

# WORKING PAPERS IN ECONOMICS

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No.02/12

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PRIVATE LABELS, RENT SHIFTING  
AND CONSUMER WELFARE.



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# Private Labels, Rent Shifting and Consumer Welfare\*

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October 31, 2011

## Abstract

This paper investigates a retailer's decision to introduce a private label and asks how the retailer's access to a private label may affect the pricing of substitute national brands. We consider a model with two vertically differentiated national brand manufacturers that negotiate sequentially with a monopolist retailer over two-part tariffs. We find that when the retailer decides to introduce a private label, this generates a price increase for one of the two national brands. Moreover, when we endogenise the order of negotiations, we find that i) the retailer's private label is always introduced, and ii) the private label always causes a price increase for the high-quality national brand only. In our model, this price increase does not occur due to a price discrimination effect, as in Gabrielsen and Sjørgard (2007) ["Private labels, price rivalry, and public policy", *European Economic Review*, (51), 403-424], but as a result of a rent-shifting effect. The welfare implications of private label introduction are discussed.

*JEL classifications:* L11, L12, L40, L42

*Keywords:* private labels, national brands, rent shifting, public policy

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\*I would like to thank Tommy Staahl Gabrielsen and Steinar Vagstad for their valuable comments. Comments by Gregory Corcos, Harald Nygård Bergh and other participants at the Fifth joint PhD Workshop in Economics (UiB-NHH) are gratefully acknowledged. Thanks also to Bruce Lyons and Greg Shaffer for helpful discussions and comments to a very early draft.

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# 1 Introduction

The market shares of retailer-owned brands, also called private labels, have grown tremendously in grocery industries all around the world during the last few decades. In Europe, the penetration of private labels has ranged from a modest 4 percent of the value sales in Greece, to an astonishing 45 percent in Switzerland, according to a 2005 study by ACNielsen. Typically, private labels are sold at lower prices than their national brand counterparts, which means that their volume shares are even higher.<sup>1</sup> Furthermore, there are strong variations in private label penetration across product categories, with generally higher shares in refrigerated food, paper, plastic and wraps, and frozen food (ACNielsen, 2005). Yet, the variation across categories also varies *across countries*.<sup>2</sup>

The recent growth in private labels, and the variation in penetration both across countries and across categories, raises important questions as to why and under which conditions retailers choose to introduce their own brands. Secondly, and more importantly, what are the welfare effects of private label development? Does private label introduction affect the pricing of national brands? Should we expect consumer welfare to be higher when private labels and national brands are close competitors or when they are more differentiated? The present article offers a theory to try to answer some of these questions.

Our paper contributes to a growing literature on private labels. This literature may be divided into several branches.<sup>3</sup> The papers perhaps closest to our work are the ones focusing on the welfare and price effects of private label introduction: A common view in this literature is that private labels benefit both retailers and consumers; they may be useful to retailers as a bargaining tool against manufacturers, and they may benefit consumers by offering more choice and lower prices.<sup>4</sup> The seminal paper in the literature is Mills (1995), which analyses the effects of private label introduction in a model with two firms; a national brand manufacturer and a monopolist retailer. Mills assumes that

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<sup>1</sup>On average the prices of private labels is 31% lower than their national brand counterparts, according to ACNielsen (2005).

<sup>2</sup>For some recent private label development trends, see Whelan's (2007, 2008) reports on the third and fourth annual symposia on retail competition, arranged by the Centre for Competition Law & Policy at the University of Oxford.

<sup>3</sup>Some papers analyse how the introduction of private labels affects the sharing of profits in the vertical structure (Narasimhan and Wilcox, 1998; Mills, 1999; Scott Morton and Zettelmeyer, 2004), or investigate the retailer's decision about where to locate its private label in the product space (Scott Morton and Zettelmeyer, 2004; Choi and Coughlan, 2006). Sometimes we see that national brand manufacturers supply their retailers with private labels, and some authors also investigate the rationale for this. See, e.g., Wu and Wang (2005) and Bergès-Sennou (2006).

<sup>4</sup>For a broader discussion regarding the welfare effects of private label introduction, see Dobson (1998), Bergès-Sennou et al. (2004) and Steiner (2004).

the manufacturer uses a linear wholesale contract, and he shows that when the retailer is selling a private label, the manufacturer is forced to reduce its wholesale price to compete against the retailer for in-store market shares. The private label therefore reduces the double marginalisation problem and improves consumer welfare. These welfare gains are larger the higher the quality of the retailer's private label.<sup>5</sup>

The view that private labels lead to lower retail prices and increased welfare has been challenged by several empirical investigations. In particular, some recent studies indicate that national brand manufacturers respond to private label introduction by increasing their prices.<sup>6</sup> Gabrielsen and Sørsgard (2007) extend Mills's model by assuming that there are two groups of consumers, "switchers" and "loyals", where the latter group is assumed to be loyal to the national brand. They also allow the national brand manufacturer to offer the retailer an exclusive dealing contract. Gabrielsen and Sørsgard find that private label introduction may cause an increase in the price of the national brand. This happens when the quality of the private label is high and when there is a sizeable number of loyal consumers; the national brand manufacturer then finds it more profitable to exploit its loyal consumers than to compete against the private label in the switching segment. They also find that the private label is not always introduced, since the national brand manufacturer may profitably induce exclusive dealing by offering the retailer a lower wholesale price in return for exclusivity when private label quality is low. The effects on consumer and total welfare are therefore mixed.<sup>7</sup>

In reality, there is often more than one national brand manufacturer in any particular product category. These manufacturers often supply brands of different (perceived) quality levels. Some empirical studies also suggest that different manufacturers respond differently to private label introduction, and that the price responses may vary with the

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<sup>5</sup>Bontemps et al. (1999) extends the model of Mills: They assume that marginal costs are increasing in quality, and allow the national brand to have a cost advantage over the private label at high quality levels. Unlike Mills, they find that the wholesale price of the national brand is a non-monotonic function of private label quality. The effect on consumer welfare is still positive, but because of the non-monotonic price response, the effect is stronger for intermediate quality levels of the private label.

<sup>6</sup>Putsis (1997) and Chintagunta et al. (2002) find that national brand manufacturers respond to the private label invasion by reducing their prices. On the other hand, Harris et al. (2002), Bonfrer and Chintagunta (2004), Gabrielsen et al. (2006), Bontemps et al. (2005), and Bontemps et al. (2008) all find that private labels may cause an increase in the prices of national brands.

<sup>7</sup>Note that Gabrielsen and Sørsgard's results rely on a particular demand function. Specifically, the result that private label introduction causes an increase in the price of the national brand, rests on the assumption that the demand from the loyal consumers is perfectly inelastic as long as the price of the national brand is below some reservation price. Furthermore, the result that private labels are not always introduced, rests on the assumption that the manufacturer use a linear contract; a two-part tariff would allow for total profit maximisation and would make exclusive dealing superfluous.

type of private label introduced (Gabrielsen et al., 2006; Bontemps et al., 2008). Because the national brand manufacturer is often assumed to be a monopolist, the current literature is unable to properly address this issue. Furthermore, we know that the contracts used between manufacturers and retailers may include both upfront payments and quantity discounts. Hence, the contracts are typically non-linear, in contrast to what is often assumed in the literature. We present a model that incorporates both of these features. We assume that a monopolist retailer negotiates terms of trade sequentially with two manufacturers of substitute brands, where one is a high-quality manufacturer and the other is a low-quality manufacturer. The retailer subsequently decides whether to introduce a private label.<sup>8</sup> Building on a model by Marx and Shaffer (1999), we show that private label introduction may cause a price increase for national brands through a rent-shifting effect. This result does not rely on a particular demand function; instead it rests on the assumption that the retailer negotiates sequentially with the national brand suppliers and that bilateral efficient two-part tariffs are used: When using non-linear tariffs, a retailer and a manufacturer (the first manufacturer) may want to use their contract as a rent-shifting device – to extract more surplus from a second manufacturer. For example, by offering the retailer a larger quantity discount, the first manufacturer is able to increase the retailer’s opportunity cost of buying from the second manufacturer (given that the two manufacturers are competitors). This forces the second manufacturer to give up more of its surplus in the negotiations with the retailer. The retailer and the first manufacturer are jointly better off as a result. When the discount from the first manufacturer comes with a reduction in the wholesale price, as when using a two-part tariff<sup>9</sup>, this also results in a reduction in the retail price of the first manufacturer’s brand, which, *ceteris paribus*, causes the consumers’ surplus to increase.

We show that when the retailer introduces a private label that is a substitute for the two manufacturers’ brands, this reduces the incentives of a manufacturer-retailer pair to use their contract as a rent-shifting device. Simply put, because access to a private label provides an efficient means for the retailer to extract rent from its manufacturers, it reduces the incentives to use supply contracts as a rent-shifting device, which is inefficient

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<sup>8</sup>We assume that the quality of the private label (exogenous) is inferior to the high-quality national brand. This assumption is not critical to our results. It simply serves to restrict the number of cases to consider. The assumption is, however, also supported empirically. Even though we have seen an increase in the development of private labels that are premium brands in their own right, the general perception is still that most private labels are inferior to or, at best, on a par with their high-quality national brand counterparts. This view is supported by ACNielsen (2005), which report that the prices of private labels are on average 31% lower than the prices of national brands.

<sup>9</sup>Combining a higher fixed fee with a wholesale price below cost.

(creates price distortions). Private label introduction therefore results in an increase in the retail price of the first manufacturer's brand in our model.

When negotiations occur sequentially, there may be an advantage for each manufacturer to move first at the contracting stage. Hence, there is an incentive for the manufacturers to try to influence the order of the negotiations. We therefore endogenise the contracting order by having the manufacturers compete for the first-mover rights. Manufacturers can do this by offering the retailer an upfront payment (a "negotiation fee" or a slotting allowance) in exchange for the right to move first at the contracting stage (Marx and Shaffer, 2001, 2008).<sup>10</sup> We show that when upfront payments are used, the retailer always chooses the contracting order that generates the highest overall profit, and the retailer's private label is always introduced in equilibrium. Moreover, in equilibrium it is always the price of the high-quality brand that is affected by the retailer's private label. The price response is also stronger the higher the quality of the private label. These results seem to be consistent with the findings in recent empirical studies on private labels.<sup>11</sup>

In our model, the effect of private label introduction on social welfare can be either positive or negative. If there are no price distortions, e.g. as in the case where the manufacturers negotiate simultaneously with the retailer, private label introduction always causes some consumers to switch products. If the private label is of lower quality, it may also attract new consumers with low willingness to pay. This implies that the private label contributes positively to consumers' surplus, *ceteris paribus*, as long as it is strictly differentiated from both national brands. When the manufacturers negotiate sequentially, however, this positive effect may be more than offset by the price increase for the high-quality brand. The price increase is larger when the retailer introduces a private label with a quality identical to either of the national brands, sometimes termed a "me-too" strategy in the literature. At the same time, when the private label simply mimics an existing brand, it is not adding any real value to consumers. The net effect on social

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<sup>10</sup>We know for example that in the Norwegian grocery sector, retailers often charge (non-refundable) negotiation fees. These are fees that manufacturers have to pay up front in exchange for the right to negotiate with the retailer. These fees may be used to deter less profitable manufacturers from approaching the retailer – which may be efficient in situations where retailers face many manufacturers and when retailers have imperfect information about the value of the manufacturers' brands. We make the point here that these fees, or any other fees that the manufacturers have to pay up front, such as for example slotting allowances, could be used to determine the order of negotiations in cases where there is a first-mover advantage for manufacturers.

<sup>11</sup>Gabrielsen et al. (2006) study the Norwegian market and find that highly distributed and ranked products are more influenced by private label introduction. They also find that more successful private labels, measured by private label market share, cause a stronger price response than less successful private labels. Similarly, Bontemps et al. (2008) find that private labels have less effect on the prices of second-tier brands than on the prices of the leading brand.

welfare is therefore negative when the private label is positioned close enough to either of the national brands. This contrasts with the common belief that consumers benefit the most when private labels and national brands compete vigorously.<sup>12</sup>

We also investigate what happens if upfront payments are not used. In this case the retailer does not always introduce the private label. The reason is the following: When the quality of the private label is sufficiently close to the first manufacturer's brand, then there is a trade-off for the manufacturer between i) setting the wholesale price high to accommodate the retailer's private label and ii) setting the wholesale price low, which may prevent private label introduction, but allows for more rent to be extracted from the second manufacturer. The retailer and the first manufacturer sometimes therefore find it profitable to choose rent-shifting over private label accommodation. This also implies that there is more private label introduction when the retailer's bargaining power against the manufacturers is high, since there is then less distortion to the first manufacturer's wholesale price in the first place. The latter result is interesting, since it suggests that factors commonly associated with buyer power, such as the use of upfront payments and the ability of retailers to dictate the terms of trade, yields more private label introduction.

