Private Labels, Price Rivalry, and Public Policy[1]

Tommy Staahl Gabrielsen[a] and Lars Sørgard[b]
[a]Department of Economics, University of Bergen,
Fosswinckelsgate 6, N-5007 Bergen, Norway.
email: tommy.gabrielsen@econ.uib.no
[b]Department of Economics, Norwegian School
of Economics and Business Administration,
Helleveien 30, N-5045 Bergen, Norway.
email: lars.sorgard@nhh.no

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Abstract

The article examines i) why private labels are introduced in some product categories and not in others, ii) how the existence of a private label a¤ects the pricing of a competing national brand, and iii) how consumers' surplus and welfare are a¤ected by private labels. We …nd that the potential for private label introduction may - in return for national brand exclusivity in that particular retail store (exclusive dealing) - lead to price concessions from the producer of the national brand. If the national brand producer decides not to o¤er an exclusivity contract, a private label is introduced. In this case private label introduction may lead to higher retail prices on national brands. We argue that our results have important implications for the interpretation of empirical results and the public policy towards national brands.

JEL classi…cation: L12, L40.

1 Introduction

Retailer-owned brands, often denoted by private labels (or simply store-brands), have had an enormous growth in the last decades in many countries and many product categories (Dobson, 1998; Connor et al, 1996). However, only recently the academic literature has begun to examine the impact of private labels. The literature on private labels is predominately empirical, but there are also some theoretical contributions. What characterizes the two strands of the literature is that the empirical literature investigates a much broader specter of issues than the theoretical literature. The empirical literature is concerned with issues such as explaining the variation in private label penetration across product categories (Sethuraman, 1992; Hoch and Banerji, 1993), e¤ects on the prices of national brands from the success of a private label (Cotterill et al., 2000; Gabrielsen et al., 2001; Harris et al., 2000), how national brand prices react to actual introduction of a retailer-owned brand (Parker and Kim, 1995; Gabrielsen et al., 2001; Putsis, 1997) or whether the introduction of a private label results in a shift of relative channel power (Chintagunta et al., 2000).

The main question explored in the theoretical literature is how actual private label introduction a¤ects wholesale terms to the retailers. Mostly this literature is concerned with how private label introduction a¤ects the division of pro…ts between manufacturers and retailers (Narasimhan and Wilcox, 1998; Scott Morton and Zettelmeyer, 2001), but also with how private label introduction a¤ects retail prices and hence consumers' surplus and welfare (Mills, 1995).

Investigating the results obtained in the received literature on private labels reveals a signi…cant discrepancy between what theory predicts and what the empirical …ndings are. Theory predicts that private label introduction is a forceful instrument for the retailers, and that by introducing private labels retailers are able to obtain substantial price concessions from national brand producers. The empirical implications from this theory are twofold. First, we should expect to see private labels introduced in almost every product category. Moreover, when private labels are introduced we should expect to see a reduction in the prices of national brands. However, the empirical …ndings are di¤erent; private labels are only introduced in selective categories (Sethuraman, 1992; Hoch and Banerji, 1993) and the price responses of national brands following private label introductions are ambiguous. In many categories prices on national brands actually increase and in other categories prices go down.

This paper aims at bridging some of the gap between what seems to be the empirical regularities and existing theory on private labels. We provide a theoretical model where we analyze the price rivalry between a national brand and a retailer that has the option to introduce a private label. Under a set of plausible assumptions we show that i) it can be perfectly rational

for a retailer not to introduce a private label in a given category, and ii) when private labels are introduced the price response of the national brand can be a price increase.

In the literature, the price concession story has several possible implications for the retail price policy of national brands. Mills (1995) argues that the retailers' bene…t from private label introduction stems from a reduction in the margins of the national brand. In such a setting private label introduction will reduce problems due to double marginalization. When a private label is introduced, the retail price of the national brand drops, which is bene…cial both for consumers and society. Scott Morton and Zettelmeyer (2001) and Narasimhan and Wilcox (1998) show that a private label can be introduced as a bargaining tool against the national brand producer. By introducing a private label, more of the surplus generated in the channel can be appropriated by the retailer. Both models, however, predict no change in the retail price following the introduction of a private label.

Scott Morton and Zettelmeyer (2001) assume that wholesale contracts are two part tari¤s, and as a consequence, the vertically integrated pro…t is always achieved. They look at a situation where the retailer can introduce a private label instead of a second national brand and choose the location of the private brand in the product characteristic space. When introducing a private brand the retailer will make his brand a close substitute to the dominant national brand. By doing so the retailer is able to limit the rent that the national brand producer can extract from the vertical channel with a two-part tari¤.

Much in the same vein is Narasimhan and Wilcox (1998). In their model, however, some consumers incur switching costs when starting to buy the private label. Again, private label introduction triggers a battle over market shares which leads to price concessions from the national brand producer. Due to a rectangular demand assumption, consumer prices are una¤ected by private label introduction. However, introduction is always bene…cial to the retailer due to lower wholesale prices from the national brand producer.[1]

The empirical part of the literature tells a di¤erent story. Focusing on the e¤ect on national brand prices from entry, most studies …nd heterogeneity. Parker and Kim (1995), Harris et al. (2000), Gabrielsen et al. (2001) and Chintagunta et al. (2000) report heterogeneity in the price responses after private label introduction, i.e. in some categories prices on national brands go up whereas in others prices go down. [2]

[1] Raju et al (1995) are also investigating the e¤ect of the introduction of a private label. However, their main focus is on how the introduction of a private label a¤ects a retailer's pro…ts and how di¤erent factors a¤ect the private label's market share. Comparative statics concerning how the introduction of a private label a¤ects prices on national brands are not reported.

[2] Putsis (1997) shows that on average prices go down, but that does not exclude the possibility that in some categories prices may go up. Unfortunately, category speci…c price

We provide a theoretical model much in the same spirit as Narasimhan and Wilcox (1998). In line with these authors we distinguish between what we call loyal and switching consumers. Only the latter group of consumers considers to switch from the national brand to the private label. Contrary to Narasimhan and Wilcox (1998) however, in our model the switching consumers have price elastic demand. It turns out that this has important implications for the resulting retail price of the national brand when a private label is introduced.

We analyze two di¤erent settings. The …rst is one in which the switching consumers regard the two brands as perfect substitutes but the private label has higher production costs. The second is a setting where the two brands are equally e¢ cient, but the switching segment incurs switching costs when purchasing the private label. In addition, we allow the manufacturer of the national brand to condition his wholesale price to a particular retailer on whether a private brand is introduced or not in that particular retailer's stores, an option that is not considered previously in this literature. This requirement is known in the literature as an exclusive dealing clause, and implies that a producer requires that a particular retailer does not sell a competing private label.[3] With this instrument at hand, which from now on we denote exclusivity clause, the retailer does not actually need to introduce the label to get a more favorable wholesale contract, the mere threat of doing so can be enough. We also argue that an alternative interpretation of an exclusivity clause is that the retailer in fact introduces the private label, but agrees not to promote it in his stores. This would de facto lead to a very low sale for the private label, and thus be equivalent to exclusivity for the national brand.

We examine how the mere existence of a private label - its potential or actual introduction - a¤ects the equilibrium outcome. A national brand monopoly (blockaded entry) is contrasted with a situation where the retailer can introduce a private label. When private label entry is feasible, one of three types of equilibria may occur. Which type of equilibrium that will occur depends on the relative size of the loyal and the switching segment.

First, national brand exclusivity may still arise as an equilibrium outcome and the price of the national brand will go down compared to the monopoly outcome. The reason is that the producer of the national brand may o¤er the retailer a low wholesale price in exchange for national brand

responses from national brands following private label introduction are not reported in Putsis (1997).

[3]Note that the manufacturer cannot impose an exclusive dealing clause on the retailer. When o¤ered an exclusive dealing contract, the retailer still decides himself whether to introduce the private label or not. This is in line with the assumptions made in the vertical restraints literature, see e.g. Bernheim and Whinston (1998), O'Brien and Sha¤er (1993,1997) and Gabrielsen and Sørgard (1999b). We follow the same approach here. For more speci…c studies of retailer power, see e.g. Dobson and Waterson (1997, 1999) and Gabrielsen and Sørgard (1999a).

exclusivity in the retail store. This type of equilibrium will occur when the national brand has few loyal consumers. This is because the alternative for the national brand is to allow entry of the private label and exploit his loyal consumers by charging a high price. Since they are few it is worthwhile for the national brand producer to compete for the switching segment.

