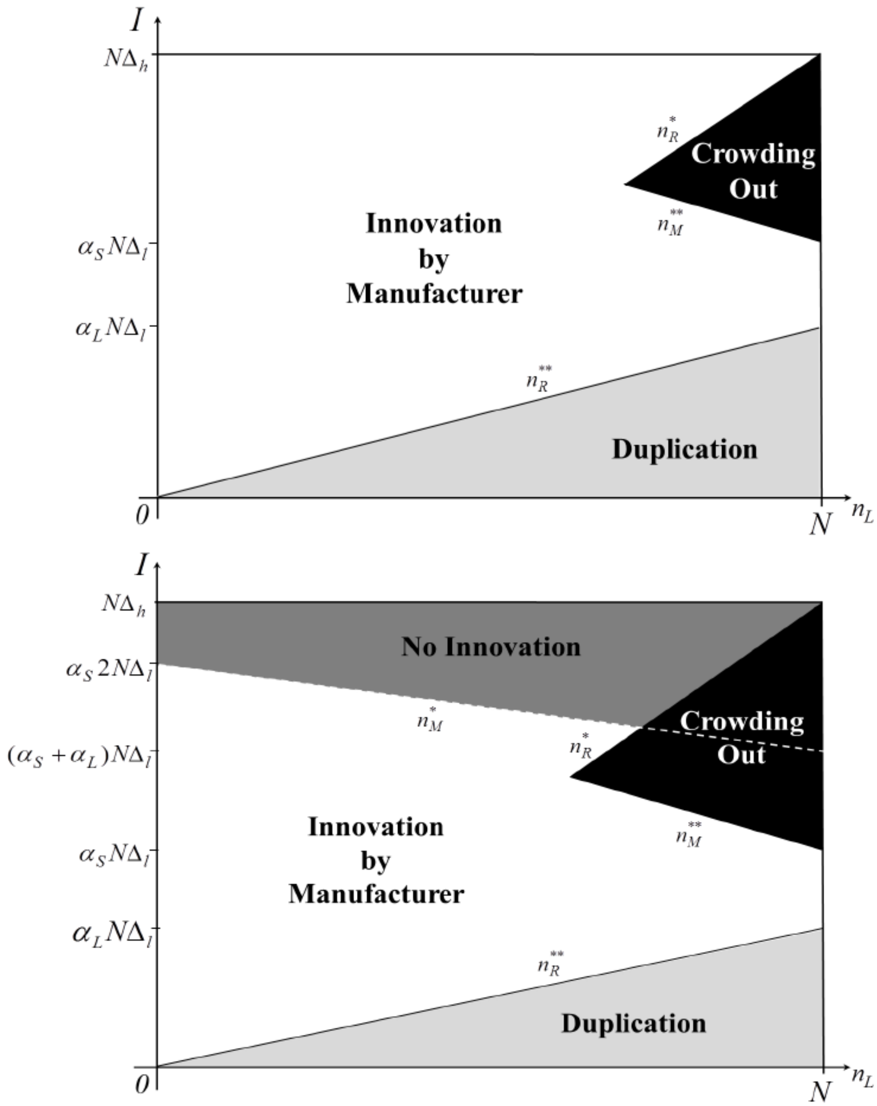

Figure 2: Equilibrium of the Generalized Innovation Game in Case of (a) $\alpha_S + \alpha_L > \Delta_h/\Delta_l$ (Upper Graph) and (b) $\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$ (Lower Graph).

Second, as indicated above, the more general distribution of bargaining power leads to a hold-up problem whenever $1 > \alpha_S \geq \alpha_L$. This prevents, in case of innovation, the manufacturer to extract the entire surplus from non-innovating retailers. Notice that when $\alpha_S > \alpha_L$ the hold-up problem problem is aggravated when the large retailer expands his size. As in the case of imitation in Section 3, the hold-up problem itself does not inevitably lead to inefficiencies. Rather, the large retailer must additionally have sufficient incentives to realize a competitive advantage over his smaller rivals such that $\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$ holds. If these criteria are met, then either a failure of innovation or crowding out of manufacturer innovation will occur when the large retailer owns sufficiently many outlets (as $n_L > n_M^*$). This is depicted in the upper part of Figure 2 (b).