In addition to the literature on private labels cited above, our paper is related to the literature that investigates the use of contracts to engage in rent shifting and opportunism, where the seminal paper is Aghion and Bolton (1987). See Marx and Shaffer (1999, 2001, 2008) for an introduction to this literature. We also offer some modifications to the results of Marx and Shaffer (1999): They show how below-cost pricing can be used by a manufacturer in an intermediate goods market as a means to extract rent from a competitor, without aiming to drive the rival out of the market. They term this "below-cost pricing without exclusion", or "predatory accommodation", since the manufacturer has an interest in the competitor staying active. We show that, when the retailer is selling a third substitute product (for example a private label), then "predatory accommodation" may lead to exclusion. In our model, it is the retailer's own brand that is excluded, but we conjecture that this may hold more generally – i.e., if the product is produced by an independent manufacturer with bargaining power.

The rest of the paper is organized as follows: Section 2 presents the model and the timing of the game. Section 3 solves the model and presents the main results. Section 5 provides some welfare results and discusses our main assumptions and possible extensions

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<sup>12</sup>See e.g. Steiner (2004). This view seems to rely on the assumption that retailers and manufacturers use linear tariffs: The retailer can then eliminate the problem of double marginalisation by positioning its private label close to the national brand. This benefits consumers, since they are able to buy a high-quality brand at a lower price.

to the model. Section 6 gives a conclusion.

## 2 The model

We consider a vertical structure where two vertically differentiated national brand manufacturers,  $h$  and  $l$ , negotiate terms of trade with a common retailer. Manufacturer  $h$  is assumed to be producing the higher quality brand. For simplicity we normalise the quality of the high-quality brand to one ( $s_h = 1$ ), and denote  $s_l \leq 1$  the quality of brand  $l$ .

In addition to selling the national brands, the retailer may choose to distribute a private label with the quality  $s_r \leq 1$ . The retailer's private label is assumed to be produced either by the retailer himself, through backwards integration, or by a fringe of competitive private label manufacturers, who in turn are selling the product to the retailer at the marginal cost of producing the good.<sup>13</sup> The quality of the retailer's brand is exogenous in the model, as are the qualities of the two national brands.

On the demand side, we assume that there is a continuum of consumers of different types, each buying only one unit and one product. The net utility of a consumer of type  $\theta$  buying product  $i$ , is

$$u(\theta, s_i) = \theta s_i - p_i, \quad (1)$$

where  $\theta \sim U[0, 1]$  is the consumer's "taste" for quality and  $p_i$  is the price of product  $i$ .<sup>14</sup> The consumers utility when not buying any of the products is normalised to zero. We assume that there is a unit mass of consumers.

From this we can denote by  $\theta_r^h = (p_h - p_r) / (1 - s_r)$  the consumer type indifferent between buying the private label or brand  $h$ , by  $\theta_r^l = (p_l - p_r) / (s_l - s_r)$  the type indifferent between the private label or brand  $l$ , and by  $\theta_l^h = (p_h - p_l) / (1 - s_l)$  the type indifferent between the the two branded products  $h$  and  $l$ . Finally, we denote by  $\theta_i^0 = s_i / p_i$  the type indifferent between buying product  $i$  or not buying any product. The resulting (direct)

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<sup>13</sup>The two assumptions are equivalent. The critical assumptions here are that the retailer is paying the marginal production cost per unit it sells of the private label, and that there is no fixed fee negotiated to obtain the private label. These are standard assumptions in the literature.

<sup>14</sup>This is the classic Mussa-Rosen (1978) utility function.



demand system is then:

$$\begin{aligned}
q_h &= \begin{cases} 1 - \theta_l^h & \text{if } s_l > s_r \\ 1 - \theta_r^h & \text{if } s_l \leq s_r \end{cases} \\
q_l &= \begin{cases} \theta_l^h - \theta_r^l & \text{if } s_l > s_r \\ \theta_r^l - \theta_l^0 & \text{if } s_l \leq s_r \end{cases} \\
q_r &= \begin{cases} \theta_r^l - \theta_r^0 & \text{if } s_l > s_r \\ \theta_r^h - \theta_r^l & \text{if } s_l \leq s_r \end{cases}
\end{aligned} \tag{2}$$

Inverting this demand system gives us the following indirect demand functions:

$$\begin{aligned}
p_h &= 1 - q_h - s_l q_l - s_r q_r \\
p_l &= \begin{cases} s_l (1 - q_l - q_h) - s_r q_r & \text{if } 0 \leq s_r \leq s_l \\ s_l (1 - q_l - q_r - q_h) & \text{if } 1 \geq s_r > s_l \end{cases} \\
p_r &= \begin{cases} s_r (1 - q_r - q_l - q_h) & \text{if } 0 \leq s_r \leq s_l \\ s_r (1 - q_r - q_h) - s_l q_l & \text{if } 1 \geq s_r > s_l \end{cases}
\end{aligned} \tag{3}$$

where simply  $q_i = 0$  if the retailer is not selling product  $i$ .

For each product  $i \in \{h, l, r\}$ , the marginal cost of production,  $c_i(s_i)$ , is assumed to be constant for the quantity produced, but increasing for the quality level  $s_i$  of the product. We are going to use the explicit function  $c_i = s_i^2/4$  when solving the model.<sup>15</sup>

**Timing of the game** To demonstrate that a retailer's private label may affect manufacturers' incentives to offer discounts to facilitate rent-shifting, we are going to assume that the retailer's negotiations with the national brand manufacturers occur sequentially. A feature of sequential negotiations is that the specific order may affect both the retailer's and the manufacturers' payoff when the manufacturers are asymmetric. At first, we endogenise the order by assuming that the retailer is able to capture some of the manufacturers' gains from moving first. The retailer can do this by making the manufacturers compete for the first-mover rights (Marx and Shaffer, 2001, 2008), or simply by charging a "negotiation fee" in exchange for the right to move first. In either case, the retailer

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<sup>15</sup>Most important, this cost function assures that it is efficient to sell all of the products. If marginal costs were independent of (or proportional to) the quality level, then, depending on relative marginal costs, sometimes only one of the products would be supplied. These are not very interesting cases. The function also guarantees that the high-quality national brand offers the highest stand-alone profit of the three products. We could have picked a slightly more general form, such as  $c_i = ks_i^2$ . However, as long as we assume that  $h$  is the more profitable product (which implies that  $k$  is not too high), the specific level of  $k$  does not matter qualitatively for the results.

collects an upfront fee from the manufacturer that has more to gain from being first to commit to a contract with the retailer.<sup>16</sup>

If upfront payments are not allowed, then the retailer is confined to pick the order that maximises his profit at the negotiation stage.<sup>17</sup> It turns out that this may affect both the equilibrium order of negotiations and the retailer's decision of whether to introduce its private label. We return to this issue in Section 3.1.

Our model has four-stages: At stage 0, the manufacturers make simultaneous offers,  $S_h$  and  $S_l$ , for the right to be first at the contracting stage (where  $S_h = S_l = 0$  if upfront payments are not used). The retailer accepts one of the offers. In the following, we let  $i \in h, l$  denote the winner at stage 0 – and let  $j \in h, l, j \neq i$  denote the loser. At stage 1, the retailer and manufacturer  $i$  negotiate a two part tariff  $T_i(q_i) = F_i + w_i q_i$ , where  $w_i$  is the wholesale price and  $F_i$  is a fixed fee paid to the manufacturer. This simple contract has the necessary ingredients to facilitate rent shifting, and also captures the defining feature of a simple quantity discount.

At stage 2, the retailer and manufacturer  $j$  negotiate a two-part tariff  $T_j(q_j)$ , before the retailer finally makes its quantity choices  $q = (q_h, q_l, q_r)$  at stage 3. Hence, the retailer's decision whether or not to sell the private label is delayed to the last stage.

We use the generalised Nash bargaining solution to determine the outcome of the negotiations at stage 1 and 2. When the parties use two-part tariffs, the Nash solution prescribes that the retailer and the manufacturer set the wholesale price so as to maximise their joint profit, and then use the fixed fee to divide their incremental gains from reaching an agreement. More specifically, the Nash solution dictates that the division of the surplus should be such that the retailer (supplier) receives its disagreement payoff, which is the amount it earns if not reaching an agreement, plus a share  $\lambda \in (0, 1)$  (and  $1 - \lambda$  to the supplier) of the total incremental gain from reaching an agreement, where  $\lambda$  is the level of the retailer's bargaining power.<sup>18</sup> We may also interpret  $\lambda$  as the level of the retailer's buyer power against the manufacturers.

To illustrate, let  $\Delta_r^i$  be the incremental gain to the retailer's flow profit when reaching

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<sup>16</sup>Marx and Shaffer (2001) argue that in this way we may view the widespread use of slotting allowances as another form of rent shifting, but from the manufacturers to the retailer.

<sup>17</sup>Marx and Shaffer (2007) study the optimal order of negotiations for a monopolist retailer negotiating with two differentiated manufacturers. They assume contracts that are sufficiently general to allow for total equilibrium profit maximisation. In contrast, we assume contracts that induce price/ quantity distortions in equilibrium. We also show how their results are slightly modified when the retailer has access to a private label.

<sup>18</sup>To reduce the number of cases to consider, we assume that both manufacturers have the same bargaining power against the retailer.

an agreement with manufacturer  $i$ , and let  $\Delta_i^r$  be the incremental gain to the manufacturer's flow profit. Then the Nash bargaining solution prescribes the following fixed fee:

$$F_i^* = \arg \max (\Delta_r^i - F_i)^\lambda (\Delta_i^r + F_i)^{1-\lambda}, \quad (4)$$

which we can solve for  $F_i$  to find

$$F_i^* = (1 - \lambda) \Delta_r^i - \lambda \Delta_i^r. \quad (5)$$

Taking  $w_i = w_i^*$  as given, the solution says that a share  $1 - \lambda$  of the gain to the retailer's flow profit should go to the manufacturer, and a share  $\lambda$  of the gain to the manufacturer's flow profit should go to the retailer – all through the fixed fee  $F_i^*$ .

We proceed by solving the game backwards, starting with stage 3.

### 3 Equilibrium analysis

**Stage 3** In the event that the negotiations with both  $h$  and  $l$  were successful, the retailer takes the contracts  $T_h(q_h)$  and  $T_l(q_l)$  as given, and chooses quantities  $q = (q_h, q_l, q_r)$  so as to maximize its profit. We let  $v^*$  denote the retailer's equilibrium flow profit (profit gross of fixed fees) when all products are sold:

$$\begin{aligned} v^* &= \max_q v(q_h, q_l, q_r) \\ &= \max_q \{ [p_h(q) - w_h] q_h + [p_l(q) - w_l] q_l + [p_r(q) - c_r] q_r \}, \end{aligned} \quad (6)$$

Let  $q^* = (q_h^*, q_l^*, q_r^*)$  be the quantities that maximise this program. In the same fashion, the retailer maximises

$$v_{-l}^* = \max_{q_h, q_r} v(q_h, q_r, 0), \quad (7)$$

if negotiations have failed with manufacturer  $l$ , and

$$v_{-h}^* = \max_{q_l, q_r} v(q_l, q_r, 0), \quad (8)$$

if negotiations have failed with manufacturer  $h$ . Let  $q_{-l}^h$  and  $q_{-l}^r$  be the quantities of  $h$  and  $r$  respectively that maximises (7), and let  $q_{-h}^l$  and  $q_{-h}^r$  be the quantities of  $l$  and  $r$  that maximizes (8). Finally, we have

$$v_r^* = \max_{q_r} v(q_r, 0, 0) \quad (9)$$

which is the retailer's profit if the negotiations have failed with both national brand manufacturers. Note that, depending on  $w_h$  and  $w_l$ , and the quality of the private label, we may get the corner solution  $q_r = 0$  (no private label introduction) from any of these maximisation problems – except in (9), which yields  $q_r > 0$  and  $v_r^* > 0$  as long as  $s_r > 0$ .

Given the demand system derived above, the retailer will adjust quantities so as to return the same prices  $p^* = (p_h^*, p_l^*, p_r^*)$  in all the subgames where the respective goods are sold, where

$$p_h^* = \frac{1 + w_h}{2}, \quad p_l^* = \frac{s_l + w_l}{2}, \quad p_r^* = \frac{s_r + c_r}{2} \quad (10)$$

As a point of reference, let  $p^M = (p_h^M, p_l^M, p_r^M)$  be the price schedule that maximises the profit of the fully integrated firm:

$$p_h^M = \frac{1 + c_h}{2}, \quad p_l^M = \frac{s_l + c_l}{2}, \quad p_r^M = \frac{s_r + c_r}{2}. \quad (11)$$

**Stage 2** At stage 2, the retailer and national brand manufacturer  $j \in h, l$  negotiates a two-part tariff  $T_j(q_j)$ , taking as given the retailer's and manufacturer  $i$ 's choice of contract at stage 1 and the retailer's equilibrium strategies at stage 3. The retailer and manufacturer  $j$  will choose  $w_j$  so as to maximise their joint profit, which, if the retailer succeeded in its negotiations with  $i$  at stage 1, is equal to

$$v^* + (w_j - c_j) q_j^* - F_i \quad (12)$$

Similarly, if the negotiations failed between the retailer and  $i$  at stage 1, the joint profit of  $r$  and  $j$  is equal to

$$v_{-i}^* + (w_j - c_j) q_{-i}^j \quad (13)$$

Maximising (12) and (13) with respect to  $w_j$ , and using the envelope theorem, gives the first-order conditions

$$\frac{\partial q_j^*}{\partial w_j} (w_j - c_j) = 0, \quad \frac{\partial q_{-i}^j}{\partial w_j} (w_j - c_j) = 0 \quad (14)$$

which says that the wholesale price  $w_j$  should be set equal to the manufacturer's marginal cost  $c_j$  in both subgames. This result is well known in the literature. Since  $F_i$  appears as a constant in the retailer's and manufacturer  $j$ 's maximisation problem at stage 2, they agree on the wholesale price  $w_j^* = c_j$  that maximises *total* channel profit and which makes the retailer the residual claimant to all sales of brand  $j$ .