Second, when the national brand has more loyal consumers, competing for the switching segment may be too costly for the national brand producer, and he may decide to concentrate on his loyal consumers. If so, the national brand producer no longer seeks exclusivity for his brand, and may increase his wholesale price. In this case the retailer introduces the private label, and the increase in the wholesale price of the national brand induces an increase in its retail price as well.[4]

Third, the private label may be introduced leaving the price of the national brand una¤ected. This happens when the national producer has so many loyal consumers that he would serve these exclusively even in a monopoly situation.

Several public policy implications can be derived from our model. First, we show the surprising result that private label introduction may be detrimental to both consumers and welfare compared to the situation where the national brand acts as an unthreatened monopolist. Note, though, that also the opposite may be true. Second, as exclusivity for the national brand can arise in our model, we show that in equilibrium there can be too much exclusivity seen from the perspective of consumers and welfare.

As we see it, the contributions we make are threefold. First, we provide a theoretical explanation of why prices of national brands may go up in cases where private labels are introduced and why they may go down in other cases due to the mere threat of a private label introduction. Second, we explain why private labels are sometimes not introduced, and in which categories we would expect to see national brand exclusivity. Finally, we are able to derive public policy implications on whether or not private labels are introduced in categories where consumers and the society at large would prefer that they were introduced.

The article is organized as follows. In Section 2 we formulate our model, and present the benchmark with national brand monopoly. In Section 3 we report results for the case of cost di¤erences between the national brand

[4] An interesting parallel to this is found in Perlo¤ et al (1996) and Frank and Salkever (1992). These authors analyze the introduction of generic drugs in the pharmaceutical industry. They show that the introduction of generic drugs may lead to a price increase for brand name drugs. These approaches are, however, distinctly di¤erent from ours. First, these papers do not model the vertical relationship within the industry. Second, they do not raise the issue whether the branded drug producer can o¤er the dealer an exclusive dealing contract and thereby deter entry by the generic brand. In their setting an exclusive dealing contract would be equivalent to a horisontal agreement with sidepayments so as to keep the generic product out of the market. Such an agreement would be in violation with antitrust law in most countries.

and the private label, while in Section 4 we report results for the case of consumer switching costs. Our results are summarized in Section 5, where we also discuss some implications for empirical testing and for public policy. In this section we also discuss an alternative interpretation of our exclusivity clause that will relate our theory to the results of other parts of the empirical literature. All proofs are relegated to the appendix where we also present tables reporting equilibrium prices, consumers' surplus and welfare in all outcomes.

2 Some preliminaries

We consider a situation where a producer of a national brand sells its brand through a single retailer. The retailer may distribute the national brand exclusively but may also introduce its own private label. Initially we consider the equilibrium outcome when there is no threat from a private label. If so, the national brand manufacturer has a monopoly, and we denote this case with subscripts m. Thereafter we allow for the introduction of a private label. The potential introduction of a private label may a¤ect the pricing policy of the national brand manufacturer. If the private label is not introduced we denote this by subscripts e (for national brand exclusivity). Finally, if the private label is actually introduced and distributed alongside the national brand, we denote this case with subscripts c (for common distribution). Let r be the retail price of the private label, and p_i; w_i; S_i and W_i, $i \in \{m; e; c\}$ denote the retail price of the national brand, the wholesale price of the national brand, consumers' surplus and welfare in the three cases.

If all consumers were indi¤erent in their choice between a national brand and a private label, and private labels were cheaper to procure for the retailers than national brands, private labels would invade all markets and national brands would be extinct. This is not what we observe, so we need to make some reasonable assumptions in order to avoid this outcome. The …rst assumption we make is that demand is derived from two types of consumers. A subset of the consumers are loyal consumers.[5] These consumers purchase a …xed quantity α of the national brand provided that the price is below a choke price $p_i \leq 1$; and will never consider to purchase the private label.[6] A second set of consumers are potential switchers - denoted by switching consumers. These consumers have a price elastic demand $q = (1 - p)^{-\gamma}$.

[5] As it turns out, in our model the national brand producer would always set its price so as to give the retailer an incentive to carry its product. If there were no loyal consumers, this would still apply.

[6] The assumption that loyal consumers never switch is crucial for our results. However, note that even if the number of loyal consumers is low, our model still applies. When the number of loyal consumers approaches zero, this will be captured in our model by α approaching zero.

Second, we want to allow for the possibility that the national brand sometimes also wants to compete for the switching customers. The predominant idea in the literature seems to be that one important distinction between national brands and private labels is that national brand producers charge retailers a markup over costs, whereas private labels can be procured at prices that are closer to marginal cost (see Barsky et al., 2001). We therefore assume that private labels can be procured at marginal cost for the retailer.

If the switching consumers regard the national and private brand as perfect substitutes, and the private label can be procured at a price that can never be matched by the national brand, this would make it impossible for the national brand producer to compete for the switching segment. Intuitively, the two brands would have monopoly power over one segment each, and there is no agreement that can be made between the parties that could increase their joint pro…t. In such a case the retailer would introduce a private label and reap the monopoly pro…t from the switching segment, and the national brand would charge a high wholesale price and reap the monopoly pro…t of the loyal segment. However, if the production of the private label is ine¢cient compared to the national brand, this would create some leeway that the national brand producer could exploit. Consistent with these ideas, Section 3 below makes the assumption that the brands are perfect substitutes for the switching segment, and that the constant marginal cost of the national brand is zero whereas it is strictly positive for the private label, i.e., $c > 0$:This assumption is supported by empirical …ndings in Barsky et al. (2001).[7]

An alternative assumption that would make it attractive for the national brand to compete for the switching consumers is that the switching consumers would buy the private label only if the price of the private label is signi…cantly lower than the price of the national brand. This idea is consistent with a model where the switching consumers have switching costs. To explore this issue, Section 4 invokes the assumptions that the brands are produced equally e¢ciently (at $c = 0$), but that the switching consumers incur costs when switching from the national brand to the private label (switching

[7] They present evidence that suggests that marginal production costs for the private labels are, if anything, higher than those for the corresponding national brands. The normal case would be that private labels are procured by the retailers at lower costs than national brands. This is a feature that is captured in our model even if the private brand has higher marginal production cost than the national brand. The reason for this is that the price-cost margin charged by national brand producers often exceeds the marginal production cost of the private label. In fact, in equilibrium we …nd that this is true. Furthermore, when allowing the private brand to have higher marginal production cost than the national brand, we …nd this realistic for two reasons. First, private brands may be imported goods and for that reason they incur trade costs, for instance transportation costs. Second, national brands may be able to exploit economies of scale as they per de…nition have larger sales as they are sold in more retail outlets.

costs). If so, only the switching consumers with high enough willingness to pay and low enough switching costs will buy the private label.

Before solving these models, we consider our benchmark case: The national brand producer is an unthreatened monopolist. Aggregate demand for the national brand is:

$$q_m = \begin{cases} \alpha + (1 - p_m)^{\beta} & \text{if } p_m \leq 1 \\ 0 & \text{if } p_m > 1 \end{cases};$$

where $\alpha \geq 0$ is the number of loyal consumers and the parameter $\beta \geq 0$ scales up and down the number of switching consumers. Only the relative size between α and β is of importance in the following. We therefore normalize the demand system above by defining $\lambda = \frac{\alpha}{\beta}$ and setting $\beta = 1$: The interpretation of a large λ is that there are many loyal consumers relative to switching consumers and vice versa when λ is small. The profit of the retailer (r) is written:

$$\pi_m^r = (p_m - w_m)(\lambda + (1 - p_m)) \tag{1}$$

and the profit of the national brand producer (n) is given by:

$$\pi_m^n = w_m(\lambda + (1 - p_m)) \tag{2}$$

The following proposition depicts the equilibrium outcomes for different λ's assuming national brand monopoly:[8]

Proposition 1 For a sufficiently low fraction of loyal consumers, $\lambda < \frac{1}{3} \equiv \lambda^M$; the equilibrium outcome entails both wholesale and retail prices below unity. Otherwise wholesale and retail prices are set at unity and only the loyal consumers are served.

Proof. See the appendix. ■

For the national brand monopolist there is a trade-off between exploiting loyal consumers by charging a high price and selling to switching consumers at a lower price.[9] When the number of loyal relative to switching consumers is high, the monopolist tends towards exploitation of loyal consumers. It then sets its wholesale price at its maximum ($w_m = 1$), and serves the loyal consumers exclusively.[10] When the number of switching consumers relative to loyal consumers is high, it may be worthwhile to sell to both types of consumers. The monopolist then sets a lower wholesale price and serves both groups. This explains why the manufacturer sells to both groups of consumers when $\lambda < \frac{1}{3}$.

[8] Table A1 in the appendix summarizes prices, profits, consumers' surplus and welfare in the monopoly case.