Finally, given that $\alpha_S + \alpha_L > \Delta_h/\Delta_l$, multiplicity becomes more severe and thus occurs for a wider range of values n_L and I whenever $\alpha_S < 1$. Graphically, this corresponds to a widening of the black triangle in Figure 2 (a) when compared to the case where the manufacturer makes take-it-or-leave-it offers to small retailers, i.e., $\alpha_S = 1$. This follows immediately from the manufacturer's stifled incentives to innovate, as he now also faces a hold-up problem vis-à-vis small retailers when $\alpha_S < 1$. As a result, this will enhance, all other things held constant, the chances for "crowding out" to arise.

Corollary 6 *Suppose that the innovating manufacturer receives α_S and α_L of the net surplus when negotiating with a small retailer and the larger retailer, respectively. Then with retail competition there are two possible inefficiencies that arise when the large retailer owns sufficiently many outlets (high n_L) and pioneering gains are sufficiently low ($\alpha_S + \alpha_L > \Delta_h/\Delta_l$). First, there can be duplication, in which case the high-quality product is offered both as a private label and as a branded product. Second, there can be "crowding out" resulting from multiplicity so that only the large retailer offers a (private label) high-quality product, whereas small retailers do not. If, however, pioneering gains are sufficiently high ($\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$), then there is additionally a failure of innovation, so that the high-quality product is not offered at all, and there can be "crowding out" for sure (i.e., as the unique equilibrium outcome).*

To analyze the impact of increased competitive pressure in the N local and independent markets on the outcome of the innovation game and thus on the types of inefficiencies, we turn again to the Hotelling model.

Hotelling Model As in the case where the manufacturer makes take-it-or-leave-it offers to non-innovating retailers, increased competitive pressure will affect the outcome of the innovation game via Δ_l and Δ_h. Recall that, as $\partial\Delta_l/\partial\tau > 0$ and $\partial\Delta_h/\partial\tau < 0$, pioneering gains are increased, whereas catch-up gains are lowered when competition gets more fierce. Hence, we can derive the following implications in terms of inefficiencies. First, duplication becomes less profitable, which is graphically illustrated by a downward rotation of the line that depicts n_R^{**} in Figures 2 (a) and 2 (b). However, both a failure of innovation as well as "crowding out" become more likely when competitive pressure increases. This follows from the manufacturer's lower incentives to innovate (irrespective of his expectation about the large retailer's innovation decision), i.e., both n_M^* and n_M^{**} decrease, and from increased pioneering gains, i.e., n_R^* decreases. Together, the impact of increased competition on the incidence of "crowding out" can thus be illustrated by a widening of the black triangle in both Figure 2 (a) and in Figure 2 (b). We summarize our results in Corollary 7.

Corollary 7 *Increased competitive pressure, measured by a reduction of the horizontal product differentiation parameter τ for the Hotelling model, has the following effects: It makes duplication less likely but makes it more likely that both only the large retailer innovates and a failure of innovation occurs.*

5 Conclusion

Economists traditionally view retailers as agents that bridge the distance between manufacturers and consumers, both in time and space. They offer products in stores that are closer to consumers than, say, the manufacturers' plants. But they do much more, and increasingly so. While retailers are still, in a nutshell, performing the final step in the distribution of merchandise and while they are still primarily engaged in the activity of purchasing products from other firms so as to resell those goods to consumers, such a description disguises the increasing role that retailers play across all functions, notably but not exclusively through private labels.

The analysis in this paper has focused on innovation as one function that may increasingly shift away from manufacturers and into the hands of large retailers. Retailers also take over an increasing part of distribution. For instance, where manufacturers previously delivered right to individual stores and possibly even controlled the display of their products, large retailers may now collect shipments directly at the factory gates.[26] Large

[26] Until the 1980s it was common practice for manufacturers to deliver products directly to the individual stores (see, for instance, Mercer, 1993). With increasing size retailers have gradually moved towards central warehousing, so that manufacturers now usually deliver to a retailer distribution centre; see, e.g., Holmes

retailers may increasingly act also as certifiers of quality with respect to consumers, which transforms both content and volume of their marketing activities.

