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Private Labeling and Competition between Retailers

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Abstract

This paper studies the effect of private labeling on retailer competition -an issue neglected in literature until now. Once implemented, private labeling may well be less favorable to society than previously thought because it can encourage consolidation of the retail industry. Either with linear pricing (when goods are not loose substitutes) or with wholesale price discrimination (when goods are not loose substitutes), the vertical channel is inclined to promote a retail monopoly while consumers prefer some retail competition. This conflict of interest would not arise in the absence of private labeling.

KEYWORDS: private labeling, store brands, product differentiation, wholesale price discrimination, downstream competition

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1. Introduction

Grocery retailing has been characterized in recent years by a significant increase in firm concentration, average store size and private label offerings. Private labels, also known as store brands, are retailers' own-branded products in competition with the national brands produced by manufacturers.

According to ACNielsen (2005),[1] private label penetration, measured by the private label share in the value of grocery sales,[2] is the highest in Western Europe with a share of 23%, compared to 19% in Canada and 16% in the United States. In the other advanced economies in Pacific Asia and emerging countries, the share is below 4%, except in New Zealand, Australia, and Eastern European countries where the share is 10%.

However, there is wide variance in private label penetration between countries and between product categories. Among Western European countries, private labeling is most prevalent in Switzerland (45%), Germany (30%), Great Britain (28%) and Spain (26%). It is less prevalent in Italy (11%), Portugal (11%), Finland (10%), Norway (8%), Ireland (7%) and Greece (4%). Between product categories, while all types of food except for baby food (e.g. refrigerated, frozen, shelf-stable, pet food) have high private label shares, ranging from a minimum of 19% for shelf-stable food to a maximum of 32% for refrigerated food; private label share is negligible for baby food (2%), cosmetics (2%), personal care (5%) and alcoholic beverages (6%).

Private labeling has been the subject of theoretical and empirical studies. However, while the latter are numerous (Steiner, 2004, survey the literature), the former are few (Bergès-Sennou et. al., 2004, survey that literature. The most notable theoretical studies include Wolinsky (1987), Mills (1995, 1999), Raju et. al. (1995), Narasimhan-Wilcox (1998), Bontems et al (1999), Scott Morton-Zettelmeyer (2004), Soberman-Parker (2004), Bergès-Sennou and Waterson (2005), Bergès-Sennou (2006) and Gabrielsen-Sorgard (2007).[3] The theoretical studies can be separated into two subsets[4]: the first (Mills, Raju et al. and Bontems et al.) shows that the introduction of a private label reduces both wholesale and retail national brand prices and increases sales.[5]

[1] ACNielsen (2005a) collected yearly data (e.g. March 2004 to March 2005) on 80 grocery product categories, some of which are non-food, in 38 countries of which 17 in Western Europe, 4 in Eastern Europe, 2 in North America, 8 in Pacific Asia, 6 in Latin America and 1 in Africa.

[2] Given that private labels are on average priced 31% lower than national brands, measuring private label share in value rather than in volume underestimates private label penetration.

[3] Katz's (1987) model could be interpreted as a competition game between a national brand and a private label but its assumption of product homogeneity makes this interpretation rather implausible.

[4] While the recent contribution by Gabrielsen-Sorgard (2007) could belong in both these subsets, the one by Bergès-Sennou and Waterson (2005) does not belong in either. It does not belong to the first subset because instead of assuming linear pricing, it assumes a wholesale two-part tariff and, hence, no double mark-up problem arises. It does not belong to the second subset because retailers' bargaining power in dealing with national brand manufacturers does not increase with private labeling.

[5] This occurs in Bontems et. al. to the extent that the quality of the private label is not too high, lower than that of the national brand, because the marginal cost of producing a private label is assumed as an increasing and convex function of quality.

Channel profit and consumer surplus both increase and the retailer is able to capture a higher fraction of the former. Private labeling is thus good because it alleviates the classic double marginalization problem. The second subset of studies (Narasimhan-Wilcox, Scott Morton-Zettelmeyer[6]) shows that the retailer, by introducing a private label, is able to improve his bargaining position in negotiations with the national brand manufacturer but causes a reduction in the channel profit. In Narasimhan-Wilcox for instance, in the most interesting equilibrium case, the reduction in the wholesale national brand price consequent to private labeling does not bring about a demand increase (since demand is assumed inelastic), so that the loss suffered by the national brand manufacturer under private labeling is larger than the gain obtained by the retailer. Some consumers benefit from buying the private label at a lower price and as a result consumer surplus increases with private labeling.