Given  $w_j^* = c_j$ , the retailer and manufacturer  $j$  then divide the incremental gains from

trade according to the Nash solution (4), with a share  $\lambda \in (0, 1)$  going to the retailer, and a share  $1 - \lambda$  going to the supplier. In the event that the retailer succeeded in its negotiations with  $i$ , the incremental gains from trade between the retailer and  $j$  are simply  $v^* - v_{-j}^*$ . On the other hand, if there was disagreement between the retailer and  $i$  at stage 1, then the incremental gains from trade between the retailer and  $j$  are  $v_{-i}^* - v_r^*$ . This proves the following result.

**Lemma 1.** *If the retailer succeeds in its negotiations with manufacturer  $i \in h, l$  at stage 1, then we have  $w_j^* = c_j$  and  $F_j^* = (1 - \lambda)(v^* - v_{-j}^*)$  for the subgame equilibrium at stage 2. If the retailer fails in its negotiations with manufacturer  $i$  at stage 1, then we have  $w_{-i}^j = c_j$  and  $F_{-i}^j = (1 - \lambda)(v_{-i}^* - v_r^*)$  for the subgame equilibrium at stage 2.*

**Stage 1** At stage 1, the retailer and national brand manufacturer  $i \in h, l$ ,  $i \neq j$ , negotiate the two-part tariff  $T_i(q_i)$ , taking as given the retailer's and manufacturer  $j$ 's equilibrium strategies at stages 2 and 3. Similar to the case at stage 2, the object of the retailer and manufacturer  $i$  is first to agree on the wholesale price  $w_i$  that maximises their joint profit. After substituting in the fixed fee  $F_j^*$  (Lemma 1), we can write the joint profit of the retailer and manufacturer  $i$  as

$$\Pi_{r-i} = v^* + (w_i - c_i) q_i^* - \underbrace{(1 - \lambda)(v^* - v_{-j}^*)}_{F_j^*} \quad (15)$$

If the negotiations between the retailer and  $i$  should fail, then, according to Lemma 1, the retailer's profit will be equal to  $v_{-i}^* - F_{-i}^j = \lambda v_{-i}^* + (1 - \lambda)v_r^*$ , and manufacturer  $i$ 's profit is zero.<sup>19</sup> The incremental gain from trade between the retailer and manufacturer  $i$  is therefore

$$\begin{aligned} v^* - F_j^* - (v_{-i}^* - F_{-i}^j) + (w_i - c_i) q_i^* \\ = \lambda(v^* - v_{-i}^*) + (1 - \lambda)(v_{-j}^* - v_r^*) + (w_i - c_i) q_i^*. \end{aligned} \quad (16)$$

According to the Nash solution (4), we then get the following fixed fee in equilibrium.

$$F_i^* = (1 - \lambda) [\lambda(v^* - v_{-i}^*) + (1 - \lambda)(v_{-j}^* - v_r^*)] - \lambda(w_i^* - c_i) q_i^*. \quad (17)$$

Maximising (15) with respect to  $w_i$ , and applying the envelope theorem, gives the following

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<sup>19</sup>Here we do not consider the upfront payment  $S_i$  paid at stage 0. Since this payment is already "sunk", it should not affect maximisation at stages 1-3. It can therefore be safely ignored.

first-order condition for joint profit maximisation:

$$\frac{\partial q_i^*}{\partial w_i} (w_i - c_i) = (1 - \lambda) (q_{-j}^i - q_i^*) \geq 0 \quad (18)$$

The right-hand side of eq. (18) is the strategic rent-shifting effect identified by Marx and Shaffer (1999). By distorting the unit price  $w_i$ , there is a potential for the parties to affect the fixed fee paid to manufacturer  $j$  at stage 2. The condition states that, when considering a reduction in the wholesale price,  $w_i < c_i$ , the manufacturer and the retailer should balance the gain that comes from reducing the second manufacturer's fixed fee  $F_j^*$  (the right-hand side) against the loss to the total profits that comes from selling brand  $i$  at a price  $p_i < p_i^M$  (the left-hand side). The loss to total profits is higher, the higher  $|\partial q_i^* / \partial w_i|$  is. Which means that, ceteris paribus, below-cost wholesale pricing is more costly when manufacturer  $i$  faces more interbrand competition. More interbrand competition means that any reduction in the wholesale price of brand  $i$  will cause a larger increase in the number of units that the manufacturer has to sell below cost.

However, some substitution between the two national brands is necessary for there to be any gain from below-cost pricing. This is reflected in the right-hand side of eq. (18): A marginal reduction in the wholesale price  $w_i$  increases the retailer's disagreement payoff at stage 2 by  $q_{-j}^i > 0$ , and hence strengthens the retailers position when negotiating with manufacturer  $j$ . This effect calls for a reduction in the fixed fee  $F_j^*$ . At the same time, a marginal reduction in  $w_i$  increases the retailer's joint profit with  $j$  by  $q_i^* > 0$ , which calls for an increase in  $F_j^*$ . As long as the two national brands are direct substitutes, the first effect dominates, and we get  $q_{-j}^i - q_i^* > 0$ . In this case the manufacturer's wholesale price should be below the manufacturer's marginal cost,  $w_i^* < c_i$ .

Note that, for below-cost wholesale pricing to arise in equilibrium, manufacturer  $j$  also has to possess some degree of bargaining power against the retailer, i.e.  $\lambda < 1$ , which we have assumed; if not, then there is no surplus rent for the retailer and manufacturer  $i$  to extract from manufacturer  $j$ ; when  $\lambda = 1$ , the retailer extracts all of manufacturer  $j$ 's surplus, irrespective of the level of the wholesale price  $w_i$ .

From eq. (18), it is easy to analyse how private label sales affect the incentives for below-cost pricing. Suppose that the retailer negotiates with manufacturer  $h$  first ( $i = h$ ). If we solve eq. (18) for  $w_h$ , we then obtain

$$\bar{w}_h = \begin{cases} \frac{1}{4} - \frac{(1 - \lambda)(s_l - s_r)(1 - s_l)(1 - s_r)}{4(1 - s_r + (1 - \lambda)(s_l - s_r))} & \text{if } s_r < s_l \\ c_h & \text{if } s_r \geq s_l \end{cases}, \quad (19)$$

where we have both  $\bar{w}_h < c_h$  and  $\partial\bar{w}_h/\partial s_r > 0$  as long as  $s_r < s_l$ . Note that  $\bar{w}_h$  is the optimal wholesale price only as long as private label introduction is optimal at stage 3 ( $q_r > 0$ ). In this case, the private label softens the effect that a reduction in  $w_h$  has on the retailer's disagreement profit with manufacturer  $l$ . This is reflected in  $(1 - \lambda)(q_{-l}^h - q_h^*)$ , which is falling in  $s_r$  up to  $s_r = s_l$  and zero for  $s_r \geq s_l$ : When  $s_r < s_l$ , a lower wholesale price  $w_h$  increases the sales  $q_h^*$  of brand  $h$ , which is positive. But an increase in  $q_h^*$  also cannibalises some of the retailer's (out-of-equilibrium) private label sales,  $q_{-l}^r$ , and this dampens the overall positive effect for the retailer of obtaining a lower  $w_h$ . The equilibrium wholesale price is therefore higher if it is optimal for the retailer to introduce the private label. When  $s_r > s_l$ , private label introduction breaks the substitution between  $h$  and  $l$ , and hence eliminates the strategic rent-shifting effect all together.<sup>20</sup> We therefore get  $w_h = c_h$  in this case.

Similarly, if the retailer negotiates with manufacturer  $l$  first, we can solve eq. (18) to obtain the optimal  $w_l$ , again given that private label introduction is profitable at stage 3:

$$\bar{w}_l = \begin{cases} \frac{s_l^2}{4} - \frac{(1 - \lambda)(s_l - s_r)(3 - s_l)(1 - s_l)}{4(1 - s_r + (1 - \lambda)(s_l - s_r))} & \text{if } s_r < s_l \\ c_l & \text{if } s_r \geq s_l \end{cases}, \quad (20)$$

where  $\bar{w}_l < c_l$  and  $\partial\bar{w}_l/\partial s_r \geq 0$  if  $s_r < s_l$ . In the same way as when manufacturer  $h$  negotiates first, we have a situation where the private label breaks the substitution between  $h$  and  $l$  when  $s_r > s_l$ , and we therefore get  $\bar{w}_l = c_l$  in this case.<sup>21</sup>

Furthermore, let  $\underline{w}_i$  denote the optimal wholesale price on brand  $i \in h, l$  when  $q_r = 0$  (or  $s_r = 0$ ), where

$$\underline{w}_h = \frac{1}{4} - \frac{(1 - \lambda)(1 - s_l)s_l}{4(1 + (1 - \lambda)s_l)}, \quad \underline{w}_l = \frac{s_l^2}{4} - \frac{(1 - \lambda)(3 - s_l)(1 - s_l)s_l}{4(1 + (1 - \lambda)s_l)} \quad (21)$$

We can see that both  $\underline{w}_h < \bar{w}_h$  and  $\underline{w}_l \leq \bar{w}_l$ .<sup>22</sup> Since the optimal wholesale price is (weakly)

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<sup>20</sup>This is a result of the Mussa-Rosen utility and demand specification, where products are only vertically differentiated (no horizontal differentiation). With some horizontal differentiation between the products as well, there could still be *some* substitution between products  $h$  and  $l$  even when  $s_l < s_r < 1$ .

<sup>21</sup>When the retailer negotiates with manufacturer  $l$  first, the private label does not affect the strategic rent-shifting effect  $(1 - \lambda)(q_{-h}^l - q_l^*)$  as long as  $s_r < s_l$ , unlike the situation when negotiating with manufacturer  $h$  first. The reason is the fact that the private label and brand  $h$  are not direct substitutes. Instead the effect of private label introduction works through  $\partial q_l^*/\partial w_l$ : Private label introduction implies that manufacturer  $l$  faces more interbrand competition, since the private label and brand  $l$  are competing for the same consumers. It is therefore more costly for manufacturer  $l$  to offer a low wholesale price when the retailer is also selling a private label.

<sup>22</sup>Notice in (21) that we have  $\underline{w}_l < 0$  for certain parameter values. If one wishes to rule out negative

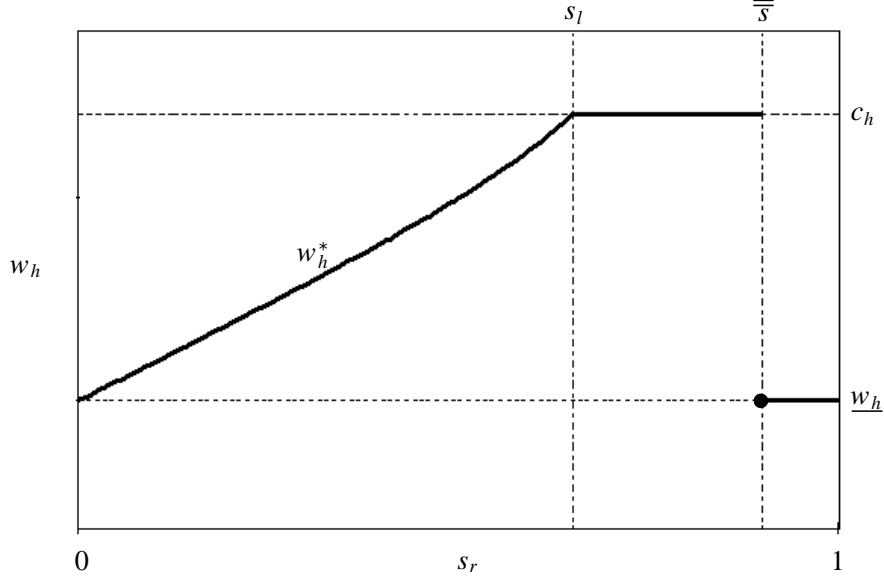


Figure 1: The optimal wholesale price  $w_h^*$  when the retailer negotiates with the high-quality manufacturer first.

higher when the private label is sold, there may also be a trade-off for the retailer and the manufacturer at stage 1 between i) accommodating for private label introduction and ii) shifting rent from the second manufacturer: A higher wholesale price may cause an increase in the fixed fee that the retailer has to pay to manufacturer  $j$ . In this case, actual private label introduction (as opposed to using the private label as a mere threat) comes at a cost. This cost is higher the more  $w_i$  increases under private label introduction, i.e. the larger is the difference  $\bar{w}_i - \underline{w}_i \geq 0$ . The real trade-off appears when the private label is located close to manufacturer  $i$ 's brand. To see this, take the extreme case when  $s_r = s_i$ . If manufacturer  $i$  and the retailer wants to accommodate the private label, they have to set  $w_i = \bar{w}_i = c_i$ . Any lower wholesale price yields  $q_r = 0$  at stage 3. However, when  $w_i = c_i$ , consumers are indifferent between buying the private label or brand  $i$ , and hence the retailer is also indifferent between setting  $q_r > 0$  and  $q_r = 0$ . Furthermore, if  $q_r = 0$ , we know that  $w_i = c_i$  is not optimal, since manufacturer  $i$  and the retailer can then agree to set  $w_i = \underline{w}_i < c_i$  to shift rent from manufacturer  $j$ . Hence, private label introduction can not be profitable in this case.