[9] In Narasimhan and Wilcox (1998) final demand is unaffected by price (rectangular demand). Therefore a national brand monopolist has no reason to lower its wholesale price below the consumers' reservation price. In contrast, in our setting it can be profitable for the manufacturer to attract switching consumers by charging a low wholesale price. By doing so it induces the retailer to set a price below the loyal consumers' reservation price.

[10] When the national brand producer sets its wholesale price at the maximum ($w_m = 1$),

3 Private label and cost asymmetries

We now allow for the possibility that the retailer may introduce a private label at marginal cost $c > 0$. Even if the retailer has this choice it may still choose to grant exclusivity to the national brand (exclusive dealing).[11] Alternatively, the retailer may introduce a private label and distributes it along with the national brand.[12] In this section we assume that if a private label is introduced, the switching consumers are indi¤erent between the two products. Furthermore, we allow the manufacturer of the national brand to condition its wholesale price on whether a private label is introduced or not. Let w_e denote the producer's wholesale price given that the retailer does not introduce the private label (exclusive dealing), while w_c denotes the wholesale price in force if the retailer chooses to introduce a private label. We study the following simple game:

Stage 1: The national brand producer o¤ers wholesale prices w_e and w_c:

Stage 2: The retailer introduces a private brand or not, and sets retail price(s). If the retailer sells the national brand exclusively, for the given w_e; it sets p_e. If it introduces a private label, for given w_c and c; it sets p_c and r:

If the retailer does not introduce a private label its pro…t is written:

$$\pi_e^r = (p_e - w_e)(\alpha + (1 - p_e)); \tag{3}$$

and if it does introduce the private label its pro…t is:

$$\pi_c^r = (p_c - w_c)q_c + (r - c)q_r; \tag{4}$$

where q_c and q_r are the quantities sold of the national and private brand, respectively. Table A2 in the appendix reports details about equilibrium values, and we have the following result:

Proposition 2 For $c \in [0;1]$ there exists a function $\alpha^N(c)$; such that if $\alpha \geq \alpha^N(c)$ the private label is introduced at a lower price than the national brand, $r < p_c = 1$. When $\alpha < \alpha^N(c)$ the retailer sells the national brand exclusively, and both wholesale and retail prices are below unity.

the retailer earns no pro…t from selling the national brand. He is therefore indi¤erent between selling the brand and not selling it. We invoke the tie-break assumption that when indi¤erent, the retailer chooses to carry the national brand. Alternatively, the national brand producer could o¤er the retailer a wholesale price $w_m = 1 - \varepsilon$; in which case the retailer would earn strictly positive pro…t from carrying the national brand. This would only serve to add extra notation without changing our results, hence we invoke our tie-break assumption.

[11] In Section 5 we discuss an alternative interpretation of exclusivity. Even if a private label is introduced by a retailer it need not be promoted by the retailer. If so, this is analogous to a situation with national brand exclusivity.

[12] Formally, we may also have that the retailer excludes the national brand when introducing a private label. However, in the present model the loyal consumers would never consider buying the private label anyway, so we need not consider this option in our model.

Proof. See the appendix. ■

Figure 1 below illustrates the result in Proposition 2. The function $\theta^N(c)$ represents the cutoff above which the private label will be introduced. When the values of θ and c are below this function the national brand achieves exclusivity.

(Figure 1 approximately here)

As was the case under national brand monopoly, the producer of the national brand serves only its loyal consumers if the fraction of loyal consumers is relatively high (θ is sufficiently large). In addition, we see from Figure 1 that the private label's unit cost matters. When the production cost of the private label increases, the incentive for the retailer to introduce a private label is dampened. Therefore, for a given number of loyal versus switching consumers the national brand producer can increase its wholesale price and still enjoy exclusivity of its brand in the retail store.

It is also interesting to note that $\theta^N(c)$ first increases in c and thereafter is constant. For low c's an increase in the cost of producing the private label makes the threat of the private label smaller. Consequently, the national brand producer may increase its exclusive dealing wholesale price and still make it profitable for the retailer to accept it. As c continues to increase, at some point the exclusive dealing wholesale price reaches its monopoly level. As c continues to increase from this point, the national brand producer continues to charge the monopoly price which is independent of c; which explains why $\theta^N(c)$ is constant for high enough c's.

We are now ready to investigate the effect of the potential for a private label. By comparing equilibrium prices, consumers' surplus and welfare from the outcomes of Propositions 1 and 2, we have the following result:

Proposition 3 $0 \cdot \theta^N(c) < \theta^M$
I. (National brand exclusivity) If $\theta \in \left[0; \theta^N(c)\right]$; $p_e \cdot p_m < 1$ and $w_e \cdot w_m < 1$.
II. (Private label introduction) If $\theta \in \left(\theta^N(c); \theta^M\right]$; $p_m < p_c = 1$ and $w_m < w_c = 1$.
III. (Private label introduction) If $\theta \in \left(\theta^M; 1\right]$; $p_c = p_m = 1$ and $w_c = w_m = 1$.
In areas I and III the existence of a private label, even if it is not introduced by the retailer, will always increase the consumers' surplus and welfare compared to national brand monopoly. In area II there exist two functions $c^S(\theta) > c^W(\theta)$ such that if $c \geq c^S(\theta)$ the consumers are better off in monopoly and if $c \geq c^W(\theta)$ welfare is higher in monopoly.

Proof. See the appendix. ■

The essence of Proposition 3 is illustrated in Figure 2.[13]

(Figure 2 approximately here)

The solid line in Figure 2 illustrates the retail price of the national brand when the producer is a monopolist, while the dotted line illustrates the retail price of the national brand under the threat of a private label.

We see from Figure 2 that there are three regimes. For low θ (area I), the national brand obtains exclusivity. In this case the private label threat results in a lower retail price of the national brand compared to the monopoly case. The reason is that when the number of loyal relative to switching consumers is low, the producer of the national brand is willing to lower its wholesale price in order to prevent the introduction of a private label. He will continue to serve the switching consumers despite the loss it causes on the sale to the loyal consumers. However, the larger the number of loyal relative to switching consumers, the larger the loss from such a strategy. Therefore, for intermediate values of θ (area II) the producer decides not to serve the switching consumers, but instead to concentrate on the loyal ones. The national brand producer then increases its wholesale price to unity, and the retailer responds by introducing the private label. As a response to the high wholesale price, the retail price of the national brand also increases to unity. This will hurt the loyal consumers as the price will be above the price set in a national brand monopoly. For sufficiently high θ (area III), the producer of the national brand would choose to serve the loyal consumers exclusively even without the threat of a private label. Then the existence of a private label has no effect on neither the wholesale nor the retail price of the national brand, despite the fact that the retailer introduces the private label.

We also see that the critical θ to induce a change in pricing strategy from the part of the national brand producer is lower under the threat of private labels than without such a threat, i.e. $\theta^N(c) < \theta^M$. This implies that under the threat of a private label a lower fraction of loyal consumers is needed for the manufacturer of the national brand to give up gaining exclusivity. Consequently, the benefits from including the switching consumers are faster eroded for a threatened national brand producer than for a monopolist as θ increases.

Intuitively, one would think that both the threat and the actual introduction of private labels would always improve both consumers' surplus and welfare. This turns out to be true when national brand exclusivity is achieved and when the introduction of a private label leaves the retail price of the national brand unchanged at unity (areas I and III). For low values of θ the threat of a private label weakly lowers wholesale and retail prices

[13] In the figure we have set $c = 1/5$, and then $w_e < w_m$ meaning that wholesale and retail prices under exclusivity will always be strictly lower than in the monopoly case.

while preserving exclusivity of the national brand, which must increase welfare and consumers' surplus. For high levels of θ a private label is introduced without affecting the price of the national brand, and the gain in consumers' surplus and welfare stems from the sale of the private label to the switching consumers.

However, in the intermediate case (area II) we get the surprising result that both consumers' surplus and welfare may be hurt by the introduction compared to the national brand monopoly case. In this case there are several forces in play. The introduction of a private label induces an increase in the retail price of the national brand. The price increase for the national brand is disadvantageous for loyal consumers but has no effect on welfare. On the other hand, the introduction of the private label is positive for switching consumers, but it also has a negative welfare effect due to higher production cost for the private label.

In area II, for a small c the benefits to switching consumers outweigh the damage to the loyal ones. The reason is that the private label will be introduced at a low price, thus generating a large surplus for the switching consumers. When c is large, the benefits to switching consumers from the introduction are smaller due to a higher price, and the damage to the loyal ones dominates. Then introduction becomes negative for the consumers on aggregate. Welfare is unaffected by the price increase to the loyal consumers. Introduction is beneficial for the switching consumers at the expense of replacing efficient production of the national brand with inefficient production of the private label. When costs are high the latter effect dominates, and welfare is reduced compared to monopoly, and vice versa when the costs of producing the private label are relatively low.