That large retailers increasingly take over on a larger share of these functions and thus of the value-added in the vertical relationship may often be due to efficiency rationales, such as the realization of economies of scale or scope. However, as the analysis in this paper suggests with a focus on innovation, such a shift in functions may also arise inefficiently, in particular when it is due to the exercise of buyer power or is used as an instrument to increase buyer power in the longer term. We showed how an inefficient shift of innovative activity away from manufacturers and towards large retailers may be due to their gatekeeping role. Precisely, we showed how this gives rise to both a rent-appropriation motive and a hold-up problem, both of which undermine a manufacturer's and inefficiently increase a large retailer's incentives. In addition, with retail competition a large retailer can gain from what we termed innovation "crowding out" when his innovative activity essentially crowds out that of the manufacturer, to the detriment of smaller competitors.

Our results should be of relevance for antitrust and competition policy in view of increasing consolidation in the retailing industry and its implications for the growth and exercise of buyer power. While competition policy should not interfere directly with the allocation of functions in the vertical chain, still the preceding analysis my inform its stance towards mergers and acquisitions that tend to increase buyer power.

(2011) and for WalMart and for developments in the UK Fernie et al. (2000) and Competition Commission (2008). There is still a tendency towards further "backwards integration", at least in parts of the food retailing industry, with retailers collecting goods directly from suppliers rather than relying on supplier delivery ("factory-gate pricing").

Appendix

Proof of Proposition 1. We start with the following auxiliary observations. It is never profitable for the manufacturer to innovate if he expects the retailer to innovate, as his payoff would be negative, i.e., $-I_M < 0$. Conversely, if the manufacturer innovates, then it could be still profitable for the retailer to innovate. Precisely, whenever $I_R \leq I_M$ holds, it follows from (1) that the retailer will always choose to innovate, as he would, even for low values of α, never gain from trade with the manufacturer. This is easily seen by noticing that $\Delta - I_R \geq (1-\alpha)\Delta$, as the manufacturer's rent must fulfill $\alpha\Delta \geq I_M$, which implies $\alpha\Delta \geq I_R$.

If, however, $I_R > I_M$ holds, then we need to distinguish two cases: $\Delta \leq I_R$ and $\Delta > I_R$. If $\Delta \leq I_R$ holds, then the retailer will only innovate if $\Delta = I_R$ and $\alpha < \alpha^*$ (if $\Delta < I_R$, the retailer will refrain from innovation irrespective of α). The manufacturer will, however, innovate whenever (2) holds.

Now suppose that $\Delta > I_R$ holds (together with $I_R > I_M$). Note that $\Pi(u_I) - I_R \geq (1-\alpha)\Delta + \Pi(u_0)$ when $\alpha \geq \alpha^{**} = I_R/\Delta$. It follows that for $\alpha^* \leq \alpha < \alpha^{**}$ it is (weakly) profitable for both the manufacturer and the retailer to innovate when they expect the other to refrain from innovation. Thus, there are two equilibria when $\alpha^* \leq \alpha < \alpha^{**}$. However, if it is the retailer who innovates, then both players can (at least weakly) benefit through coordinating on that the manufacturer innovates. In that case, the manufacturer and the retailer gain $\alpha\Delta - I_M \geq 0$ and $I_R - \alpha\Delta \geq 0$, respectively. Pareto dominance can be further applied when $\alpha = \alpha^{**}$. In that case, when coordinating on that the manufacturer innovates (instead of the retailer), he gains $\alpha\Delta - I_M > 0$ (as $\alpha^{**} > \alpha^*$), while the retailer is indifferent between both outcomes. Hence, the equilibrium where the retailer innovates can be ruled out. **Q.E.D.**

Proof of Proposition 2. Taking the retailer's outside option into account, the manufacturer will now innovate if and only if $\alpha K \geq I_M$ holds, which can be rewritten as $\alpha \geq I_M/K = \alpha_K^*$. Further, notice that the retailer would never prefer to innovate himself if the manufacturer chooses to innovate, as from (4) it follows that $\Delta - I_R \leq \Delta - \alpha K$ (strictly for any $\alpha < 1$), where the right-hand side represents the retailer's gain when the manufacturer innovates and faces the threat of imitation.