Of course, private label introduction is always optimal as long as  $q_r^*(\underline{w}_i) > 0$ , in which case  $w_i = \bar{w}_i$  is the optimal wholesale price. We also have  $\partial q_r^*(\underline{w}_i) / \partial s_r < 0$  when  $s_r < s_l$ ,

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wholesale prices, then one could put a lower bound on  $s_l$  and/ or  $\lambda$ . Otherwise, one would have to study corner solutions, i.e. where  $w_l = 0$ .



and  $\partial q_r^*(w_l)/\partial s_r > 0$  and  $\partial q_r^*(w_h)/\partial s_r < 0$  when  $s_r > s_l$ . This implies that when the private label and manufacturer  $i$ 's brand are *weaker* substitutes, there is also a higher chance that private label introduction is optimal. The discussion above is summarized in the following lemmas.

**Lemma 2.** *Our subgame equilibrium at stage 1 has  $w_i^* \leq c_i$ , where  $w_i^* = \bar{w}_i \leq c_i$  whenever private label accommodation is jointly optimal for the retailer and manufacturer  $i$  at stage 1, and  $w_i^* = \underline{w}_i < c_i$  otherwise, where  $\bar{w}_i \geq \underline{w}_i$ . It is a necessary condition for private label introduction that the retailer's private label is sufficiently differentiated from the first manufacturer's brand, i.e.  $|s_r - s_i| > 0$ .*

Proof. See appendix.

**Lemma 3.** There exist thresholds  $\underline{s}$ ,  $\bar{s}$  and  $\bar{\bar{s}}$  satisfying  $\underline{s} < s_l < \bar{s} < \bar{\bar{s}} < 1$  such that the private label is always introduced if  $s_r < \underline{s}$  or  $\bar{s} < s_r < \bar{\bar{s}}$ . *Furthermore:*

- *If  $\underline{s} \leq s_r \leq \bar{s}$ , the private label is introduced only when the retailer negotiates with manufacturer  $h$  first.*
- *If  $\bar{\bar{s}} \leq s_r \leq 1$ , the private label is introduced only when the retailer negotiates with manufacturer  $l$  first.*

Proof. See appendix.

Lemmas 2-3 are illustrated in Figure 1 for the case when  $h$  moves first, and in Figure 2 for the case when  $l$  moves first. Our results show that when it is jointly optimal for the retailer and the first manufacturer to introduce the private label, then the manufacturer will accommodate for private label introduction by offering a higher wholesale price  $w_i = \bar{w}_i$ . We can see from Figure 1 and 2 that private label introduction is profitable only when the private label is sufficiently differentiated from the first manufacturer's brand.<sup>23</sup>

**Stage 0** At stage 0, the manufacturers offer the retailer upfront payments,  $S_h$  and  $S_l$ , to compete for the right to move first at the contracting stage. Let  $\pi_i^1 - S_i$  and  $\pi_j^2$  be the profit of the manufacturer moving first and second at the contracting stage, respectively, where  $\pi_i^1 = F_i^* + (w_i^* - c_i)q_i^*$  and  $\pi_j^2 = F_j^*$ . We let  $\omega_h$  and  $\omega_l$  denote the manufacturer's

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<sup>23</sup>In Lemma 3, we have assumed a tie-breaking rule where, if the retailer and the first manufacturer are indifferent between  $w_i = \bar{w}_i$  and  $w_i = \underline{w}_i$ , then they set  $w_i = \underline{w}_i$  (i.e., no private label accommodation in this case).

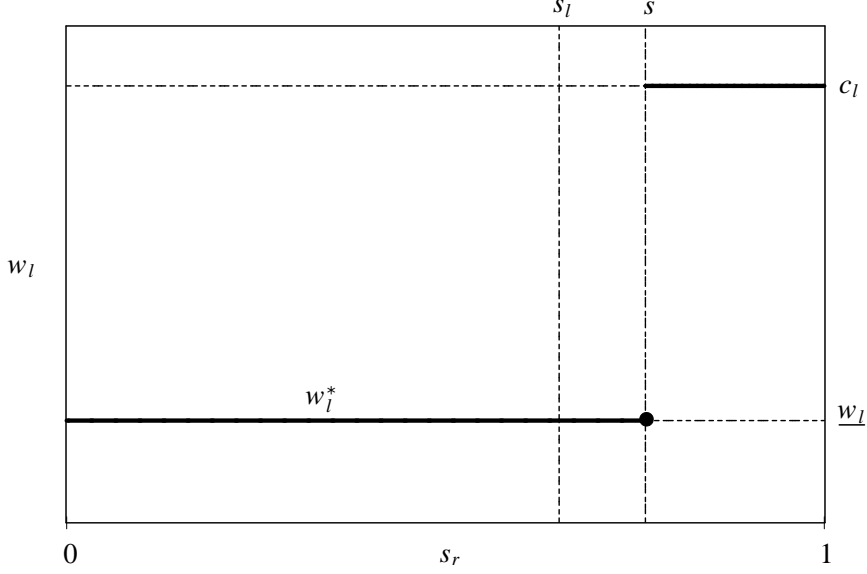


Figure 2: The optimal wholesale price  $w_l^*$  when the retailer negotiates with the low-quality manufacturer first.

willingness-to-pay for the first-mover right:  $\omega_h = \pi_h^1 - \pi_h^2$  and  $\omega_l = \pi_l^1 - \pi_l^2$ , where  $\omega_h > 0$  and  $\omega_l > 0$  as long as  $s_r \notin (\bar{s}, \bar{s})$ .<sup>24</sup> We can then write the retailer's profit as

$$\pi_r = \Pi^h + S_h - \pi_h^1 - \pi_l^2 \quad (22)$$

when accepting  $h$ 's offer  $S_h$ , and

$$\pi_r = \Pi^l + S_l - \pi_h^2 - \pi_l^1 \quad (23)$$

when accepting  $l$ 's offer  $S_l$ , where  $\Pi^i = \Pi(w_i^*, c_j)$  is the total industry profit when manufacturer  $i \in h, l$  moves first. In equilibrium, manufacturer  $j$ , whose offer is rejected by the retailer at stage 0, always offers its full willingness to pay for the first-mover rights:  $S_j^* = \pi_j^1 - \pi_j^2$ . Whereas manufacturer  $i$ , whose offer is accepted, offers *at most* its willingness to pay:  $S_i \in [0, \pi_i^1 - \pi_i^2]$ . The following condition then has to hold for the retailer to accept manufacturer  $i$ 's offer.

$$\Pi^i + S_i - \pi_i^1 - \pi_j^2 \geq \Pi^j + S_j^* - \pi_i^2 - \pi_j^1 \iff S_i \geq \omega_i - (\Pi^i - \Pi^j) \equiv S_i^* \quad (24)$$

<sup>24</sup>It is easy to verify that  $\omega_h = \omega_l = 0$  when  $s_r \in (\bar{s}, \bar{s})$ . From Lemma 2 and Assumption 1, we then have  $w_h = c_h$  and  $w_l = c_l$  in equilibrium (i.e., no distortions to prices), irrespective of the order of negotiations.

If we assume a tie-breaking rule, then the best thing manufacturer  $i$  can do, and still obtain the first-mover right, is to adjust its offer  $S_i$  so that the condition holds with equality. Since the manufacturer is not willing to offer more than  $\omega_i$ , manufacturer  $i$  can win the right to negotiate first if and only if  $\Pi^i \geq \Pi^j$  – i.e., only as long as the overall profit is (weakly) higher when  $i$  moves first. This partially proves the following result.

**Lemma 4.** *The following three cases depict the equilibrium at stage 0.*

- $s_r \leq \bar{s}$ . *The manufacturers make the offers  $S_h^* = \omega_h - (\Pi^h - \Pi^l)$  and  $S_l^* = \omega_l$ . The retailer accepts the offer  $S_h^*$  to negotiate with  $h$  first, and earns the profit  $\pi_r = \Pi^l - \pi_h^2 - \pi_l^2$  in equilibrium.*
- $\bar{s} < s_r < \bar{\bar{s}}$ . *The manufacturers make the offers  $S_h^* = S_l^* = 0$ . The retailer may accept either offer and earns the profit  $\pi_r = \Pi(c_h, c_l) - \pi_h^2 - \pi_l^2$  in equilibrium.*
- $s_r \geq \bar{\bar{s}}$ . *The manufacturers make the offers  $S_h^* = \omega_h$  and  $S_l^* = \omega_l - (\Pi^l - \Pi^h)$ . The retailer accepts the offer  $S_l^*$  to negotiate with  $l$  first, and earns the profit  $\pi_r = \Pi^h - \pi_h^2 - \pi_l^2$  in equilibrium.*

Proof. The subcase  $s_l \leq s_r \leq 1$  follows from the fact that the industry profit is maximised for wholesale prices equal to marginal costs, i.e.  $\Pi(c_h, c_l) > \Pi(w_i, c_j)$  for all  $w_i \neq c_i$  and  $i \neq j \in h, l$ . The subcase  $s_r < s_l$  can be proved by showing that  $\Pi(\bar{w}_h, c_l) > \Pi(c_h, \bar{w}_l)$ . (See the appendix for this last case).

Lemmas 2-4 provide us with our key result:

**Proposition 1.** *When the national brand manufacturers offer the retailer upfront payments, the retailer's private label is always introduced in equilibrium. Only the price of the high-quality national brand is affected by the retailer's private label. We have two regimes:*

- *If  $s_r < s_l$ , then  $p_l^* = p_l^M$  and  $p_h^* < p_h^M$ , where  $\partial p_h^*/\partial s_r \geq 0$ . Furthermore:  $\lim_{s_l \rightarrow 1} \partial p_h^*/\partial s_r = 0$  and  $\lim_{s_l \rightarrow s_r} \partial p_h^*/\partial s_r = \frac{1}{8}(1 - \lambda)(1 - s_r)$ .*
- *If  $s_r \geq s_l$ , then  $p_l^* = p_l^M$  and  $p_h^* = p_h^M$ .*

When the manufacturers are able to offer the retailer upfront payments for the right to negotiate first, then the retailer chooses the order that generates the highest overall profit. This implies that the retailers private label is always introduced in equilibrium, since the industry profit is maximised when all products are sold. When  $s_r < s_l$ , total

profit is maximised by negotiating with the high-quality manufacturer first, and we have  $p_h^* < p_h^M$  and  $p_l^* = p_l^M$ . When  $s_r \geq s_l$ , the retailer's private label breaks the rivalry between the two national brands and there are no incentives to distort prices to shift rent. We therefore have  $p_h^* = p_h^M$  and  $p_l^* = p_l^M$  in this case. Our result also shows that the relative "success" of the high-quality brand matters: As the two national brands become closer (weaker) substitutes, the effect of the private label becomes smaller (stronger).

### 3.1 Role of upfront payments in facilitating private label introduction

The result above fits in well with some of the existing empirical evidence on private labels' impact on national brand prices.<sup>25</sup> However, our results also seem to suggest that all types of private labels will be introduced in equilibrium, and that private label penetration therefore should not depend on factors such as the degree of differentiation between national brands, or on the ability of the retailer to dictate the contract terms (buyer power). This stands in contrast to the real-life observation that private label penetration varies considerably both between and within stores (across product lines).<sup>26</sup>

At the same time, we know that the use of upfront payments, for example slotting allowances, varies between product categories. Given our results, it is therefore natural to ask what is the role of upfront payments in facilitating private label introduction in our model?<sup>27</sup> To answer this, we now assume that upfront payments are not used. This has the immediate consequence of limiting the retailer's ability to extract rent from its manufacturers. Without upfront payments ( $S_h = S_l = 0$ ), the retailer's profit when

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<sup>25</sup>Bontemps et al. (2008) present evidence that retailer owned brands have caused an increase in the prices of national brands in France – and that the effect is considerably stronger for leading national brands than for secondary brands. Similar evidence from the Norwegian market is presented in an unpublished paper by Gabrielsen et al. (2006). Current theories of private labels usually assume a bilateral monopoly with one national brand manufacturer and are therefore unable to address this issue.