Even if the comparison with national brand monopoly already gives us some public policy implications, this comparison is not the most relevant. A more interesting and relevant question for policy is the following: Given that private labels can be introduced, will they be introduced when they should? Are they sometimes introduced when they should not? In other words: are the private incentives to introduce private labels in line with the social ones? To answer these kinds of questions we must compare consumer surplus and welfare under the threat of introduction and actual introduction of private labels. From the previous discussion we know that monopoly may in fact sometimes improve welfare and consumers' surplus. When a national brand producer threatened by private label entry sets prices like a monopolist and achieves exclusivity, the same results will apply. Let us therefore focus on the arguably most relevant case where the price set by a threatened national brand producer is below the one that would be set by a monopolist.[14] In this case define $\theta^W(c)$ as the critical θ above which welfare under private label introduction is higher than under national brand

[14] This corresponds to the case depicted in Figure 2 where c is sufficiently low.

exclusivity. In the same manner we de…ne $\theta^S(c)$ as the critical θ above which consumers' surplus under private label introduction is higher than under national brand exclusivity.

Then we can show:

Proposition 4 (Public policy). $0 = \theta^S(c) < \theta^W(c) < \theta^N(c)$:

Proof. See the appendix. ■

We see from the proposition that there is too much exclusivity from both the consumers' and society's point of view. For low enough θ's the retailer accepts national brand exclusivity without taking into account the fact that the switching consumers would have been better o¤ with the introduction of a private label, supplied at a lower price than that of the national brand.

Will consumers always prefer that private labels actually are introduced? On the one hand, private label introduction leads to higher or unchanged price of the national brand. On the other hand, the switching consumers would be better o¤ with a private label at a lower price than an exclusive national brand. The statement $\theta^S(c) = 0$ in Proposition 4 says that the latter e¤ect dominates. When the national brand gains exclusivity by setting a lower wholesale price than a monopolist would set, consumers will on aggregate be better o¤ with actual introduction.

From a welfare point of view, the introduction of a private label is cost ine¢cient. This explains why welfare is higher under exclusivity for small values of θ. When θ is low, the wholesale and retail prices of the national brandi are relatively low under exclusivity. Introducing a private label would bene…t consumers on aggregate, but it would incur ine¢ciency in production that might o¤set the gain for the consumers. The larger the relative number of loyal consumers (θ); the higher the price of the national brand under exclusivity, and the larger is the gain to consumers from the introduction of a private label. Therefore, for su¢cient high θ the gain to the consumers is large enough to dominate the welfare loss due to ine¢cient production of the private label.

4 Private label and switching costs

When consumers have switching costs and a private label is introduced, only the share of the switching consumers with low enough switching costs will buy the private label. We now assume that $c = 0$: Let $\iota(s) \cdot 1$ denote the share of the switching consumers that has switching costs lower than or equal to s:[15] If a private label is introduced, the switching consumers will choose whether to buy the private or the national label. Let $¢ = p_c - r$

[15] See Klemperer (1987) for a similar modelling approach to switching costs.

denote the price difference between the national and the private label. In equilibrium we must have:

$$q_c = \theta + (1 - \lambda(\phi))(1 - p_c):$$

The national brand producer sells to its loyal consumers θ; and the share of the switching segment whose consumers have reservation price above p_c and switching costs that are higher than the price difference between the two labels. The private label faces demand from two types of consumers. First, the private label will sell to switching consumers with reservation price above p_c and switching costs lower than the price difference. Second, the private label will sell to consumers with reservation price between r and p_c; and who have reservation price minus switching costs above r: Hence, demand for the private label is written:

$$q_r = \lambda(\phi)(1 - p_c) + \int_{x=r}^{p_c} \lambda(x - r)[\lambda d(1 - x)] \qquad (5)$$

To simplify we assume that $s \sim U[0; L]$; where $L \in (0; 1]$:[16]

Consider first the case when the retailer introduces the private label. The profit function of the retailer is written:

$$\begin{aligned}
\pi_c^r &= (p_c - w_c)\left[\theta + (1 - \frac{p_c - r}{L})(1 - p_c)\right] \\
&\quad + r\left[\frac{p_c - r}{L}(1 - p_c) + \int_r^{p_c} \frac{x - r}{L}[\lambda d(1 - x)\right] \\
&\quad \text{m} \\
\pi_c^r &= (p_c - w_c)\left[\theta + \left(1 - \frac{p_c - r}{L}\right)(1 - p_c)\right] \\
&\quad + r\left[\frac{p_c - r}{L}(1 - p_c) + \frac{(p_c - r)^2}{2L}\right]
\end{aligned}$$

In a similar setting, Narasimhan and Wilcox (1998) found that different equilibria will arise for different parameter values. In some cases the national brand manufacturer lowers its wholesale price to induce the retailer to increase the retail price of the private label and thereby reduce the market share of the private label. However, for other parameter values the national brand manufacturer decides to set a high wholesale price so that it serves

[16] Note that we could also have that $L > 1$; but since the maximum price differential that can exist in our model is 1, an $L > 1$ would mean that some of the switching consumers would never switch, and thereby be regarded as loyals. In our model the fraction of loyals can be increased by increasing θ:

only the loyal consumers after the private label is introduced.[17] This latter case can be an equilibrium outcome in our model as well.

We …rst derive the following useful result:

Lemma 1 If the retailer introduces the private label and $\tau \geq \max\{0; \tau^K(L)\}$, then $w_c = p_c = 1$:

Proof. See the appendix. ■

The result shows that if the fraction of loyal consumers are su¢ciently large, then the introduction of a private label would imply that the retail price of the national brand is set at its maximum.[18] This can be seen by considering the national producer's decision problem. If there are many loyal consumers, the national producer would respond to the introduction of a private label by setting his wholesale price as high as possible ($w_c = 1$) and only serve the loyal consumers. Then, obviously, the retailer sets a high retail price ($p_c = 1$).

Under the condition in Lemma 1, the pro…t function of the retailer reduces to

$$\pi_c^r = r\frac{(1-r)^2}{2L}. \tag{6}$$

Maximizing this yields $r = \frac{1}{3}$. Thus, under the assumptions above we have that $\phi = \frac{2}{3}$; and since $\pi(\frac{2}{3}) = \frac{2}{3L} \cdot 1 \Leftrightarrow L \geq \frac{2}{3}$: Hence, we must have that $L \in [\frac{2}{3}; 1]$:

When the retailer carries the national brand exclusively his pro…t is

$$\pi_e^r = (p_e - w_e)(\tau + (1 - p_e))$$

Then we have the following result[19]:

Proposition 5 For $\tau \geq \max\{0; \tau^K(L)\}$ and $L \in [\frac{2}{3}; 1]$ there exists a function $\tau^N(L)$; such that when $\tau \geq \tau^N(L)$ the private label is introduced at a lower price than the national brand, $r < p_c = 1$. When $\tau < \tau^N(L)$ the retailer sells the national brand exclusively, and both wholesale and retail prices are below unity.

[17] In Table 1 in Narasimhan and Wilcox (1998), type 3 equilibrium is the one where the manufacturer of the national brand decides to set a high wholesale price and only serve the loyal consumers. We see from the parameter values de…ning type 3 equilibrium, that this equilibrium can be present if one of the following is true: (1) the reservation price is su¢ciently high, (2) the cost of the private label is su¢ciently high, or (3) the switching cost is su¢ciently low.

[18] Note that $\tau^K(L)$ is partly negative, but may also be positive for high enough values of L; and then increasing in L: This means that if the switching segment has high switching costs, and the national brand has very few loyal consumers, the national brand producer may want to …ght for the switching consumers even if a private label is introduced. In the following we will assume that the condition in Lemma 1 holds.

[19] Again, details about equilibrium values are reported in Table A3 in the appendix.

Proof. See the appendix. ■

As in the previous section the relative number of loyal and switching consumers is of importance for the equilibrium outcome. If θ is low enough, exclusivity will arise and the intuition is as in the previous section. When θ is high enough, the national brand producer decides not to deter the private label and concentrates on exploiting his large group of loyal consumers.