The latest development in product-lines literature is connected with private labeling. Avenel-Caprice (2006) studied the choice of the optimal product line in a vertical structure composed of manufacturers and retailers with market power -a situation typical of national brand/private label competition. In a vertical differentiation model where a high quality item (i.e. a national brand) is offered by a monopolist while a low quality item (i.e. a private label) is offered by a competitive fringe, they show that different product lines can emerge as an equilibrium outcome according to parameter values. Our analysis, which overcomes the perfect substitutability hypothesis between different private labels proposed by Avenel-Caprice, will offer two interesting insights on this theme.

However, the assumption of a monopoly retailer is common to all private label models (except Avenel-Caprice), leaving aside the issue of how private labeling interacts with retailer competition. It would be interesting to see whether private labeling promotes retailer competition, reduces it, or leaves it unchanged.

If private labeling significantly affected retailer competition, it could not be considered simply as a bargaining tool in the hands of retailers to get more payoff from manufacturers in their vertical dealings because it would produce external effects with significant impact on third parties, including consumers. If this was the case, an overall welfare assessment becomes more difficult.

To achieve this, it is necessary to assess not only the short run effect of private labeling on prices, sales and profits but also its medium-long term effect on (retailer) competition.

Moreover, pricing has been crucially restricted to linear even at wholesale level[7] whereas nonlinear pricing is a common practice in vertical relationships between manufacturers and retailers. Some form of wholesale nonlinear pricing could indeed be practiced by a manufacturer, even as a defensive move against private labeling, so that ignoring it would mean overlooking a potentially important part of the story.

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[6] Unlike Narasimhan-Wilcox, Scott Morton-Zettelmeyer focus on the strategic importance for retailers of deciding the brand positioning of private labels in their supply terms negotiations with manufacturers.

[7] Scott-Morton and Zettelmeyer, Bergès-Sennou and Waterson, Avenel and Caprice represent recent exceptions to this.

The main objective of this paper is to offer a theoretical analysis on how private labeling affects competition between retailers, while also considering its interaction with wholesale pricing.

When this is complete, a new offsetting effect of private labeling is added to the conventional effect of encouraging low prices and high consumer surplus. According to this new effect, private labeling makes a concentrated retail industry more appealing for the vertical channel. With linear prices, this occurs when all brands are close substitutes. With wholesale price discrimination, this effect occurs for a larger range of product substitutability, that is, when goods are not loose substitutes.

Moreover, under wholesale price discrimination, the national brand manufacturer makes a larger profit when dealing with a downstream monopoly than when dealing with a downstream duopoly. Thus, the vertical channel finds it profitable to eliminate downstream competition, even though this harms consumers.

Intuitively, when marketing a private label, a retailer, by becoming multiproduct, internalizes the negative cross-effect of one brand's demand on the other brand's price, due to imperfect brand substitutability. This induces them to avoid offering too much of one brand which would bring about a reduction in the other brand's price. This effect is particularly strong when brands are close substitutes. When this occurs, they are more inclined to limit the respective supplies of brands with the aim of maintaining higher retail prices.

This explains why, under linear pricing, a monopoly retailer, able to set higher prices than a Cournot duopoly, is preferable for the downstream industry.[8] The downstream industry's gain coming from (downstream) monopolization is strong enough, when goods are close substitutes, to offset the corresponding loss made by the national brand manufacturer due to a reduction in national brand sales. When wholesale (perfect) price discrimination is feasible, the effect of private labeling in consolidating the retail industry worsens. The national brand manufacturer can partly exploit the downstream profit increase due to monopolization through fixed fees, even though they have to leave the retailer a strictly positive reservation profit, coming from the retailer's ability to refuse to distribute the national brand and sell only their private label.

For these reasons, in a medium-long term perspective, private labeling may be less favorable to society than commonly thought. The concerns recently expressed by Dobson (1998) and Clarke et al. (2002) along the lines that private labeling may contribute to increased concentration in retailing are fully confirmed by our analysis.