<sup>26</sup>This may of course in part be due to fixed costs in product development, and differences in marginal production costs between private labels and national brands. Also, it is likely that i) the size of retail chains (how many markets they operate in) and ii) the intensity of competition in local retail markets, both affect the profitability of private label development for the retailers. These are factors that we have ignored in our model.

<sup>27</sup>Questions have been raised by commentators about the role of slotting allowances in either decreasing or promoting the penetration of private labels in the retail grocery industry. See for example the note made by Jeffrey Schmidt, former Director of the Bureau of Competition at the Federal Trade Commission: "United States competition law policy – the private label experience", in the Report on the fourth annual Symposium on Retail Competition held in Oxford in May 2008

negotiating with manufacturer  $i$  first, is

$$\pi_r = \Pi^i - \pi_i^1 - \pi_j^2, \quad (25)$$

which is optimal for the retailer only as long as

$$\Pi^i - \pi_i^1 - \pi_j^2 \geq \Pi^j - \pi_j^1 - \pi_i^2 \iff \omega_j \geq \omega_i - (\Pi^i - \Pi^j) \equiv S_i^*. \quad (26)$$

This condition is the opposite of condition (24) that we found for the case when upfront payments are used. This means that the retailer now chooses the order that generates the smallest industry profit in equilibrium. This proves the following result.

**Lemma 5.** *If upfront payments are not used ( $S_h = S_l = 0$ ), then the retailer has strict preferences over the order of negotiations as long as  $s_r \leq \bar{s}$  or  $s_r \geq \bar{\bar{s}}$ . The following three cases then covers the retailer's optimal choice at stage 0.*

- *The retailer negotiates with manufacturer  $l$  first if  $s_r \leq \bar{s}$ .*
- *The retailer is indifferent between the order of negotiations when  $\bar{s} < s_r < \bar{\bar{s}}$ .*
- *The retailer negotiates with manufacturer  $h$  first if  $s_r \geq \bar{\bar{s}}$ .*

Lemma 5 shows that, in the absence of upfront offers from the manufacturers, the retailer has strict preferences for the order of negotiations as long as either manufacturer has strict incentives to engage in rent-shifting at the contracting stage – which, according to Lemmas 2-3, happens when  $s_r \leq \bar{s}$  and  $s_r \geq \bar{\bar{s}}$ . Our result is similar to the result reported in Marx and Shaffer (2007). In a model without upfront payments, they find that a buyer does best by negotiating with its "weakest" manufacturer first, which allows him to extract more rent from the "stronger" manufacturer at the next stage. They also show that if the two manufacturers have equal bargaining powers, as in our model, then the stronger manufacturer is simply the one offering the highest stand-alone profit.

Our result is similar, but somewhat modified: The retailer in our model has access to a private label, and the "strength" of a manufacturer is therefore partially determined by the quality gap between the manufacturer's brand and the retailer's private label.<sup>28</sup> Hence, the retailer may consider manufacturer  $h$  to be the "weaker" one when

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<sup>28</sup>Another difference from our model, is the fact that, in Marx and Shaffer (2007), the contracts between the retailer and the manufacturers are assumed to be sufficiently general to allow for maximisation of total profits and complete extraction of the second manufacturer's rent, which implies that prices are not distorted in equilibrium.

the quality-gap between brand  $h$  and the retailer's private label is small ( $s_r \geq \bar{s}$ ), even if manufacturer  $l$  offers a strictly lower stand-alone profit (as per assumption). Hence, it is the manufacturers' *contributions* to the total profit that determines the retailer's preferences, not their stand-alone profits.

Our second key result follows from Lemmas 2-3 and 5.

**Proposition 2.** *When upfront payments are not used ( $S_h = S_l = 0$ ), the private label is introduced only when  $s_r < \underline{s}$  or  $\bar{s} < s_r < \bar{\bar{s}}$ . It then follows that there is more private label introduction when the retailer has high bargaining power ( $\lambda \rightarrow 1$ ) and when the degree of differentiation between national brands is small ( $s_l \rightarrow 1$ ).*

Proof. It follows from the proof of Lemmas 2-3 that there is more private label introduction when  $\lambda \rightarrow 1$  and  $s_l \rightarrow 1$  (see the appendix).

Propositions 1 and 2 suggest that upfront payments to the retailer are key in facilitating private label introduction.<sup>29</sup> When upfront payments are not used, manufacturers are unable to induce the retailer to pick the order that maximises overall profits. Instead, the retailer strategically picks the order that gives him a larger share of a (sometimes) strictly smaller total profit. This may result in the retailer choosing rent-shifting over private label accommodation, and using the private label as a mere threat. In this case there will be more private label introduction when the retailer's bargaining power is high ( $\lambda \rightarrow 1$ ), and/ or when the degree of differentiation between national brands is small. The reason for this is the fact that the wholesale prices are less distorted when the retailer has more bargaining power and when the degree of differentiation between national brands is small (see (19)-(21)). Ceteris paribus, less distortion to wholesale prices leaves more room for private label introduction.

## 4 Discussion and welfare analysis

The competition for rent that is created under sequential bargaining over non-linear contracts helps to alleviate some of the efficiency loss of the retailer's monopoly power. In

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<sup>29</sup>Sudhir and Rao (2006) find that the number of private labels is higher in categories with slotting allowances than in categories where such fees are not used. They interpret this as evidence for the hypothesis that slotting allowances arise as means for the efficient allocation of scarce shelf space (Sullivan, 1997). If the retailer's access to private labels increases, then this would certainly increase the scarcity of the retailer's shelf space, ceteris paribus, and slotting allowances could arise as a result. However, this does not explain why there are more private labels in these categories in the first place. Given our results, we may conjecture that there is a two-way causality.

our model the retail price of the high-quality brand is always below the monopoly price,  $p_h(\underline{w}_h) < p_h^M$ , as long as the private label is not introduced, whereas the price of the low-quality brand is  $p_l(c_l) = p_l^M$  (assuming upfront payments are used). Hence, since private label introduction also causes an increase in the price of the high-quality brand,  $p_h^M \geq p_h(\overline{w}_h) > p_h(\underline{w}_h)$ , consumers' surplus may go either up or down. Producers' surplus (total industry profit) always increases as a result of private label introduction.<sup>30</sup> Total welfare may therefore go either way. However, it is easy to show that when there is only a small degree of differentiation between the private label and either national brand ( $s_r \rightarrow s_l$  or  $s_r \rightarrow 1$ ), then both the consumers' surplus and total welfare decreases as a result of private label introduction. The reason is the fact that, when the private label "mimics" either national brand, private label introduction causes a larger increase in the price of the high-quality brand (monopoly pricing is restored), without adding any real choice to the consumer. We have the following result:

**Proposition 3.** *A ban on private labels may increase consumers' surplus, but only when the quality of the private label is sufficiently close to the quality of either national brand. Moreover, a ban on private labels always increases social welfare when either  $s_r = s_l$  or  $s_r = 1$ .*

Proof. See appendix.

Proposition 3 stands in contrast to the common belief that consumer (and social) welfare improves when private labels and national brands compete vigorously. The key to our result is the fact that we allow the retailer and the manufacturers to use two-part tariffs: When only linear tariffs are allowed, competition between national brands and private labels reduces the problem of double marginalisation and causes a reduction in the prices of national brands. Consumer welfare may increase as a result, because, even though there is less variety (less differentiation), the consumers are able to buy high quality products at lower prices.<sup>31</sup> This is not the case in our model. When we allow for two-part tariffs, strong competition between private labels and national brands causes both an increase in prices and less choice for the consumer – and both contributes to a reduction in consumer surplus.

Figure 3 and 4 give an illustration of the potential loss in consumer surplus from private label introduction for the case  $s_r = s_l$  or  $s_r = 1$  (Figure 3) and the case  $s_r \leq s_l$

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<sup>30</sup>With a private label, there is a new product, which contributes positively to industry profits ceteris paribus, and less distortion to prices, which also increases industry profits.

<sup>31</sup>Note that with the Mussa-Rosen utility function, consumers' and total welfare depend not only on total output, but also on the quality level of each product.

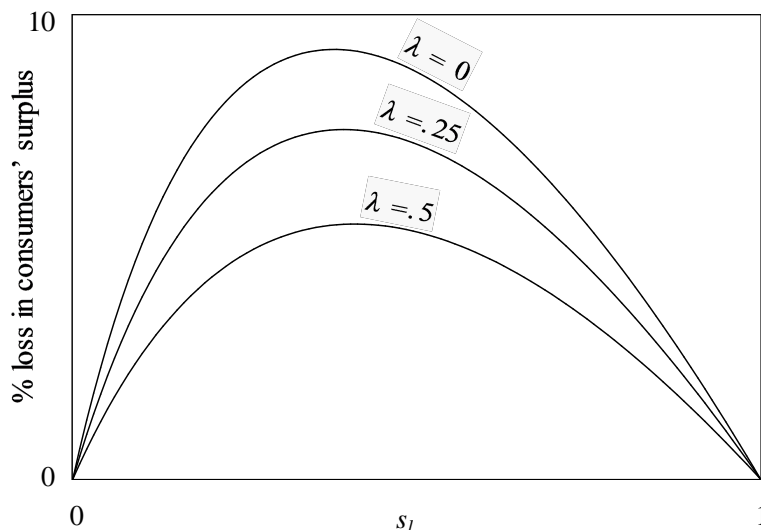


Figure 3: The percentage loss in consumer surplus plotted against  $s_l$ , when either  $s_r = s_l$  or  $s_r = 1$ .

(Figure 4). We can see that the loss in consumer surplus varies greatly, both with the degree of differentiation between national brands, with the degree of retailer bargaining power, and with the degree of differentiation between the private label and the low-quality national brand.<sup>32</sup>

We now give a brief discussions of the robustness of our results. Since our theory builds on Marx and Shaffer (1999), our model is also subject to the same criticism: First and foremost, for any of our results to go through, we need the retailer to negotiate sequentially with the manufacturers. With simultaneous bargaining, the equilibrium yields (efficient) marginal cost wholesale pricing both before and after private label introduction.<sup>33</sup> However, it can be shown that, if given the choice, the retailer strictly prefers sequential contracting (with upfront payments) over simultaneous contracting. Furthermore, we know that each manufacturer (weakly) prefers to commit to a contract *before* its rival. Sequential contracting could therefore very well arise endogenously.

We also require the second manufacturer to know the outcome of the negotiations at

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<sup>32</sup>The effect on consumer surplus is restricted in our model, due to the assumption that there is only vertical differentiation between products (no horizontal differentiation). With both vertical and horizontal differentiation between products, we would be able to increase the market share of the low-quality national brand (more quality) without affecting the intensity of competition (by adding more horizontal differentiation). We conjecture that this would cause more distortion to the price of the high-quality brand *ceteris paribus*, which would increase the loss in consumer surplus from private label introduction.

<sup>33</sup>See e.g. Bernheim and Whinston (1998) and O'Brien and Shaffer (1997).



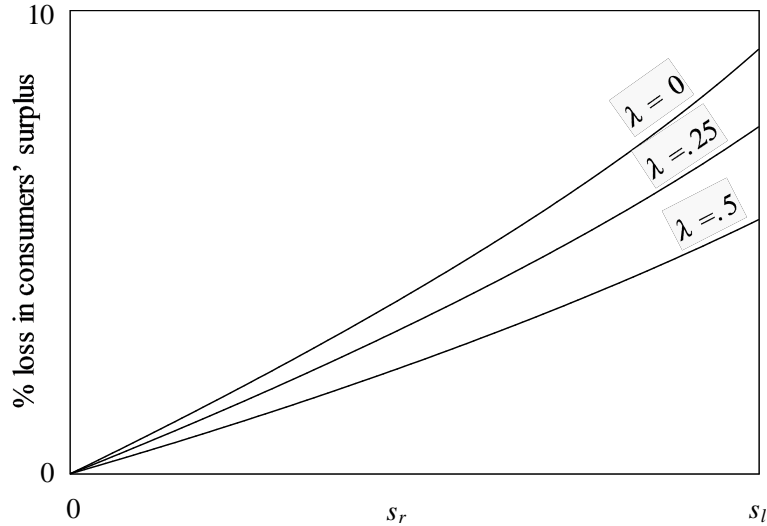


Figure 4: The percentage loss in consumer surplus plotted against  $s_r$  over the interval  $(0, s_l)$ , when  $s_l = .43$ .

stage 1 before entering into its negotiations with the retailer at stage 2. If the contract terms were unobservable to the second manufacturer, it would introduce problems of asymmetric information: While the retailer knows the outcome of the first negotiation, the second manufacturer does not. It remains an open question what happens in this case. Marx and Shaffer (1999) conjecture that wholesale prices would be equal to marginal cost in this case. However, we make the point here that the problem of sequential contracting with unobservable contracts (asymmetric information) appear, at least initially, to be different from the problem of simultaneous contracting (with symmetric information).<sup>34</sup> To say something about the outcome in the sequential contracting model when contracts are secret, we would need to make additional assumptions.<sup>35</sup>

We do not allow the retailer to renegotiate its contract with a manufacturer. Since sequential negotiations create distortions, there is always an incentive for the retailer and the first manufacturer to correct the distortion ex post. However, as noted by Marx and

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<sup>34</sup>In simultaneous contracting models, it is usually assumed that the retailer has a number of agents, each negotiating with a manufacturer on the retailer's behalf. Hence, there is no problem of asymmetric information in this case, as each manufacturer and agent holds the same information.