By comparing Propositions 1 and 5, we have the following result:

Proposition 6 $0 \cdot \max\{0; \theta^K(L)\} \pounds \theta^N(L) < \theta^M$
I. (National brand exclusivity) If $\theta \in [\max\{0; \theta^K(L)\}; \theta^N(L)\cent$; $p_e \cdot p_m < 1$ and $w_e \cdot w_m < 1$.
II. (Private label introduction) If $\theta \in [\theta^N(L); \theta^M\cent$; $p_m < p_c = 1$ and $w_m < w_c = 1$.
III. (Private label introduction) If $\theta \in [\theta^M; 1\cent$; $p_c = p_m = 1$ and $w_c = w_m = 1$.

The actual introduction, or the threat of introduction, always improves welfare and the consumers' surplus compared to national brand monopoly.

Proof. See the appendix. ■

The price results reported in the Proposition are qualitatively identical to the results reported in the previous Section (see Proposition 3). The threat of a private label may force the national brand producer to price concessions, in which case both wholesale and retail prices will be lower than in monopoly. When θ becomes large the national brand producer no longer …nds exclusivity pro…table and starts to exploit his loyal customers and the retailer introduces a private label. In this case both wholesale and retail prices are higher than those charged by an unthreatened monopolist. The intuition is as in the previous section.

Note that welfare and consumers will now unambiguously bene…t from the existence of a private label. This means that the bene…t for the switching consumers is su¢ciently large to o¤set the loss for the loyal consumers and the pro…t loss for the national brand.

As in the previous section de…ne $\theta^W(L)$ and $\theta^S(L)$ as the critical θ above which welfare and consumers' surplus are higher under private label introduction than under national brand exclusivity.[20] We then have:

Proposition 7 When $L \in [\frac{2}{3}; 1]$; then $0 = \theta^S(L) < \theta^W(L) < \theta^N(L)$:

Proof. See the appendix ■

Note that the ranking is the same as in Proposition 4, where we assumed cost asymmetry and no switching costs. This implies that also in this version of the model we predict that we may observe exclusivity in cases where neither consumers nor the society as a whole would prefer exclusivity.

[20] As in Proposition 4 we focus on the case where $w_e < w_m$:

5 Discussion and concluding remarks

According to traditional theory, private label introduction is an extremely valuable instrument for retailers and should therefore be adopted by retailers in most categories. In this paper we have argued that private label introduction is not universal across markets and product categories. On the contrary, we observe that private labels are introduced in speci…c markets and product categories. Therefore, before we can put faith in the theoretical results that are obtained, we must have a theory that explains why retailers sometimes choose not to introduce a private label. This paper is an attempt to contribute to such a theory.

Moreover, most existing theory predicts a downward pressure on prices of national brands following the introduction of a private label. However, most empirical studies …nd that the national brand producer's response to a private label introduction is ambiguous (see Parker and Kim, 1995; Harris et al., 2000; Gabrielsen et al., 2001; Chintagunta et al., 2000). Sometimes a price increase is more likely than a price decrease .

We have extended the received literature in one direction by allowing the producers of national brands to o¤er exclusivity clauses (in the literature labeled exclusive dealing clauses) in response to a threat of private label introduction. With this instrument at hand, the retailers may be willing to trade its private label introduction for lower wholesale prices from national brand producers. We get as a result that the mere threat of private labels - and not necessarily their actual introduction - may be su¢cient to reduce wholesale and retail prices of national brands. However, sometimes private labels are introduced after all. Our theory predicts that this may lead to higher prices on national brands, since the national brand producer by de…nition does not o¤er an exclusivity contract anymore and may give up serving the switching consumers. This may explain why some empirical studies …nd that the national brand price in some cases increase after private label introduction.

The theoretical ambiguity suggests that the competitive e¤ect of private labels can be distinctly di¤erent from one product category to another. A natural response to this is to examine the results from empirical studies, to …nd out more about the competitive (or anticompetitive) e¤ect of private labels. However, our study indicates that one should be careful with the interpretation of empirical results. In principle, one should distinguish between three di¤erent situations: (1) no threat of private label introduction, (2) threat of private label introduction and (3) actual introduction of private labels. Our theory predicts that the price of the national brand is lower in case (2) than in cases (1) and (3), if there is any di¤erence at all. A natural empirical test would be to disaggregate data - if possible - and examine how the manufacturer of a national brand responds to an actual introduction of a private label.

Empirically it is di¢cult to distinguish case (1) from case (2). However, sometimes store managers argue that threat of introduction of a private label is not enough, but that a retailer needs to actually introduce a private label in order to be a credible threat to national brands. Scott Morton and Zettelmeyer (2001) present some evidence that this may sometimes be perceived as true. If so, it may seem as if national brand exclusivity could never arise as an equilibrium outcome if private labels could be introduced by the retailer. However, if the point is to make a credible threat to a national brand, once the private label is introduced it need not be promoted. In fact, many private labels are introduced but obtain very low sales because they receive very little prominent shelf space in the store. We argue that in principle this can be interpreted as our exclusivity clause. If so, we are also able to observe scenario (2) above. With this interpretation, our theory predicts that we should observe the lowest wholesale (and retail) prices on national brands when the private label obtains small market share or small market coverage. This is consistent with the …ndings in Gabrielsen et al. (2001), and partly with Cotterill et al. (2000) and Harris et al. (2000) which all …nd that limited success of the private label (in terms of market share or coverage) tends to lower prices of national brands at least in some categories.

Any possible price-increasing e¤ect of private labels raises the question if consumers and society as a whole are better o¤ with the introduction of private labels. The received theoretical literature compares a national brand monopoly with a situation where a private label is introduced. We …nd that in such a case we may have that both consumers and society are worse o¤ with private label introduction. However, we have argued that a more relevant comparison should be between the case where a manufacturer of a national brand achieves exclusivity in the retail store and the case where it does not and the retailer introduces a private label. In our model we …nd that we may have too much exclusivity. This implies that there are some instances where both consumers and society as a whole would prefer private label introduction, while the national brand producer prefers exclusivity.

We believe that the interplay between pricing and private label introduction is complicated and many factors may play a role. Even though we have focused on factors di¤erent from existing theories, our analysis has in common with existing ones the fact that many details are left out. One should therefore view our theory as complementary to other theories rather than a competing theory that aims at explaining 'everything'. For example, one important aspect that we have not considered is the possibility of introducing private labels with lower (or higher) quality than existing brands. Introducing a private label with inferior (superior) quality may be motivated by simple price discrimination reasons as consumers may have di¤erent taste for quality. This, and other aspects, are left for future research.

6 Appendix

6.1 Proofs

Proof of Proposition 1:

Maximizing (1) with respect to p_m yields the price

$$p_m = \frac{1}{2}(\theta + 1 + w_m): \tag{7}$$

Inserting this into (2) and maximizing with respect to w_m yields $w_m = \frac{1}{2}(\theta + 1)$; and inserting this in (7) yields $p_m = \frac{3}{4}(\theta + 1) \cdot 1 \Leftrightarrow \theta \cdot \frac{1}{3} \acute{} \theta^M$: Hence, depending on the parameters we have two di¤erent equilibria. Type I: $\theta \cdot \theta^M$: In this case retail and wholesale prices are set at $w_m = \frac{1}{2}(\theta + 1)$; resulting in the retail price $p_m = \frac{3}{4}(\theta + 1)$: Type II: $\theta > \theta^M$: In this case retail and wholesale prices are set at $w_m = p_m = 1$.

Inserting these prices in the expressions for pro…ts, consumers' surplus and welfare yields the expressions reported in Table A1. QED.

Proof of Proposition 2:

We solve the game backwards, and start with the retail prices. To have national brand exclusivity we must have $w_e < p_e < 1$: Substituting w_e for w_m in (7) and inserting this price into the retailer's pro…t yields:

$$\pi^r_e = \frac{(\theta + (1 - w_e))^2}{4}: \tag{8}$$

If the retailer carries both brands, it obviously charges the loyal consumers $p_c = 1$ and maximizes pro…t on the falling demand curve by setting a lower price for the private label. The producer of the national brand realizes this and therefore o¤ers $w_c = 1$, and the retailer earns zero pro…ts selling the national brand. If so, the retailer sets the price of the private label equal to $r = \frac{1+c}{2}$; and the retailer's pro…t is $\pi^r_c = \frac{(1-c)^2}{4}$:

At stage 1, the producer sets wholesale prices contingent on whether the retailer carries a national brand or not. First, it can choose to serve only its loyal customers. Then it o¤ers $w_e = w_c = 1$ and earns $\pi^n_c = \theta$: Alternatively, it can set $w_c = 1$; and $w_e < 1$ in such a way that the retailer is better o¤ accepting the exclusive dealing clause. The retailer will accept exclusive dealing if $\pi^r_e - \pi^r_c > 0$: Solving with respect to w_e this holds when $w_e < \theta + c \acute{} w^¤_e$:

For su¢ciently high c; $w^¤_e$ may exceed w_m; in which case $w_e = w_m$ should be o¤ered instead. Comparing the two yields that $w_m \cdot w^¤_e \Leftrightarrow \theta \cdot 1 - 2c$: Hence we have two cases.

i) If $\theta < 1 - 2c$; $w_e = w^¤_e$, and to have exclusivity we must have that $p_e(w^¤_e) < 1 \Leftrightarrow \theta < \frac{1-c}{2}$; hence $\theta < \min\{1 - 2c; \frac{1-c}{2}\}$ which is the condition reported in Table A2. Under exclusivity the producer's pro…t is

$\pi^n_e = \frac{(1-c)(1+c)}{2}$: Comparing this with $\pi^n_c = 1$ yields that obtaining exclusivity is more profitable for the national brand producer when:

$$\frac{(1-c)(1+c)}{2} \geq 1 \iff 1 \leq \frac{c(1-c)}{1+c}$$

When $1 \leq \frac{c(1-c)}{1+c}$ holds, $1 < \frac{1-c}{2}$ holds if $\frac{1-c}{2} - \frac{c(1-c)}{1+c} \geq 0 \iff \frac{1}{2}\frac{(1-c)^2}{1+c} \geq 0$; i.e. always, hence $p_e < 1$ and exclusivity can be obtained.

ii) If $1 \geq 1 - 2c$; $w_e = w_m$ is offered. In this case we can have exclusivity when $p_e(w_m) < 1 \iff 1 < \frac{1}{3}$; and we have the second set of conditions in Table A2. Under exclusivity the producer's profit equals the monopoly profit $\pi^n_m = \frac{1}{8}(1+1)^2$. This is higher than or equal to $\pi^n_c = 1$ whenever

$$\frac{1}{8}(1+1)^2 \geq 1 \iff 1 \leq 3 - 2\sqrt{2}$$

Since $3 - 2\sqrt{2} < \frac{1}{3}$; $p_e < 1$ when $1 \leq 3 - 2\sqrt{2}$:

Finally, note that when $1 = 1 - 2c \iff c = \frac{1-1}{2}$ we have that $1 \leq \frac{c(1-c)}{1+c} \iff 1 \leq 3 - 2\sqrt{2}$; i.e., the two conditions converge. The two conditions intersect when $\frac{c(1-c)}{1+c} = 3 - 2\sqrt{2} \iff c = \sqrt{2} - 1$.

Summing up the two cases yields that national brand exclusivity will arise as an equilibrium outcome when $1 < 1^N(c)$ where

$$1^N(c) = \begin{cases} \frac{c(1-c)}{1+c} & \text{if } c \leq \sqrt{2} - 1 \\ 3 - 2\sqrt{2} & \text{otherwise} \end{cases}$$

QED.

Proof of Proposition 3:

The maximum value of $1^N(c)$ for $c \in [0;1]$ is $3 - 2\sqrt{2} < \frac{1}{3}$: The prices follow directly from a comparison between Propositions 1 and 2. To prove the second part note first that the mere threat of a private label is weakly beneficial for the consumers and welfare if $1 \in \left[0; 1^N(c)\right]$. The producer of the national brand lowers (for low c's) or charges the same (for high c's) wholesale price to attract the retailer to accepting exclusive dealing of the national brand. Second, if $1 \in \left[1^M; 1\right]$ the monopolist serves only loyal consumers, and the introduction of a private label is beneficial for the switching consumers who initially were not served by the producer of the national brand which also enhances welfare. For $1 \in \left[1^N(c); 1^M\right]$, the effect is ambiguous because loyal consumers get higher prices whereas switching consumers get lower prices. The consumers' surplus in this case is written:

$$S_c = \frac{(1-r)^2}{2} = \frac{1}{8}(1-c)^2$$

whereas S_m for $\tau \cdot \tau^M$ is given in Table A1.

$$S_c \geq S_m \Leftrightarrow \frac{1}{8}(1-c)^2 = \frac{1}{32}(5\tau+1)(1-3\tau)$$

$$\Leftrightarrow c \leq 1 - \frac{1}{2}\sqrt{(2\tau - 15\tau^2 + 1)} \equiv c^S(\tau)$$

Hence, consumers' surplus increases compared to monopoly for the set

$$\Delta = \{c, \tau : c \leq c^S(\tau), \tau \geq \tau^N(c), \tau^M\}$$

and consumers' surplus decreases compared to monopoly for the set:

$$\Delta^{-1} = \{c, \tau : c > c^S(\tau), \tau \geq \tau^N(c), \tau^M\}$$

Welfare when the private label is introduced is given by

$$W_c = \tau + S_c + (1-r)(r-c) = \tau + \frac{3}{8}(1-c)^2$$

and W_m for $\tau \cdot \tau^M$ is given in Table A1.

$$W_c \geq W_m \Leftrightarrow \tau + \frac{3}{8}(1-c)^2 \geq \frac{1}{32}\left[7 - 9\tau^2 + 14\tau\right]$$

$$\Leftrightarrow c \leq 1 - \frac{1}{6}\sqrt{(21 - 54\tau - 27\tau^2)} \equiv c^W(\tau)$$

Hence, welfare increases compared to monopoly for the set

$$\Omega = \{c, \tau : c \leq c^W(\tau), \tau \geq \tau^N(c), \tau^M\}$$

and welfare decreases compared to monopoly for the set:

$$\Omega^{-1} = \{c, \tau : c > c^W(\tau), \tau \geq \tau^N(c), \tau^M\}$$

It is straightforward to show that the sets Δ; Δ^{-1}; Ω and Ω^{-1} are non-empty. QED.

Proof of Proposition 4:

First, note that when $\tau \geq \tau^M$; 1 it is better for both consumers and welfare that the private label is introduced. The reason is that the private label includes the switching consumers without affecting the pricing of the national brand. Second, look at the interval $\tau \geq 0; \tau^M$: Consumers' surplus when national brand has exclusivity and $w_e = w_e^{\alpha}$ is

$$S_e = \frac{\tau + (1-p_e) + \tau}{2}(1-p_e)$$

$$= \frac{1}{2}\left[\tau + \frac{1}{2} - \frac{1}{2}c\right]\left[\frac{1}{2} - \tau - \frac{1}{2}c\right]$$

whereas if the private label is introduced, consumers' surplus is S_c from the proof of Proposition 3. In this case consumers are better o¤ under private label introduction if:

$$S_c \geq S_e \Leftrightarrow \frac{1}{8}(1-c)^2 \geq \frac{1}{2}\left(1+\frac{1}{2}-\frac{1}{2}c\right)\left(\frac{1}{2}-1-\frac{1}{2}c\right)$$

$$\frac{1}{2}1^2 \geq 0;$$

i.e. always.

Then consider welfare under national brand exclusivity:

$$\begin{aligned} W_e &= S_e + p_e(1+(1-p_e)) \\ &= \frac{1}{2}\left(1+\frac{1}{2}-\frac{1}{2}c\right)\left(\frac{1}{2}-1-\frac{1}{2}c\right) + \left(1+\frac{1}{2}+\frac{1}{2}c\right)\left(\frac{1}{2}-\frac{1}{2}c\right) \end{aligned}$$

and welfare under private label introduction

$$W_c = 1 + S_c + (1-r)(r-c) = 1 + \frac{3}{8}(1-c)^2$$

Then we have that welfare is higher under private label introduction if:

$$W_c \geq W_e \Leftrightarrow 1 \geq \frac{\sqrt{(1+6c-3c^2)}-1-c}{2} \equiv 1^W(c)$$

Moreover we have that

$$1^W(c) \leq 1^N(c)$$

$$\frac{\sqrt{(1+6c-3c^2)}}{2}-\frac{1+c}{2} \leq \frac{c(1-c)}{1+c}$$

Solving this with equality yields two solutions $\{c=1; c=0\}$; hence for $c \in (0;1)$ the inequality either holds for all values or it does not hold. Inserting for $c=\frac{1}{2}$ we have that $0{:}15139 < 0{:}166\,67$ which holds, hence $1^W(c) < 1^N(c)$ for $c \in (0;1)$: QED.