Finally, there are multiple equilibria where either the manufacturer or the retailer innovates when $\alpha = \alpha_K^*$ and $\Delta > I_R$. However, the equilibrium where the retailer innovates is (weakly) Pareto dominated. This follows from the manufacturer being indifferent, while the retailer gains $I_R - \alpha K > 0$ when coordinating on that the manufacturer innovates. The rest of the argument is completely analogous to that of Proposition 1**. Q.E.D.**

Proof of Proposition 3. Recall that by Lemma 2 the manufacturer always innovates if he is the only one to do so, i.e., $2N\Delta_l > I$ follows from (1). If he expects the large retailer to innovate, then he innovates only if $n_L \leq n_M^{**}$. The large retailer, however, innovates if $n_L \geq n_R^{**}$ ($n_L \geq n_R^*$) given that he expects the manufacturer to innovate (not to innovate), with $n_R^{**} > n_R^*$.

First, we characterize the equilibrium for $N\Delta_l \geq I$. It is straightforward to check that $n_R^{**} \in (1, N]$ only when $N\Delta_l \geq I$. (The large retailer would never have an incentive to innovate if $N\Delta_l < I$ given that the manufacturer also decides to innovate.) Alternatively, note that $n_R^{**} = N$ if $N\Delta_l = I$, while $n_R^{**} < N$ for all $N\Delta_l > I$, so that $n_R^{**} \in (1, N]$ holds for $N\Delta_l \geq I$. Further notice that $n_M^{**} = N$ if $N\Delta_l = I$, while $n_M^{**} < N$ if $N\Delta_l < I$. In summary, for $n_L \leq n_R^{**}$ only the manufacturer innovates in equilibrium, as $n_L \leq n_M^{**}$ always holds for $N\Delta_l \geq I$. Notice that for $n_L = n_R^{**}$ there are multiple equilibria where either both or only the manufacturer innovates. However, the equilibrium where only the manufacturer innovates (weakly) Pareto dominates the equilibrium where both innovate. That is, given that both innovate the manufacturer gains $n_L\Delta_l > 0$ when both coordinate such that he innovates alone, whereas the large retailer is indifferent between both outcomes at $n_L = n_R^{**}$.

Second, we characterize the equilibrium for $N\Delta_l < I$, which implies $n_M^{**} \in (1, N]$. It follows that by Lemma 2 the manufacturer innovates when $n_L \leq n_M^{**}$. If, however, $n_L > n_M^{**}$, then the manufacturer will never innovate if the large retailer also innovates. Nevertheless, by assumption (1) the manufacturer always prefers to innovate for $n_L > n_M^{**}$ when he expects the large retailer not to innovate. Recall also that $n_R^{**} > n_R^*$. Multiple equilibria, in which either the manufacturer or the large retailer innovates, can thus arise when $n_L \geq n_M^{**}$ and $n_L \geq n_R^*$ hold. Otherwise, i.e., when either $n_L < n_M^{**}$, while $n_L \geq n_R^*$, or $n_L \geq n_M^{**}$, while $n_L < n_R^*$, or $n_L < n_M^{**}$ and $n_L < n_R^*$, only the manufacturer innovates in equilibrium.