<sup>35</sup>First, we would need to specify a strategic or non-cooperative model of bargaining. Second, we would need make some assumptions about the second manufacturers beliefs (about the outcome of the first negotiation), and how the manufacturer updates its beliefs after its contract offer is unexpectedly rejected by the retailer. E.g., if the retailer rejects an offer, could this serve as a credible signal of the type of contract the retailer has with the first manufacturer? And if so, in which situations is the signal not credible?

Shaffer (1999), allowing for one renegotiation (after stage 2) is not sufficient to remove all the distortion, since the retailer and the second manufacturer then have incentives to distort their contract at stage 2, to shift rent from the first manufacturer at the next stage (when the renegotiation takes place). To remove all distortions, after every successful negotiation there would therefore have to be an opportunity for renegotiation. Marx and Shaffer (1999) also demonstrate that if one allows the first manufacturer to renegotiate its contract, but only if the negotiations break down between the retailer and the second manufacturer, then the distortion actually increases.

Finally, we have treated the quality of the private label (and the national brands) as exogenous in our model. We argue that this is often a natural assumption; the quality of products in the grocery industry is often more influenced by the consumers' perception, hence product "quality" is perhaps more precisely described as *perceived* quality than actual quality. However, it would be interesting to investigate what happens if the retailer has the possibility to influence the positioning of the private label, for example by spending resources on product development and advertising. Would the retailer differentiate its private label from the national brand, or would it perhaps be more profitable to position close to one of the national brands?<sup>36</sup> The exact outcome would depend on both the retailer's bargaining power, on the degree of differentiation between national brands, and on the timing of the retailer's product development (before or after contracts are negotiated). Some insight is provided by Lemma 4. A look at the retailer's equilibrium profit indicates that the retailer often prefers higher quality levels ( $s_r \geq s_l$ ) – assuming that the retailer have to make its decision prior to the contracting stage.<sup>37</sup> A comprehensive investigation of this problem is beyond the scope of this paper. We therefore leave this question for future research.

## 5 Conclusion

This paper analyses a retailer's decision to introduce a private label and asks how the private label may affect the prices of national brands and social welfare. In most of the received literature, the national brand manufacturer is assumed to be a monopolist. We

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<sup>36</sup>The issue of private label positioning in product space is investigated by Scott Morton and Zettelmeyer (2004) in a model with non-linear tariffs, and by Choi and Coughland (2006) in a model with linear tariffs. Both consider an industry with two national brand manufacturers, as in our model.

<sup>37</sup>If the retailer makes its decision after the contracting stage, the question becomes more complicated. But we conjecture that the retailer's incentive would then be to differentiate the private label from both national brands.

consider rather a model with two vertically differentiated national brand manufacturers that negotiate terms of trade sequentially with the retailer. The retailer subsequently decides whether to introduce its private label. We find that private label introduction may increase the price of the high quality national brand, through a rent-shifting effect, while the low-quality brand is unaffected by the retailer's private label. The effect on social welfare is therefore unclear.

The reason for our results are the following: We allow the manufacturers to use bilateral efficient (two-part) tariffs in negotiations with the retailer. Without the private label, the high-quality manufacturer has an incentive to offer the retailer a discount on its wholesale price (below-cost), in return for a higher fixed fee. This allows the retailer to extract more surplus from the rival manufacturer, who produces a lower quality brand at a lower cost. The retailer and the high-quality manufacturer are jointly better off as a result. We show that when the retailer introduces a private label, this rent-shifting effect is either softened or completely eliminated, and this causes the high-quality manufacturer to increase its wholesale price and reduce its fixed fee. The retail price of the high-quality brand increases as a result.

Empirical evidence suggests that private label introduction affects the prices of national brands differently. Importantly, it often seems to be the case that private labels cause an increase in the price of successful brands (brand leaders with high market share), while the effect on the prices of second tier brands is often smaller or non-existent. Our results are consistent with this observation. First, we find that there is no effect on the price of the low-quality brand. Second, we show that the effect on the high-quality brand is larger when the manufacturer has some success (higher quality) than when the two national brands are close to each other in product space (no quality gap).

There are strong variations in private label penetration both across product categories and across stores. We show that the retailer may sometimes find it optimal not to introduce its private label: When upfront payments (negotiation fees / slotting allowances) are not used (not feasible), the retailer is limited in its ability to extract rent from the manufacturers – and even more so when the retailer's bargaining power is low. In this case, the retailer may seek to increase its rent by accepting an offer to purchase the national brand that is closest to the private label at a unit price below cost. In doing so, the retailer strengthens its bargaining power vis-a-vis the "stronger" manufacturer, whose national brand is more differentiated from the private label. Moreover, when the retailer buys a close substitute to the private label at a price below cost, then it may not be profitable to sell the private label. Hence, private label introduction may not occur in this case. Upfront payments therefore play an important role in facilitating private label

introduction in our model. When upfront payments are not used, there is more private label introduction when i) the retailer has a higher bargaining power, ii) when there is low degree of differentiation between the two national brands, and iii) when there is high degree of differentiation between the private label and the national brands.

Our model suggests that ownership of the product is important, even though the retailer is a monopolist and that private labels therefore are distinct from other (independent) low-quality brands. For example, by taking as our benchmark an upstream monopoly with only the high-quality manufacturer, we can use our model to compare entry of the low-quality national brand manufacturer with the introduction of an identical private label. In this case, private label introduction allows the retailer and the high-quality manufacturer to maximise total profits. Hence, there would be no change in the price of the high-quality brand. On the other hand, if the low-quality manufacturer were to enter instead, total profit maximisation would not be possible, as there would be an incentive for rent-shifting. In this case, the price of the high-quality brand would decrease.

Our results show that welfare may increase or decrease as a result of private label introduction. Moreover, we find that there is no clear-cut connection between private label quality and social welfare. The reason is the fact that, when manufacturers use two-part tariffs, there is no downward pressure on national brand prices as the quality of the private label increases. Instead, there may be an upward pressure on the price of the high-quality brand, due to possible rent-shifting effects. In this case, consumers are better off when the private label is differentiated from both national brands. This contrasts with the common view that consumers are better off when private labels and national brands compete fiercely. The conclusion is that one should be careful when assessing the welfare effects of private labels. In particular, the conclusion will rely both on the degree of competition between the products and on the type of contracts that are used.

## Appendix

**Proof of Lemmas 2-3** We have four cases to consider, depending on which manufacturer the retailer negotiates with first,  $l$  or  $h$ , and depending on whether  $s_r < s_l$  or  $s_r > s_l$ . We consider each case in turn.

**I** Suppose the manufacturer negotiates with manufacturer  $l$  first and that  $s_r < s_l$ . The negotiations between the retailer and manufacturer  $h$  at stage 2 yields  $w_h^* = c_h$  (Lemma

1). The retailer's flow payoff at stage 3 is

$$v(q_h, q_l, q_r) = (1 - q_h - s_l q_l - s_r q_r - c_h) q_h + (s_l (1 - q_l - q_h) - s_r q_r - w_l) q_l + (s_r (1 - q_r - q_l - q_h) - c_r) q_r \quad (27)$$

if the negotiations with manufacturer  $h$  at stage 2 are successful ( $q_h > 0$ ), and

$$v_{-h}(q_l, q_r, 0) = (s_l (1 - q_l) - s_r q_r - w_l) q_l + (s_r (1 - q_r - q_l) - c_r) q_r \quad (28)$$

if the negotiations with  $h$  are not successful ( $q_h = 0$ ). Maximising (27) w.r.t.  $q_h$ ,  $q_l$  and  $q_r$  yields

$$\begin{aligned} q_h^* &= \frac{3 + 4w_l - 4s_l}{8(1 - s_l)} \\ q_l^* &= \min \left\{ \frac{(s_l s_r + s_l - s_r - 4w_l)(1 - s_r)}{8(s_l - s_r)(1 - s_l)}, \frac{s_l - 4w_l}{8s_l(1 - s_l)} \right\} \\ q_r^* &= \max \left\{ \frac{4w_l - s_l s_r}{8(s_l - s_r)}, 0 \right\} \end{aligned} \quad (29)$$

Maximising (28) w.r.t.  $q_l$  and  $q_r$ , yields

$$\begin{aligned} q_l &= q_{-h}^l = \min \left\{ \frac{4s_l + s_r^2 - 4w_l - 4s_r}{8(s_l - s_r)}, \frac{4s_l - 4w_l}{8s_l} \right\} \\ q_r &= q_{-h}^r = \max \left\{ \frac{4w_l - s_l s_r}{8(s_l - s_r)}, 0 \right\} (= q_r^*) \end{aligned} \quad (30)$$

In this case  $q_r^* > 0$  only as long as  $w_l > s_l s_r / 4$ , which implies that private label introduction at stage 3 is profitable only as long as  $w_l$  is strictly positive. The condition for joint profit maximisation between the retailer and manufacturer  $l$  at stage 1 is (see eq. (18))

$$\frac{\partial q_l^*}{\partial w_l} (w_l - c_l) = (1 - \lambda) (q_{-h}^l - q_l^*) \quad (31)$$

In solving this condition for  $w_l$ , given  $q_r^* > 0$ , we obtain

$$w_l = \bar{w}_l = \frac{s_l^2}{4} - \frac{(1 - \lambda)(s_l - s_r)(3 - s_l)(1 - s_l)}{4(1 - s_r + (1 - \lambda)(s_l - s_r))} \quad (32)$$

where  $\bar{w}_l < s_l^2 / 4 = c_l$  as long as  $s_r < s_l < 1$  and  $\lambda < 1$ , and  $\bar{w}_l \rightarrow s_l^2 / 4$  when  $s_r \rightarrow s_l$ . We

can see that  $\bar{w}_l > s_l s_r / 4$ , and hence  $q_r^* > 0$ , only as long as

$$s_l > \frac{3(1-\lambda)}{5-4\lambda-2s_r+\lambda s_r} \equiv \beta(s_r) \quad (33)$$

where  $\partial\beta/\partial s_r > 0$ . I.e., (even) at the wholesale price  $w_l = \bar{w}_l$ , private label introduction at stage 3 is profitable for the retailer only as long as the degree of vertical differentiation between the private label and brand  $l$  is sufficiently high. Suppose instead that private label introduction is not optimal, i.e.  $q_r^* = 0$ . Solving the condition for joint profit maximisation in this case, yields

$$w_l = \underline{w}_l = \frac{s_l^2}{4} - \frac{(1-\lambda)(3-s_l)(1-s_l)s_l}{4(1+(1-\lambda)s_l)} = \lim_{s_r \rightarrow 0} \bar{w}_l < \bar{w}_l \quad (34)$$

$\underline{w}_l$  is strictly positive only as long as  $s_l > 3(1-\lambda)/(5-4\lambda)$ . The joint profit of the retailer and manufacturer  $l$ , given that private label accommodation is (jointly) optimal, is

$$\begin{aligned} \Pi_{r-l}(\bar{w}_l) &= \lambda v^*(\bar{w}_l) + (1-\lambda)v_{-h}^*(\bar{w}_l) + (\bar{w}_l - c_l)q_l^*(\bar{w}_l) \\ &= \frac{\left\{ \begin{array}{l} s_l(25 + 16\lambda s_r - 17s_r - 24\lambda - s_r^2 + 2s_r^3 - \lambda s_r^3) \\ -s_l^2(1-s_r)(7 + 2\lambda s_r - 3s_r - 6\lambda) - 9(s_r - \lambda) \end{array} \right\}}{64(1-s_r + (1-\lambda)(s_l - s_r))}, \end{aligned} \quad (35)$$

whereas their joint profit when  $q_r^* = 0$ , is equal to

$$\lim_{s_r \rightarrow 0} \Pi_{r-l}(\bar{w}_l) = \frac{9\lambda + 6(1-\lambda)(4-s_l)s_l + s_l(1-s_l)}{64(1+s_l-\lambda s_l)} \quad (36)$$

It can be shown that the function  $\Pi_{r-l}(\bar{w}_l)$  is concave over the interval  $s_r \in [0, s_l]$ . We therefore normalise  $\lambda = 0$ , without loss of generality. Taking the second derivative of  $\Pi_{r-l}(\bar{w}_l)$  w.r.t  $s_r$ , yields

$$g(s_r, s_l) = -\frac{\left\{ \begin{array}{l} 18 - 8s_l s_r^3 - (13 - 3s_l)s_l^3 \\ -6(1+s_l)(1+s_l-2s_r)s_r s_l - 47(1-s_l)s_l \end{array} \right\}}{32(1+s_l-2s_r)^3} < 0 \quad (37)$$

which is negative as long as  $s_r \leq s_l \leq 1$ . Moreover, we have  $\lim_{s_r \rightarrow 0} \Pi_{r-l}(\bar{w}_l) > \lim_{s_r \rightarrow s_l} \Pi_{r-l}(\bar{w}_l)$ . Hence, there exists a critical value  $\underline{s}$ , where  $\underline{s} < s_l$ , such that private label accommodation is strictly profitable if  $s_r < \underline{s} < s_l$ , and strictly unprofitable if  $\underline{s} < s_r < s_l$ . Consider the case  $s_l = .7$  and  $\lambda = .25$ . Solving the inequality

$\Pi_{r-l}(\bar{w}_l) > \lim_{s_r \rightarrow 0} \Pi_{r-l}(\bar{w}_l)$  for  $s_r$  in this case yields  $s_r < 0.39751 (= \underline{s})$ .