Proof of Lemma 1:

We have that if

$$\frac{\partial \pi_c}{\partial p_c} = L(1+1)-2p_c(L+1)+3p_c^2+2r-3rp_c+w_c(1-2p_c+L+r) \geq 0;$$

then the retailer would set $p_c = 1$: If $p_c = 1$; then we know that $r = \frac{1}{3}$ (see the proof of Proposition 5 that follows). Evaluated at $p_c = 1$; we thus have that $\frac{\partial \pi_c}{\partial p_c} \geq 0$ if

$$1 \geq \frac{(1-w_c)(3L-2)}{3L} \equiv 1^K(L;w_c)$$

It can easily be seen that if $w_c = 1$; the condition is met for all relevant values of θ; that is $\theta > 0$: For lower values of w_c; though, $\theta^K(L; w_c)$ can be positive. Clearly, the national producer will never set $w_c < \max\{w_e^{\alpha}; w_m\}$; the wholesale price that deters the retailer from introducing the private label. If we set $w_c = \max\{w_e^{\alpha}; w_m\}$ in the expression for $\theta^K(L; w_c)$ and solve the inequality for θ (where w_e^{α} is found in Proposition 5 to follow, and w_m in Proposition 1) we have for $w_e^{\alpha} < w_m$:

$$\theta \geq \frac{\sqrt{6}(3L - 2)}{9\sqrt{L}(3L - 1)}$$

and for $w_e^{\alpha} \geq w_m$:

$$\theta \geq \frac{3L - 2}{9L - 2}.$$

Then we have:

$$\theta \geq \theta^K(L) \equiv \begin{cases} \frac{\sqrt{6}(3L-2)}{9\sqrt{L}(3L-1)} & \text{if } w_e^{\alpha} < w_m \\ \frac{3L-2}{9L-2} & \text{if } w_e^{\alpha} \geq w_m \end{cases}$$

which is a sufficient condition for $p_c = 1$ in equilibrium. QED.

Proof of Proposition 5:

Given that $p_c = 1$ and $w_c = 1$; maximizing (6) with respect to the price of the private label yields $r = \frac{1}{3}$:Inserting this in (6) yields $\pi_c^r = \frac{2}{27L}$. Comparing this with the retailer's profit under exclusivity given in (8) we have that the retailer will not introduce the private label if

$$\frac{(\theta + 1 - w_e)^2}{4} \cdot \frac{2}{27L} \quad () \quad w_e \cdot \theta + 1 - \frac{2\sqrt{6}}{9\sqrt{L}} \equiv w_e^{\alpha}$$

which defines the highest wholesale price that the producer can charge to prevent the introduction of a private label. Inserting w_e^{α} for w_m in (7) yields the retailer's optimal price given that the private label is going to be deterred, p_e: Given this, quantity sold is $q_e = \theta + (1 - p_e)$: Doing this yields:

$$p_e = \begin{cases} \theta + 1 - \frac{\sqrt{6}}{9\sqrt{L}} & \text{if } \theta < \frac{\sqrt{6}}{9\sqrt{L}-1} \\ 1 & \text{if } \theta \geq \frac{\sqrt{6}}{9\sqrt{L}} \end{cases}$$

$$q_e = \begin{cases} \frac{\sqrt{6}}{9\sqrt{L}} & \text{if } \theta < \frac{\sqrt{6}}{9\sqrt{L}-1} \\ \theta & \text{if } \theta \geq \frac{\sqrt{6}}{9\sqrt{L}} \end{cases}:$$

In order to have exclusivity we must have that $p_e < 1$: In addition the wholesale price may be below or equal to the monopoly wholesale price. Then we have 2 cases to consider:

i) $w_e^{\alpha} < w_m \iff \tau < \frac{4\sqrt{6}-9\sqrt{L}}{9-\sqrt{6L}}$ and $p_e < 1 \iff \tau < \frac{\sqrt{6}}{9-\sqrt{6L}}$; yielding $\tau < \min\{\frac{\sqrt{6}}{9-\sqrt{6L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9-\sqrt{6L}}\}$; and we have the first set of conditions in Table A3. Under national brand exclusivity the national brand earns

$$\Pi_e^n = w_e q_e = \left(\frac{\tau+1}{2}\right)\left(\frac{2-\sqrt{6L}}{9-\sqrt{6L}}\right)^2$$

Hence, we have that exclusivity is preferred by the national brand when:

$$\Pi_e^n \geq \Pi_c^n \iff \left(\frac{\tau+1}{2}\right)\left(\frac{2-\sqrt{6L}}{9-\sqrt{6L}}\right)^2 \geq \tau$$

$$h(L) \equiv \frac{1}{3}\left(\frac{3\sqrt{6L}-4}{9L-\sqrt{6L}\sqrt{L}}\right)^2 \geq \tau$$

When $\tau \leq h(L)$ we have that $p_e < 1$ when $\frac{\sqrt{6}}{9-\sqrt{6L}} < h(L) > 0$ which is always true. We must also have that $w_e < w_m$ for $\tau \leq h(L)$ which is true when $\frac{4\sqrt{6}-9\sqrt{L}}{9-\sqrt{6L}} < h(L) > 0 \iff L < L^{\alpha} \equiv \frac{4}{9} + \frac{8}{27}\sqrt{2}$. Finally, $h(L) \geq 0 \iff L \geq \frac{8}{27}$; which always holds for $L \in (\frac{2}{3}; 1]$.

ii) $w_e^{\alpha} \geq w_m \iff \tau \geq \frac{4\sqrt{6}-9\sqrt{L}}{9-\sqrt{6L}}$ If so, the producer sets w_m and the retailer sets $p_e(w_m) = p_m = \frac{3}{4}(\tau+1) < 1 \iff \tau < \frac{1}{3}$ (explaining the second set of conditions in Table A3). Under exclusivity the producer earns the monopoly profit (see Table A1): $\Pi_e^n = \frac{1}{8}(\tau+1)^2$ which is larger than or equal to $\Pi_c^n = \tau$ whenever

$$\frac{1}{8}(\tau+1)^2 \geq \tau \iff \tau \leq 3 - 2\sqrt{2}.$$

Since $3 - 2\sqrt{2} < \frac{1}{3}$; $p_e < 1$ when $\tau \leq 3 - 2\sqrt{2}$.

Note that when $\tau = \frac{4\sqrt{6}-9\sqrt{L}}{9-\sqrt{6L}} \iff L = \frac{32}{27(\tau+1)^2}$ we have that $\tau \leq h(L) \iff \tau \leq 3 - 2\sqrt{2}$, i.e., the two conditions converge (at $L = \frac{4}{9} + \frac{8}{27}\sqrt{2}$).

Summing up the two cases yields:

$$\tau^N(L) = \begin{cases} \frac{1}{3}\left(\frac{3\sqrt{6L}-4}{9L-\sqrt{6L}\sqrt{L}}\right)^2 & \text{if } \frac{2}{3} \leq L \leq \frac{4}{9} + \frac{8}{27}\sqrt{2} \\ 3 - 2\sqrt{2} & \text{if } \frac{4}{9} + \frac{8}{27}\sqrt{2} < L \leq 1 \end{cases}$$

QED.

Proof of Proposition 6:

The statement $0 \leq \max\{0; \tau^K(L)\} \leq \tau^N(L) < \tau^M$ is easily verified by plotting the expressions in $L \in [\frac{2}{3}; 1]$: The comparisons of prices follow directly from Propositions 1 and 5. To prove the last part first note that

for $\theta \in \left[\max\{0; \theta^K(L)\}; \theta^N(L)\right)$ no private label is introduced, but due to threat of introduction the national brand producer sets a lower price than the monopolist, hence both consumers' surplus and welfare are increased by the existence of a private label. Second, when $\theta \in \left(\theta^M; 1\right]$ the monopolist serves the loyal consumers exclusively, whereas private label introduction also includes some switching consumers and welfare and consumers' surplus also increase in this case. For $\theta \in \left(\theta^N(L); \theta^M\right]$ private label introduction will increase the price to loyal consumers whereas switching consumers will get a lower price compared to the monopoly case. Under private label introduction the consumers' surplus is

$$S_c = \frac{1}{2}(1 - r)q_r = \frac{2}{27L}:$$

Private label introduction increases consumers' surplus compared to monopoly when

$$S_c \geq S_m \Leftrightarrow \frac{2}{27L} \geq \frac{1}{32}(5\theta + 1)(1 - 3\theta)$$

$$L \leq \frac{64}{27(1 + 2\theta - 15\theta^2)} \equiv L^S(\theta):$$

It can then easily be shown that for $\theta < \theta^M$ we have that $L^S(\theta) > 1$. Therefore private label introduction will always improve consumer surplus when $L \in (\frac{2}{3}; 1]$.

Welfare under private label introduction is

$$W_c = \theta + rq_r + \frac{1}{2}(1 - r)q_r = \theta + \frac{4}{27L}:$$

We then have that

$$W_c \geq W_m \Leftrightarrow \theta + \frac{4}{27L} \geq \frac{1}{32}\left(7 - 9\theta^2 + 14\theta\right)$$

$$L \leq \frac{128}{27(7 - 18\theta - 9\theta^2)} \equiv L^W(\theta):$$

It is straightforward to show that for $\theta \in \left(\theta^N(L); \theta^M\right]$ and $L \in (\frac{2}{3}; 1]$; $L^W(\theta) > 1$; hence private label introduction will always bene…t welfare. QED.