The paper proceeds as follows. We sketch out the model in section 2. In section 3, we study the no-private-labeling case as a useful benchmark. In section 4, private labeling is introduced under linear pricing. In section 5 we study private labeling under wholesale price discrimination. Concluding remarks are included in section 6. An appendix ends the paper.

[8] Of course the incumbent retailer would prefer to remain a monopolist while the entrant retailer would prefer a downstream duopoly. When the former's gain prevails on the latter's loss, however, the downstream industry should be in favor of being organized as a monopoly.

2. The Model

A monopoly manufacturer produces a national brand and sells to two retailers, each of whom can also distribute their own private label, purchased from an upstream competitive fringe[9].

A private label is an imperfect substitute for the national brand due either to a difference in quality or in advertising (or both) creating this perception in consumers. The two private labels are also differentiated products: as retailer-specific brands, unique to each retailer, it seems quite natural to see them as imperfect substitutes. In focusing on these three sources of product differentiation, for the sake of tractability, no further source of differentiation is assumed. The consumer is thus indifferent regarding which retailer to buy the national brand from.

An important issue concerns the type of product differentiation that fits competition between national brands and private labels better. While, traditionally, vertical product differentiation has been preferred, in recent times, the development of premium private labels by important and large retailers who advertise heavily (e.g. the British *Tesco* or the Swiss *Migros*) has given support to the view that horizontal product differentiation fits it better. Premium private labels have closed the quality gap with national brands. Given this, we have decided to follow here the latter approach, already followed by Wolinsky (1987) among others. However, comparing the obtained qualitative results by the two different approaches and noting that they are similar, we can well state that the type of product differentiation is not crucial in private label models.

All the three products (one national brand and two private labels) are produced with the same constant-unit-cost technology.[10] For simplicity, and without any further loss of generality, let us take this production unit cost to be zero. Furthermore, a retailer's demand quantity is assumed to be equal to the amount demanded by his customers, in accordance with a *just-in-time* manufacturing-delivery philosophy.

On advertising we will start by assuming that it is given.[11] This implies that its contribution to make national brands and private labels as imperfect substitutes is taken exogenously and that its cost is sunk. Afterwards however, we will study what happens if the national brand manufacturer could endogenously affect product substitutability

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[9] One of the key issues in this literature is who will produce the private label (either a competitive fringe or national brand manufacturers). Only very recently has this issue been dealt with in a theoretical model [Bergès-Sennou (2006)], while the literature has mostly assumed what is perhaps more typical of a grocery market: private labels are produced by a competitive fringe. Only Wolinsky and Soberman-Parker consider the case of dual branding, in which private labels are produced by national brand manufacturers. Both cases are empirically observed but it is difficult to assess their relative frequency. However they share an important common feature: private labels have a smaller purchasing cost for retailers than competing leading national brands.

[10] The likely advantage due to economies of scale for a national brand manufacturer against a private label producer should be roughly offset by the higher wages that the former pays for his employees relative to the latter. Barsky et. al. (2001) argue that this is typical in the US food industries.

[11] In other words we assume that advertising is determined over a longer period than that necessary to change the number of active firms on the market -something that is not implausible.

through advertising when the cost of the latter is not sunk but depends (linearly) on the amount of advertising made.

In the initial game with advertising as given, decisions by manufacturers and retailers are taken sequentially according to the following perfect and complete information two-stage game: in the first stage, given the feasible wholesale pricing scheme, manufacturers set wholesale prices and fixed fees (when available). In the second stage, retailers, given the wholesale prices and possibly the upstream fixed fees, and anticipating the consumers' demands, determine the retail quantities offered according to a Cournot subgame[12].

In the game with endogenous advertising, we add a new stage at the beginning where the national brand manufacturer decides the amount of advertising and through it the degrees of product substitutability between his product and private labels.

In both games, in the last stage, retailers are free to choose which product to market out of three alternative options: only the national brand, only their private label or both the national brand and their private label. We search for pure-strategies subgame perfect equilibria, on which our analysis will be focused.

We initially assume upstream monopoly pricing, but the retailer's ability to offer a private label, by increasing his reservation profit to a strictly positive amount, brings into our model some buyer bargaining power in dealing with the manufacturer. However, we will discuss later the effect of having some bargaining between bilateral monopolists. Vertical contracts are assumed public and non renegotiable, so that they entail full commitment value (see note 17 for more comments on this).