**II** Suppose the retailer negotiates with manufacturer  $h$  first. The retailer's flow payoff at stage 3, using the fact that  $w_l^* = c_l$ , is

$$\begin{aligned} v(q_h, q_l, q_r) = & (1 - q_h - s_l q_l - s_r q_r - w_h) q_h + (s_l(1 - q_l - q_h) - s_r q_r - c_l) q_l \\ & + (s_r(1 - q_r - q_l - q_h) - c_r) q_r \end{aligned} \quad (38)$$

if the negotiations with manufacturer  $l$  at stage 2 are successful ( $q_l > 0$ ), and

$$v_{-l}(q_h, q_r, 0) = (1 - q_h - s_r q_r - w_h) q_h + (s_r(1 - q_r - q_h) - c_r) q_r \quad (39)$$

if the negotiations with  $l$  are not successful ( $q_l = 0$ ). Maximising (38) w.r.t.  $q_h$ ,  $q_l$  and  $q_r$  yields

$$q_h^* = \frac{4 + s_l^2 - 4s_l - 4w_h}{8(1 - s_l)}, q_l^* = \frac{s_l s_r + 4w_h - s_l - s_r}{8(1 - s_l)}, q_r^* = \frac{1}{8} s_l \quad (40)$$

$q_r^*$  is positive and independent of  $w_h$ ; private label introduction is therefore always optimal when negotiating with  $h$  first as long as  $s_r \leq s_l$  (and given that  $q_l^* > 0$ , which always is the case). Maximising (39) w.r.t.  $q_h$  and  $q_r$  yields

$$q_h = q_{-l}^h = \frac{4 + s_r^2 - 4w_h - 4s_r}{8(1 - s_r)}, q_r = q_{-l}^r = \frac{4w_h - s_r}{8(1 - s_r)} \quad (41)$$

where again  $q_{-l}^r > 0$  since  $q_l^* > 0$ . The condition for joint profit maximisation between the retailer and manufacturer  $h$  at stage 1 is

$$\frac{\partial q_h^*}{\partial w_h} (w_h - c_h) = (1 - \lambda) (q_{-l}^h - q_h^*) \quad (42)$$

which we can solve for  $w_h$  to obtain

$$w_h = \bar{w}_h = \frac{1}{4} - \frac{(1 - \lambda)(s_l - s_r)(1 - s_l)(1 - s_r)}{4(1 - s_r + (1 - \lambda)(s_l - s_r))} \quad (43)$$

where  $\bar{w}_h < 1/4 = c_h$  as long as  $s_r < s_l < 1$  and  $\lambda < 1$ , and  $\bar{w}_h \rightarrow 1/4$  as  $s_r \rightarrow s_l$ . No private label introduction is equivalent to  $s_r = 0$ , in which case we have

$$w_h = \underline{w}_h = \frac{1}{4} - \frac{(1 - \lambda)(1 - s_l)s_l}{4(1 + s_l - \lambda s_l)} = \lim_{s_r \rightarrow 0} \bar{w}_h \quad (44)$$

**III** Suppose that  $s_r > s_l$ , and that the retailer negotiates with manufacturer  $l$  first. The retailer's flow payoff at stage 3 is then

$$\begin{aligned} v(q_h, q_l, q_r) &= (1 - q_h - s_l q_l - s_r q_r - c_h) q_h + (s_r (1 - q_r - q_h) - s_l q_l - c_r) q_r \\ &\quad + (s_l (1 - q_l - q_h - q_r) - w_l) q_l \end{aligned} \quad (45)$$

if the negotiations with manufacturer  $h$  at stage 2 are successful ( $q_h > 0$ ), and

$$v_{-h}(q_l, q_r, 0) = (s_r (1 - q_r) - s_l q_l - c_r) q_r + (s_l (1 - q_l - q_r) - w_l) q_l \quad (46)$$

if the negotiations with  $h$  are not successful ( $q_h = 0$ ). Maximising (45) w.r.t.  $q_h$ ,  $q_l$  and  $q_r$  yields

$$\begin{aligned} q_h^* &= \min \left\{ \frac{1}{8} (3 - s_r), \frac{3 + 4w_l - 4s_l}{8(1 - s_l)} \right\} \\ q_l^* &= \min \left\{ \frac{(s_l s_r - 4w_l) s_r}{8(s_r - s_l) s_l}, \frac{s_l - 4w_l}{8s_l(1 - s_l)} \right\} \\ q_r^* &= \max \left\{ \frac{4w_l + s_r - s_l - s_l s_r}{8(s_r - s_l)}, 0 \right\} \end{aligned} \quad (47)$$

where  $q_r^* > 0$  as long as  $w_l > (s_l - s_r + s_l s_r) / 4 = b < c_l$ . Maximising (46) w.r.t.  $q_l$  and  $q_r$  yields

$$\begin{aligned} q_r &= q_{-h}^r = \max \left\{ \frac{4w_l + 4s_r - 4s_l - s_r^2}{8(s_r - s_l)}, 0 \right\} \\ q_l &= q_{-h}^l = \min \left\{ \frac{(s_l s_r - 4w_l) s_r}{8(s_r - s_l) s_l}, \frac{s_l - w_l}{2s_l} \right\} \end{aligned} \quad (48)$$

where  $q_{-h}^r > 0$  as long as  $w_l > (4s_l - 4s_r + s_r^2) / 4 = a$ , and  $a < b$ . The joint profit,  $\Pi_{r-l}(w_l) = \lambda v^*(w_l) + (1 - \lambda) v_{-h}^*(w_l) + (w_l - c_l) q_l^*(w_l)$ , is continuous everywhere on  $w_l$ . Moreover,  $\Pi_{r-l}$  is concave on  $w_l$  for either  $w_l < a$  or  $w_l > b$ , with maxima at  $w_l = \underline{w}_l$  and  $w_l = c_l$  respectively.  $\Pi_{r-l}$  is either concave or convex over the interval  $w_l \in (a, b)$ , depending on the parameter values:

$$\frac{\partial^2 \Pi_{r-l}}{\partial w_l^2} = \frac{(1 - \lambda)(1 - s_r) s_l - (s_r - s_l)}{2(s_r - s_l)(1 - s_l) s_l} \geq 0 \text{ when } a < w_l < b, \quad (49)$$

Moreover, we have

$$\lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{r-l}}{\partial w_l} \Big|_{w_l = b - \varepsilon} = \frac{1}{8s_l} (s_r - s_l) > 0 \quad (50)$$



and

$$\lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{r-l}}{\partial w_l} \Big|_{w_l = a - \varepsilon} = \lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{r-l}}{\partial w_l} \Big|_{w_l = a + \varepsilon} \quad (51)$$

(49) is negative when the bargaining power of the retailer  $\lambda$  is sufficiently high, and when the degree of differentiation between the private label and the high-quality brand,  $1 - s_r$ , is sufficiently low compared to the degree of differentiation between the private label and the low-quality brand,  $s_r - s_l$ . In this case,  $\Pi_{r-l}$  is concave everywhere on  $w_l$ , with  $w_l = c_l$  as the unique maximum. (49) is positive when the bargaining power of the retailer is sufficiently low, and when the degree of differentiation between the private label and the high-quality brand is sufficiently high compared to the degree of differentiation between the private label and the low-quality brand.  $\Pi_{r-l}$  is then concave on  $w_l$  for  $w_l < a$ , convex on  $w_l$  over the interval  $w_l \in (a, b)$ , and concave on  $w_l$  for  $w_l > b$ . We then have two local maxima, at  $w_l = \bar{w}_l = c_l$  and  $w_l = \underline{w}_l$ , respectively. To solve for the optimal strategy, it is then sufficient to compare the joint profit  $\Pi_{r-l}$  when  $w_l = c_l$  and  $q_r^* > 0$ , with the joint profit when  $w_l = \underline{w}_l$  and  $q_r^* = 0$ . In this case, the condition that private label accommodation be profitable, is

$$\begin{aligned} \Pi_{r-l}(c_l) \Big|_{q_r^* > 0} &= \frac{\lambda(1-s_r)(3-s_r)^2 + s_r(4-s_r)^2 + s_r s_l(s_r - s_l)}{64} \\ &> \frac{9\lambda + 6(1-\lambda)(4-s_l)s_l + s_l(1-s_l)}{64(1+(1-\lambda)s_l)} = \Pi_{r-l}(\underline{w}_l) \Big|_{q_r^* = 0} \end{aligned} \quad (52)$$

The critical value  $\bar{s}$  is the value for  $s_r$  that solves  $\Pi_{r-l}(c_l) \Big|_{q_r^* > 0} = \Pi_{r-l}(\underline{w}_l) \Big|_{q_r^* = 0}$ . Consider the case  $s_l = .7$  and  $\lambda = .25$ . Solving (52) for  $s_r$  in this case yields  $s_r > 0.78616$  ( $= \bar{s}$ )

**IV** Suppose that  $s_r > s_l$ , and that the retailer negotiates with manufacturer  $h$  first. The retailer's flow payoff at stage 3 is then

$$\begin{aligned} v(q_h, q_l, q_r) &= (1 - q_h - s_l q_l - s_r q_r - w_h) q_h + (s_r(1 - q_r - q_h) - s_l q_l - c_r) q_r \\ &\quad + (s_l(1 - q_l - q_h - q_r) - c_l) q_l \end{aligned} \quad (53)$$

if the negotiations with manufacturer  $l$  are successful ( $q_l > 0$ ), and

$$v_{-l}(q_h, q_r, 0) = (1 - q_h - s_r q_r - w_h) q_h + (s_r(1 - q_r - q_h) - c_r) q_r \quad (54)$$

if the negotiations with  $l$  are not successful ( $q_l = 0$ ). Maximising (53) yields

$$\begin{aligned} q_h^* &= \min \left\{ \frac{4 + s_r^2 - 4s_r - 4w_h}{8(1 - s_r)}, \frac{4 + s_l^2 - 4s_l - 4w_h}{8(1 - s_l)} \right\} \\ q_l^* &= \min \left\{ \frac{1}{8}s_r, \frac{4w_h - s_l}{8(1 - s_l)} \right\} \\ q_r^* &= \max \left\{ \frac{4w_h + s_l s_r - s_l - s_r}{8(1 - s_r)}, 0 \right\} \end{aligned} \quad (55)$$

where  $q_r^* > 0$  iff  $w_h > (s_r + s_l - s_l s_r)/4 = b$ , and  $b < c_h$ . Maximising (54) yields

$$q_{-l}^h = \min \left\{ \frac{4 + s_r^2 - 4w_h - 4s_r}{8(1 - s_r)}, \frac{1 - w_h}{2} \right\}, q_{-l}^r = \max \left\{ \frac{4w_h - s_r}{8(1 - s_r)}, 0 \right\} \quad (56)$$

where  $q_{-l}^r > 0$  iff  $w_h > s_r/4 = a$ , and  $a < b$ . The joint profit  $\Pi_{r-h}(w_h) = \lambda v^*(w_h) + (1 - \lambda) v_{-l}^*(w_h) + (w_h - c_h) q_h^*(w_h)$  is continuous everywhere on  $w_h$ , and may be either concave or convex over the interval  $w_h \in (a, b)$  depending on the parameter values:

$$\frac{\partial^2}{\partial w_h^2} \Pi_{r-h} = \frac{(1 - \lambda)(s_r - s_l) - (1 - s_r)}{2(1 - s_r)(1 - s_l)} \leq 0 \text{ for } a < w_h < b \quad (57)$$

Moreover, we have

$$\lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{h-l}}{\partial w_h} \Big|_{w_h=b-\varepsilon} = \frac{1}{8}(1 - s_r) > 0 \quad (58)$$

and

$$\lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{h-l}}{\partial w_h} \Big|_{w_h=a-\varepsilon} = \lim_{\varepsilon \rightarrow 0} \frac{\partial \Pi_{h-l}}{\partial w_h} \Big|_{w_h=a+\varepsilon} \quad (59)$$