Proof of Proposition 7:

The consumers' surplus and welfare under private label introduction is derived in the proof of Proposition 6. When the private label is not introduced the consumers' surplus is

$$S_e = \frac{1}{2}(q_e + \theta)(1 - p_e) = \frac{1}{27L} - \frac{\theta^2}{2}$$

and welfare

$$W_e = p_e q_e + \frac{1}{2}(q_e + \theta)(1 - p_e) = \frac{\sqrt{6}}{9\sqrt{L}}\theta + \frac{\sqrt{6}}{9\sqrt{L}} - \frac{1}{27L} - \frac{\theta^2}{2}$$

Comparing S_e with S_c yields:

$$S_c - S_e \geq \frac{2}{27L} - \frac{1}{27L} - \frac{\theta^2}{2}$$

$$\theta^2 \geq -\frac{2}{27L}$$

which is always true, hence $\theta^S(L) = 0$. Doing the same comparison for welfare yields:

$$W_c - W_e \geq \theta + \frac{4}{27L} - \frac{1}{9\sqrt{L}}\sqrt{6}\theta + \frac{1}{9}\frac{\sqrt{6}}{\sqrt{L}} - \frac{1}{27L} - \frac{\theta^2}{2}$$

$$\theta \leq \frac{\sqrt{L}\sqrt{6} - 9L + \sqrt{3}\sqrt{L(27L-8)}}{9L} \equiv \theta^W(L)$$

It can then easily be shown that $0 < \theta^W(L) < \theta^N(L)$ for $L \in \left[\frac{2}{3}; 1\right]$. QED.

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6.2 Tables and …gures

Table A1: Monopoly

w_m	$\frac{(^1+1)}{2}$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 1 otherwise
p_m	$\frac{3}{4}(^1+1)$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 1 otherwise
r	NA
$\dagger^r_m$	$\frac{(^1+1)^2}{16}$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 0 otherwise
$\dagger^n_m$	$\frac{(^1+1)^2}{8}$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 1 otherwise
S_m	$\frac{(5^1+1)(1¡3^1)}{32}$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 0 otherwise
W_m	$\frac{7¡9^{1^2}+14^1}{32}$ if $0 \cdot ^1 \cdot \frac{1}{3}$ 1 otherwise

Table A2: Cost asymmetries

	i = e	i = c
w_i	^1+c if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{(^1+1)}{2}$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	1
p_i	$^1+\frac{(1+c)}{2}$ if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{3}{4}(^1+1)$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	1
r	NA	$\frac{1+c}{2}$
$\dagger^r_i$	$\frac{(1¡c)^2}{4}$ if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{(^1+1)^2}{16}$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	$\frac{(1¡c)^2}{4}$
$\dagger^n_i$	$\frac{(1¡c)(^1+c)}{2}$ if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{(^1+1)^2}{8}$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	1
S_i	$\frac{1}{2}\frac{1+2^1¡c}{2}\frac{1¡2^1¡c}{2}$ if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{(5^1+1)(1¡3^1)}{32}$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	$\frac{(1¡c)^2}{8}$
W_i	$\frac{3¡4^{1^2}¡2c¡c^2+4^1(1¡c)}{8}$ if $^1 < \min\{1¡2c; \frac{1¡c}{2}\}$ $\frac{7¡9^{1^2}+14^1}{32}$ if $1¡2c \cdot ^1 \cdot \frac{1}{3}$	$^1+\frac{3}{8}(1¡c)^2$

Table A3: Switching costs for $L \in (\frac{2}{3}; 1]$

	$i = e$	$i = c$
w_i	$\tau + 1 - \frac{2}{9}\sqrt{\frac{6}{L}}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{(\tau+1)}{2}$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	1 if $\tau \geq \frac{1}{9}\sqrt{6}\sqrt{\frac{(3L-2)}{L(3L-1)}}$
p_i	$\tau + 1 - \frac{\sqrt{6}}{9\sqrt{L}}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{3}{4}(\tau + 1)$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	1 if $\tau \geq \frac{1}{9}\sqrt{6}\sqrt{\frac{(3L-2)}{L(3L-1)}}$
r	NA	$\frac{1}{3}$
Π_i^r	$\frac{2}{27L}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{(\tau+1)^2}{16}$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	$\frac{2}{27L}$
Π_i^n	$(\tau + 1 - \frac{2}{9}\sqrt{\frac{6}{L}})\frac{\sqrt{6}}{9\sqrt{L}}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{(\tau+1)^2}{8}$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	τ
S_i	$\frac{1}{27L} - \frac{\tau^2}{2}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{(5\tau+1)(1-3\tau)}{32}$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	$\frac{2}{27L}$
W_i	$\frac{\sqrt{6}}{9\sqrt{L}}(\tau + 1) - \frac{1}{27L} - \frac{\tau^2}{2}$ if $\tau < \min\{\frac{\sqrt{6}}{9\sqrt{L}}; \frac{4\sqrt{6}-9\sqrt{L}}{9\sqrt{L}}\}$ $\frac{7-9\tau^2+14\tau}{32}$ if $\frac{\sqrt{6}}{9\sqrt{L}} \leq \tau \leq \frac{1}{3}$	$\tau + \frac{4}{27L}$

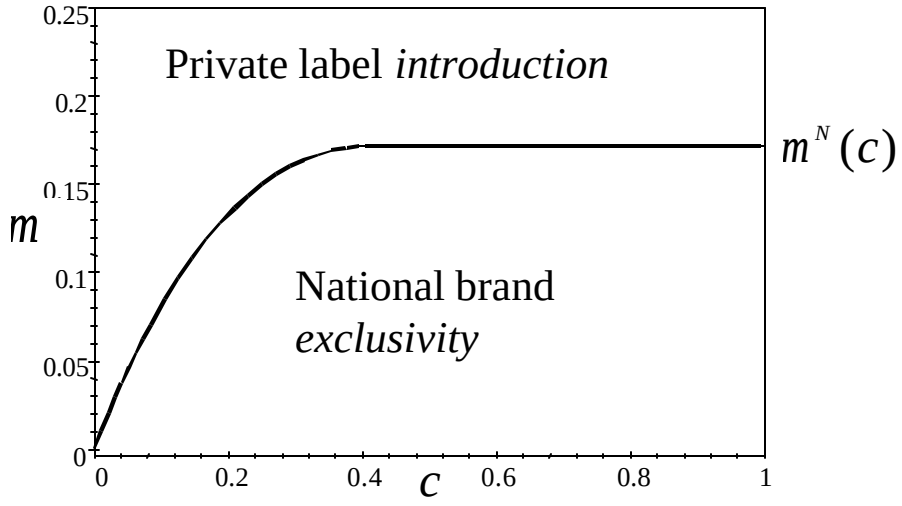

Figure 1: National brand exclusivity versus private label introduction

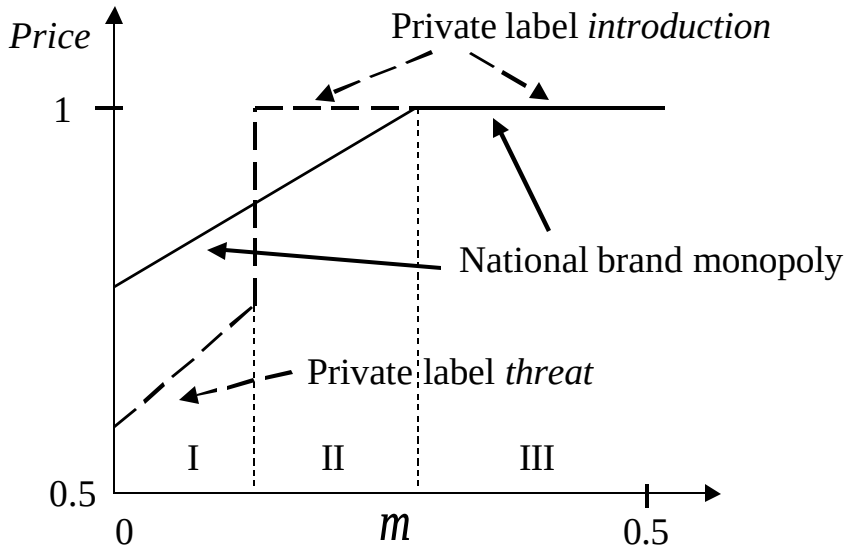

Figure 2: National brand retail price