Finally, we demonstrate that for $N\Delta_l < I$ multiplicity cannot be eliminated by only selecting those equilibria which are not (weakly) Pareto dominated. Suppose that only the large retailer innovates in equilibrium. In that case, he obtains $n_L\pi(u_I, u_0) - I$, while the manufacturer obtains zero. If both the large retailer and the manufacturer coordinate such that the manufacturer innovates instead, then the manufacturer gains $2N\Delta_l - I > 0$, whereas the large retailer gains $-n_L\Delta_H + I$, where $\Delta_H = \pi(u_I, u_0) - \pi(u_0, u_I) > \Delta_h > \Delta_l$. It is immediately checked that the large retailer always looses, as $n_L \leq I/\Delta_H$ can never hold because $I/\Delta_H < I/\Delta_h = n_R^*$. When the manufacturer initially innovates, he always loses by giving up the innovation (as $n_L \leq n_M^*$). We conclude that multiplicity cannot be eliminated by selecting equilibria which are not Pareto dominated. **Q.E.D.**

Proof of Proposition 4. First, we present some immediate results. Recall that the large retailer always prefers imitation over innovation, as $K \leq I$. This implies that duplication never occurs in equilibrium (neither for $n_L < n_K^*$ nor for $n_L \geq n_K^*$), so that only the manufacturer innovates in equilibrium when $n_L < n_M^{**}$. In the following, it thus remains to characterize the equilibrium for $n_L \geq n_M^{**}$.

Second, we characterize the equilibrium for $n_L < n_K^*$ (and $n_L \geq n_M^{**}$). As imitation is not profitable, it does not present a credible threat, so that the manufacturer is able to appropriate $n_L\Delta_l$ from the large retailer instead of K. The equilibrium thus corresponds to that in Proposition 3 except that duplication never occurs.

Third, we characterize the equilibrium for $n_L \geq n_K^*$ (and $n_L \geq n_M^{**}$). Recall that, in case of innovation, the manufacturer obtains K from the large retailer, where $K \leq n_L\Delta_l$, as $n_L \geq n_K^*$. The manufacturer thus innovates only if $n_L \leq n_M^* = 2N - (I - K)/\Delta_l$, where $n_M^* = N$ if $I = N\Delta_l + K$, while $n_M^* < N$ for all $I > N\Delta_l + K$, so that $n_M^* \in [n_K, N]$ holds for $N\Delta_l + K \leq I \leq 2N\Delta_l$. Further, recall that $n_R^* \in (1, N]$ holds for $I \leq N\Delta_h$. From (7) it follows that in case of $N\Delta_h \leq N\Delta_l + K$ and $K \geq N(\Delta_h - \Delta_l)$, respectively, the manufacturer always innovates if he expects the large retailer not to innovate. However, in case of $N\Delta_h > N\Delta_l + K$ and $K < N(\Delta_h - \Delta_l)$, respectively, (and irrespective of whether $N\Delta_h > 2N\Delta_l$ or $N\Delta_h \leq 2N\Delta_l$, as $N\Delta_l \geq K$ for $n_K \leq N$) the manufacturer innovates only if $n_L \leq n_M^*$. Hence, we need to distinguish $N(\Delta_h - \Delta_l) \leq K$ and $N(\Delta_h - \Delta_l) > K$. In the former case, there are multiple equilibria, where either the manufacturer or the large retailer innovates when $n_L \geq n_R^*$. Otherwise, i.e., $n_L < n_R^*$, only the manufacturer innovates in equilibrium, as $n_L \leq n_M^*$ always holds. (Notice that when $N(\Delta_h - \Delta_l) = K$ and $n_L = n_M^*$ multiple equilibria where either only the manufacturer innovates or there is a failure of innovation arise for $n_L < n_R^*$. However, the equilibrium where there is a failure of innovation can be ruled out, as it is (weakly) Pareto dominated by the equilibrium where the manufacturer innovates alone: The manufacturer is indifferent between both outcomes, while the large retailer (at least weakly) gains when the manufacturer innovates, as $n_L \geq n_K^*$.) In the latter case, the equilibrium outcome in case of $N(\Delta_h - \Delta_l) \leq K$ is preserved when $n_L \leq n_M^*$. However, when $n_L > n_M^*$ so that the manufacturer abstains from innovation (albeit he would be the only one to innovate), we additionally obtain the following: If $n_L \geq n_R^*$, then only the large retailer innovates in equilibrium, while, otherwise, there is no innovation at all. (For $n_L = n_R^*$ there are multiple equilibria where either only the large retailer innovates or there is a failure of innovation. However, the latter can be ruled out, as it is (weakly) Pareto dominated.)