(57) is negative when the bargaining power of the retailer  $\lambda$  is sufficiently high, and when the degree of differentiation between the private label and the low-quality brand,  $s_r - s_l$ , is sufficiently low compared to the degree of differentiation between the private label and the high-quality brand,  $1 - s_r$ . In this case,  $\Pi_{r-h}$  is concave everywhere on  $w_h$ , and with  $w_h = \bar{w}_h = c_l$  as the unique maximum. (57) is positive when the bargaining power of the retailer is sufficiently low, and when the degree of differentiation between the private label and the low-quality brand is sufficiently high compared to the degree of differentiation between the private label and the high-quality brand. In this case,  $\Pi_{r-h}$  is concave on  $w_h$  for  $w_h < a$ , convex on  $w_h$  over the interval  $w_h \in (a, b)$ , and concave on  $w_h$  for  $w_h > b$ . We then have two local maxima, at  $w_h = c_l$  and  $w_h = \underline{w}_h$ , respectively. It is then sufficient to compare the joint profit  $\Pi_{r-h}$  when  $w_h = c_l$  and  $q_r^* > 0$ , with the joint profit when  $w_h = \underline{w}_l$  and  $q_r^* = 0$ . The condition that private label accommodation be profitable, is

then

$$\begin{aligned}\Pi_{r-h}(c_h)|_{q_r^* > 0} &= \frac{9 + s_r(1 - s_r + s_l\lambda(s_r - s_l))}{64} \\ &> \frac{9}{64} + \frac{s_l(1 - s_l)(\lambda + s_l - \lambda s_l)}{64(1 + s_l - \lambda s_l)} = \Pi_{r-h}(\underline{w}_h)|_{q_r^* = 0}\end{aligned}\quad (60)$$

Consider the case  $s_l = .7$  and  $\lambda = .25$ . Solving (60) for  $s_r$  in this case yields  $s_r < 0.92357(=\bar{s})$ . **Q.E.D.**

**Proof of Lemma 4** To complete the proof, it is sufficient to show that  $\Pi^h = \Pi(\bar{w}_h, c_l) > \Pi(c_h, \bar{w}_l) = \Pi^l$  when  $s_r < s_l$ . Taking the difference  $\Pi^h - \Pi^l$  in this case yields

$$\Pi^h - \Pi^l = (1 - \lambda)^2 \frac{(s_l - s_r)(1 - s_r)(1 - s_l)(9 + s_r - 7s_l + s_l s_r + s_l^2 - s_r^2)}{64(1 - s_r + (1 - \lambda)(s_l - s_r))^2} > 0,$$

which always is positive. It is not necessary to consider the case  $\Pi^l = \Pi(c_h, \underline{w}_l)$ , since it involves more distortion to the wholesale price  $w_l$ ; all else equal, it therefore also yields a smaller overall industry profit. **Q.E.D.**

**Proof of Proposition 3** For the case  $s_r \leq s_l$ , the consumers' surplus can be written

$$\begin{aligned}CS|_{s_r \leq s_l} &= s_r \int_{\frac{p_r^*}{s_r}}^{\frac{p_l^* - p_r^*}{s_l - s_r}} \theta \, d\theta + s_l \int_{\frac{p_l^* - p_r^*}{s_l - s_r}}^{\frac{p_h^* - p_l^*}{1 - s_l}} \theta \, d\theta + \int_{\frac{p_h^* - p_l^*}{1 - s_l}}^1 \theta \, d\theta \\ &\quad - q_r^* p_r^* - q_l^* p_l^* - q_h^* p_h^*\end{aligned}\quad (61)$$

where  $p_r^* = s_r(s_r + 4)/8$ ,  $p_l^* = s_l(s_l + 4)/8$  and  $p_h^* = (1 + \bar{w}_h)/2$ . Consumers' surplus under a ban on private labels, is simply  $CS|_{s_r=0}$ . Normalising  $\lambda = 0$ , yields

$$CS|_{s_r=0} = \frac{9 + 9s_l^2 + 25s_l - 8s_l^3 + s_l^4}{128(1 + s_l)^2},\quad (62)$$

and

$$\begin{aligned}\varphi(s_r, s_l)|_{\lambda=0} &= \frac{CS|_{s_r \leq s_l}}{CS|_{s_r=0}} \Big|_{\lambda=0} \\ &= (1 + s_l)^2 \frac{\left\{ \begin{aligned} &\delta_r s_l^4 - 8\delta_r s_l^3 + s_r \delta_r (25 - 6s_r) s_l^2 + 5(3 + \delta_r) s_r^3 s_l \\ &+ (3 + s_r^2 - 7s_r)^2 + s_l(25 + 9s_l - 58s_r) \end{aligned} \right\}}{(9 + 25s_l + 9s_l^2 - 8s_l^3 + s_l^4)(\delta_r + s_l - s_r)^2} \leq 1\end{aligned}\quad (63)$$

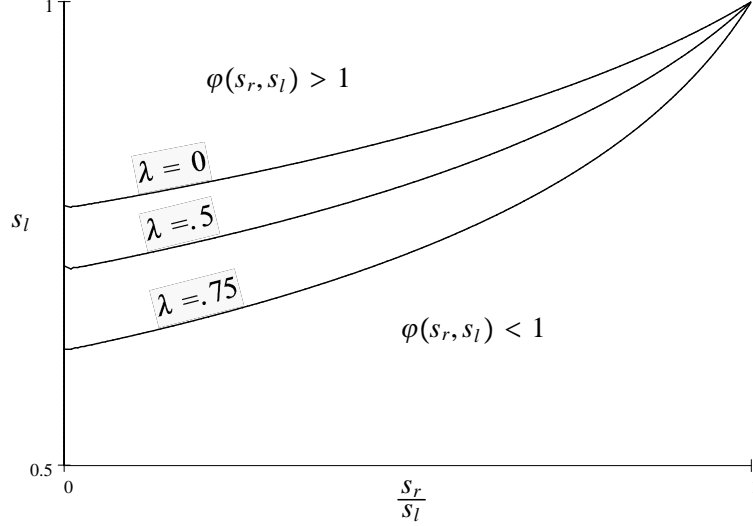


Figure 5:  $\varphi(s_r, s_l) = 1$  plotted against  $s_r/s_l$  for different values for  $\lambda$ . Private label introduction causes an increase in consumers' surplus when  $\varphi(s_r, s_l) > 1$ , and a decrease when  $\varphi(s_r, s_l) < 1$ .

where  $\delta_r = 1 - s_r$ . Private label introduction causes an increase in consumers' surplus when  $\varphi(s_r, s_l) > 1$ , and a decrease when  $\varphi(s_r, s_l) < 1$ . In Figure 5 we have plotted the condition  $\varphi(s_r, s_l) = 1$  for different values for  $\lambda$ . It shows that the private label causes an increase in consumers' surplus only as long as the private label and the low-quality brand are sufficiently differentiated, and as long as  $\lambda$  is sufficiently high. An increase in  $\lambda$ , makes for a smaller increase in the price of the high-quality brand when a private label is introduced, and therefore relaxes the condition  $\varphi(s_r, s_l) \geq 1$ . When  $\lambda = 1$ , the condition always holds.

For the case  $s_r > s_l$ , we have  $p_h^* = 5/8$  if the private label is introduced ( $q_r^* > 0$ ). In this case, the consumers' surplus is equal to

$$\begin{aligned}
 CS|_{s_r > s_l} &= s_l \int_{\frac{p_l^*}{s_l}}^{\frac{p_r^* - p_l^*}{s_r - s_l}} \theta \, d\theta + s_r \int_{\frac{p_r^* - p_l^*}{s_r - s_l}}^{\frac{p_h^* - p_r^*}{1 - s_r}} \theta \, d\theta + \int_{\frac{p_h^* - p_r^*}{1 - s_r}}^1 \theta \, d\theta \\
 &= \frac{-q_l^* p_l^* - q_r^* p_r^* - q_h^* p_h^*}{128} \\
 &= \frac{9 - s_r^2 + s_r + s_l s_r^2 - s_l^2 s_r}{128}
 \end{aligned} \tag{64}$$

$CS|_{s_r > s_l}$  is maximised for  $s_r = (1 + s_l)/2 \equiv s_r^*$ , i.e. when there is maximum differentiation between the private label and the two national brands (conditional on  $s_r > s_l$ ). For the case  $s_r > s_l$ , the maximum consumers' surplus is therefore

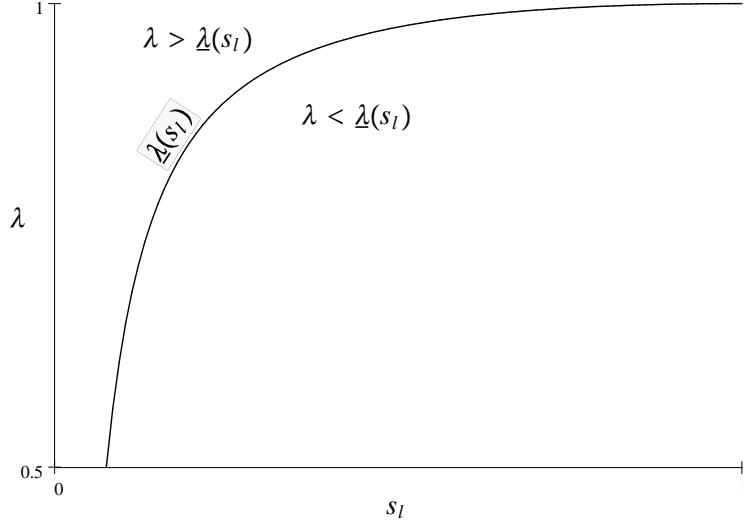


Figure 6: The case  $s_r > s_l$ , and with maximum differentiation between the private label and the two national brands, i.e.  $s_r = s_r^*$ . Private label introduction causes an increase in consumers' surplus when  $\lambda > \underline{\lambda}(s_l)$ , and a decrease when  $\lambda < \underline{\lambda}(s_l)$ .

$$CS|_{s_r=(1+s_l)/2} = \frac{36 + 1 + (1 - s_l)(1 + s_l)^2}{512} \quad (65)$$

Using (61), we can write the consumers' surplus without the private label, as

$$CS|_{s_r=0} = \frac{9 + (1 - \lambda)^2 s_l^4 - 8(1 - \lambda)^2 s_l^3 + (1 - 2\lambda)(9 - 8\lambda) s_l^2 + (25 - 24\lambda) s_l}{128(1 + s_l - \lambda s_l)^2} \quad (66)$$

Solving  $CS|_{s_r=(1+s_l)/2} \geq CS|_{s_r=0}$  for  $\lambda$ , yields

$$\lambda \geq s_l \frac{11 + 25s_l - 7s_l^2 - s_l^3 - 2\sqrt{37 + 5s_l^2 - 26s_l}}{(3 - s_l)(9 + s_l)s_l^2} \equiv \underline{\lambda}(s_l) \quad (67)$$

$\underline{\lambda}(s_l)$  is plotted in Figure 6. We can see that for the case  $s_r = s_r^* > s_l$ , private label introduction causes an increase in consumers' surplus only when  $\lambda$  is sufficiently high, and/ or when there is a high degree of differentiation between the private label and both national brands (similar to the case  $s_r < s_l$ ).

Finally, consider the overall social welfare function:

$$W|_{s_r < s_l} = s_r \int_{\frac{p_r^*}{s_r}}^{\frac{p_l^* - p_r^*}{s_l - s_r}} \theta \, d\theta + s_l \int_{\frac{p_l^* - p_r^*}{s_l - s_r}}^{\frac{p_h^* - p_l^*}{1 - s_l}} \theta \, d\theta + \int_{\frac{p_h^* - p_l^*}{1 - s_l}}^1 \theta \, d\theta - q_r^* c_r - q_l^* c_l - q_h^* c_h \quad (68)$$

When  $s_r = s_l$  (or equivalently, when  $s_r = 1$ ),  $W$  is equal to

$$W|_{s_r = s_l} = \frac{3(9 + s_l - s_l^2)}{128} \quad (69)$$

Total welfare without the private label ( $s_r = 0$ ) is equal to

$$W|_{s_r = 0} = \frac{\left\{ \begin{array}{l} 27 - (1 - \lambda)^2 s_l^4 - 4(1 - \lambda)(2 - \lambda) s_l^3 \\ + (32\lambda^2 - 62\lambda + 27) s_l^2 + (63 - 60\lambda) s_l \end{array} \right\}}{128(1 + s_l - \lambda s_l)^2} \quad (70)$$

Taking the difference  $W|_{s_r = s_l} - W|_{s_r = 0}$ , yields

$$-\frac{s_l(1 - s_l)(1 - \lambda)(6 + 2s_l(1 - 2\lambda) + s_l(1 - \lambda)(1 - 2s_l))}{128(1 + s_l - \lambda s_l)^2} < 0 \quad (71)$$

which is negative in the permitted range of parameters,  $\lambda \in (0, 1)$  and  $s_l \in (0, 1)$ . **Q.E.D.**

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