To enable closed form solutions of the model, we follow Dobson-Waterson (1996) and assume retail demands for the three products from maximizing the following quasi-linear quadratic utility function:

$$U=(q_{01}+q_{02})+q_1+q_2-\frac{1}{2}(q_{01}+q_{02})^2-\frac{1}{2}q_1^2-\frac{1}{2}q_2^2+$$

$$-(q_{01}+q_{02})(\gamma q_1+\beta q_2)-\delta q_2 q_1+q_o \tag{1}$$

where q denotes quantity demand. For each q, the first subscript (i) refers to the specific brand: 0 for national brand, 1 for retailer 1's private label, 2 for retailer 2's private label; its second subscript (j) refers to the distributing retailer (1 or 2). Since only the national brand can be sold by both retailers, the latter subscript has to be

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[12] With differentiated products, it is well-known that the choice between price and quantity competition is not crucial, given that they show very similar results. Another reason for assuming downstream Cournot competition is given by the existence of capacity constraints in the retailing industry. We know from Kreps-Scheinkman (1983) that, under plausible conditions, price competition with binding capacity constraints is the same as Cournot competition.

specified only when the former subscript is zero. q_o represents the exogenously given amount of the numeraire. We have three crucial parameters measuring the respective degrees of product substitutability in the utility function: γ represents the degree of product substitutability between the national brand and retailer 1's private label; β represents the degree of product substitutability between the national brand and retailer 2's private label; δ represents the degree of product substitutability between the two private labels. The corresponding degree of product differentiation between brands is the inverse of that of product substitutability.

From straightforward consumer utility maximization, the following inverse demands for the three products are obtained:

$$p_0 = 1-(q_{01}+q_{02})-\gamma q_1-\beta q_2 \tag{2}$$

$$p_1 = 1-q_1-\gamma(q_{01}+q_{02})-\delta q_2 \tag{3}$$

$$p_2 = 1-q_2-\beta(q_{01}+q_{02})-\delta q_1 \tag{4}$$

$q_{0j}, q_j \geq 0$ with $i = 0,1,2$ and $j = 1,2$; $0 < \beta, \gamma < 1$ and $0 < \delta \leq 1$.

p_i represents the i-th good's retail price. The maximum reservation price that buyers are willing to pay for these items in terms of the numeraire has been normalized to one. Unfortunately, with three product substitutability parameters, the problem is algebraically intractable, so a simplification is needed. The restriction $\beta = \gamma$ is not acceptable because, since the two private labels have the same degree of product substitutability with the national brand, this would imply that they are perfect substitutes, thus violating the essence of private labels as retailer-specific brands. A reasonable way, already followed by Dobson-Waterson (1996), to keep the plausible asymmetries between private labels but ensuring algebraic tractability, is to nest the restriction $\gamma = \beta\delta$.[13] In this way, we can focus only on two degrees of product substitutability: β and δ. If the two private labels were perfect substitutes ($\delta = 1$), this would still imply that the degrees of product differentiation between the national brand and each private label are the same ($\beta = \gamma$). But we are now also able to treat the realistic case $\delta < 1$.

Under this condition, β and γ are different from each other and hence some asymmetry arises due to different degrees of substitutability between goods. When advertising is given, being the private label's wholesale price set at marginal cost

[13] Nothing important would change if we instead restricted $\beta = \gamma\delta$.

assumed as zero[14], the respective profit functions for retailers and the manufacturer can be written as follows

$$\pi_j^d = (p_0 - v)q_{0j} + p_j q_j \qquad j = 1,2. \tag{5}$$

$$\pi^u = v(q_{01} + q_{02}) \tag{6}$$

Where v represents the national brand's uniform wholesale price; the superscript d stands for downstream, u for upstream. Let us now solve the model under no private labeling, a useful benchmark to assess the effect of private labeling on retailer competition.

3. The Benchmark: No Private Labeling

Equation (2) under the restriction $q_1 = q_2 = 0$ becomes: $p_0 = 1 - q_{01} - q_{02}$. Let us first focus on linear pricing and afterwards on wholesale price discrimination.