Finally, we demonstrate that for $n_L \geq n_K^*$ and provided that (15) holds multiple equilibria cannot be eliminated by selecting those which are not Pareto dominated whenever $n_L \geq n_M^{**}$ and $n_L \geq n_R^*$. Suppose that the large retailer innovates alone. Then, his payoff is $n_L\pi(u_I, u_0) - I$, while the manufacturer's payoff is zero. When both coordinate such that the manufacturer innovates instead, then the manufacturer gains $(2N - n_L)\Delta_l + K - I$, which is weakly positive, as $n_L \leq n_M^*$. The large retailer gains $n_L\Delta_l - K - n_L\Delta_H + I$, where $\Delta_H = \pi(u_I, u_0) - \pi(u_0, u_I) > \Delta_h > \Delta_l$, which is (weakly) positive only if $K \leq I[\pi(u_I, u_I) - \pi(u_0, u_0)]/\Delta_h$ and $n_L \leq (I - K)/\widetilde{\Delta}$, with $\widetilde{\Delta} = \pi(u_I, u_0) - \pi(u_I, u_I)$. As, however, condition (15) specifies that $n_L > (I - K)/\widetilde{\Delta}$ the large retailer's gain is strictly negative. An analogous reasoning applies for the case in which the manufacturer initially innovates: While the large retailer always benefits, the manufacturer (weakly) loses by giving up the innovation (as $n_L \leq n_M^*$). We conclude that for $n_L \geq n_M^{**}$ and $n_L \geq n_R^*$ neither of the two pure strategy equilibria is Pareto dominant when (15) holds, so that multiplicity prevails. **Q.E.D.**

Proof of Proposition 5. By Lemma 3 we know the individual incentives to innovate contingent on the expectations about the other player's innovation decision, so that the equilibrium of the innovation stage can be fully characterized.

First, we characterize the equilibrium for $\alpha_L N\Delta_l \geq I$. Notice that $n_M^{**} = N$ if $I = \alpha_S N\Delta_l$ and $n_M^{**} < N$ if $\alpha_S N\Delta_l < I < \alpha_S 2N\Delta_l$, so that $n_M^{**} \in (1, N]$ holds for $\alpha_S N\Delta_l \leq I < \alpha_S 2N\Delta_l$. Further, $n_R^{**} = N$ if $I = \alpha_L N\Delta_l$, while $n_R^{**} < N$ for all $I < \alpha_L N\Delta_l$, so that $n_R^{**} \in (1, N]$ holds for $I \leq \alpha_L N\Delta_l$. As $\alpha_S N\Delta_l \geq \alpha_L N\Delta_l$, it follows immediately that in equilibrium there is duplication if $n_L > n_R^{**}$, while, otherwise, only the manufacturer innovates. Notice that for $n_L = n_R^{**}$ there are multiple equilibria where either both or only the manufacturer innovates. However, the equilibrium where only the manufacturer innovates (weakly) Pareto dominates the equilibrium where both innovate. Precisely, given that both innovate the manufacturer gains $\alpha_L n_L \Delta_l \geq 0$ (strictly if $\alpha_L > 0$) when both coordinate on that where only the manufacturer innovates, whereas the large retailer is indifferent between both outcomes at $n_L = n_R^{**}$.

Second, we characterize the equilibrium for $\alpha_L N\Delta_l < I$ which implies n_M^{**} when additionally $\alpha_S N\Delta_l \leq I < \alpha_S 2N\Delta_l$ (and excludes n_R^{**}, as $n_R^{**} \in (1, N]$ holds for $\alpha_L N\Delta_l \geq I$). It is straightforward that $n_R^* = N$ if $I = N\Delta_h$, while $n_R^* < N$ if $I < N\Delta_h$, so that $n_R^* \in (1, N]$ holds for $I \leq N\Delta_h$. Further, note that $n_M^* = N$ if $I = (\alpha_S + \alpha_L)N\Delta_l$, while $1 < n_M^* < N$ if $(\alpha_S + \alpha_L)N\Delta_l < I < \alpha_S 2N\Delta_l$, so that $n_M^* \in (1, N]$ holds for $(\alpha_S + \alpha_L)N\Delta_l \leq I < \alpha_S 2N\Delta_l$. From (7) it follows that in case of $N\Delta_h < (\alpha_S + \alpha_L)N\Delta_l$ the manufacturer always innovates if he expects the large retailer not to innovate. However, in case of $N\Delta_h \geq (\alpha_S + \alpha_L)N\Delta_l$ (and irrespective of whether $N\Delta_h > 2N\Delta_l$ or $N\Delta_h \leq 2N\Delta_l$ when $1 > \alpha_S \geq \alpha_L$, as $(\alpha_S + \alpha_L)N\Delta_l < 2N\Delta_l$) the manufacturer innovates only if $n_L \leq n_M^*$. Hence, we need to distinguish $\alpha_S + \alpha_L > \Delta_h/\Delta_l$ and $\alpha_S + \alpha_L \leq \Delta_h/\Delta_l$. In the former case, multiplicity arises where either the manufacturer or the large retailer innovates if $n_L \geq n_M^{**}$ and $n_L \geq n_R^*$ simultaneously hold. Otherwise, i.e., when either $n_L < n_M^{**}$, while $n_L \geq n_R^*$, or $n_L \geq n_M^{**}$, while $n_L < n_R^*$, or $n_L < n_M^{**}$ and $n_L < n_R^*$, only the manufacturer innovates in equilibrium. In the latter case, the equilibrium outcome in case of $\alpha_S + \alpha_L > \Delta_h/\Delta_l$ is preserved when $n_L < n_M^*$. However, when $n_L \geq n_M^*$, we additionally obtain: If $n_L \geq n_R^*$, then only the large retailer innovates in equilibrium, while, otherwise, there is no innovation at all. Notice that for $n_L = n_M^*$ and $n_L \geq n_R^*$, i.e., the manufacturer is indifferent between innovating and and not innovating when he expects the large retailer to abstain from innovation (multiplicity), while the large retailer (weakly) prefers to innovate, the equilibrium where only the large retailer innovates is (weakly) Pareto dominant, as (16) holds.

Finally, we demonstrate that in case of $\alpha_L N\Delta_l < I$ and provided that (16) holds multiple equilibria cannot be eliminated by selecting those equilibria which are Pareto dominant whenever $n_M^{**} \leq n_L (< n_M^*)$ and $n_L \geq n_R^*$. Suppose that the large retailer innovates alone in equilibrium. When both the large retailer and the manufacturer coordinate such that the manufacturer innovates instead, then the large retailer gains $(1 - \alpha_L)n_L\Delta_l -$

$n_L\Delta_H + I$, where $\Delta_H = \pi(u_I, u_0) - \pi(u_0, u_I) > \Delta_h > \Delta_l$, whereas the manufacturer gains $\alpha_S(2N - n_L)\Delta_l + \alpha_L n_L \Delta_l - I$. The manufacturer's gain is (weakly) positive, as $n_L \leq n_M^*$. The large retailer's gain is (weakly) positive only if $\alpha_L \leq [\pi(u_I, u_I) - \pi(u_0, u_0)]/\Delta_l$ and $n_L \leq I/[\widetilde{\Delta} + \alpha_L \Delta_l]$ simultaneously hold, with $\widetilde{\Delta} = \pi(u_I, u_0) - \pi(u_I, u_I)$. As, however, condition (16) specifies that $n_L > I/[\widetilde{\Delta} + \alpha_L \Delta_l]$, we can immediately infer that the large retailer's gain is strictly negative. When the manufacturer initially innovates, he always loses by giving up the innovation (as $n_L \leq n_M^*$). We conclude that neither (pure strategy) equilibrium is Pareto dominant when (16) holds, so that multiplicity prevails. **Q.E.D.**

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