3.1 Linear Pricing

Given that $q_1 = q_2 = 0$, the retailers' profit can be written as follows: $\pi_j^d = (p_0 - v)\, q_{0j}$. Equation (6) remains valid as manufacturer profit. Using backward induction to solve the game, we start with the last stage subgame.

When there are two active retailers competing à la Cournot, the retail quantities are simultaneously set by them to maximize their individual profit subject to the above given inverse product demand. From the first order conditions, the two retailers' reaction functions can be obtained as follows: $q_{0j} = (1 - v - q_{0k})/2$ with $j,k = 1,2; j \neq k$. Substituting, the following retailers' equilibrium demand functions are found: $q_{0j} = (1 - v)/3$. In the first stage, the monopoly manufacturer sets the linear wholesale uniform price by maximizing π^u subject to the two retailers' equilibrium demand functions already established. It is easy to see that the optimal solution for v is equal to $1/2$. The equilibrium quantity of the good sold by each retailer is $1/6$. The equilibrium retail price is $2/3$. The retailer's equilibrium profit is $1/36$. The manufacturer's equilibrium profit is $1/6$. The channel profit, $\Pi = \pi^u + 2\pi^d$, is

[14] The results are insensitive to restricting the profit functions to zero wholesale price for the private labels immediately.

therefore equal to $2/9$. Welfare can be measured à la Marshall by summing net consumer utility and channel profit. We thus get: $W = U - q_o$ where U is given by (1) under the restriction $q_1 = q_2 = 0$. In equilibrium we get: $5/18$.

When there is a monopoly retailer (let us now assume also that $q_{02} = 0$), it is easily shown that the retailer's equilibrium demand is equal to $(1-v)/2$. The upstream monopolist still finds it optimal to set $v = 1/2$. As a consequence, the monopoly retailer sells in equilibrium $1/4$ at a retail price of $3/4$ and makes a profit of $1/16$. The monopoly manufacturer makes an equilibrium profit of $1/8$. Consequently the equilibrium channel profit is now equal to $3/16$ while welfare is equal to $7/32$.

Comparing the two-retailer case with that of a monopoly retailer, we notice that channel profit is higher with two retailers than with one. Consumers also benefit from a reduced retail price and hence welfare also increases with downstream competition.

3.2 Wholesale Price Discrimination

Now consider the case where the national brand manufacturer can practice perfect price discrimination. To do so, it is sufficient for the latter to use a set of (retailer-specific) two-part tariffs. While the inverse demand function for the national brand is unchanged relative to that of the subsection 3.1, the respective retailers' and manufacturer's profit now become: $\pi_j^d = (p_0 - v_j)q_{0j} - F_j$ with $j = 1,2$ and $\pi^u = v_1 q_{01} + v_2 q_{02} + F_1 + F_2$. F_j represents the fixed fee paid by the j-th retailer. When there are two active retailers, Cournot competition at the last stage gives rise to the following reaction functions: $q_{0j} = (1 - v_j - q_{0k})/2$ for $j,k = 1,2; j \neq k.$ The resulting equilibrium retailer demand functions are $q_{0j} = (1 - 2v_j + v_k)/3$ for $j,k = 1,2; j \neq k.$ In the first stage, the upstream monopolist determines the fully extracting fixed fees as follows: $F_j = (p_0 - v_j)q_{0j}$; consequently his profit becomes equal to the channel profit: $\pi^u = \Pi = p_0(q_{01} + q_{02})$. After having substituted the retailers' equilibrium demands in the inverse demand function and then in the manufacturer's profit function, we are in a position to determine the optimal wholesale price. It is easy to show that the optimal solution is: $v_1 + v_2 = 1/2$. There are infinite combinations of v_1 and v_2 satisfying this condition. The equilibrium industry quantity is consequently equal to: $q_{01} + q_{02} = 1/2$. Hence, in equilibrium, we have: $p_0 = 1/2$ and $\pi^u = \Pi = 1/4$.

When there is only one active retailer (assume now also that $q_{02} = 0$), the inverse demand for the national brand is: $p_0 = 1 - q_{01}$ and, as with linear pricing, the equilibrium retailer demand results in: $(1-v)/2$. The extracting fixed fee is set at: $F = (p_0 - v)q_{01}$. The upstream monopolist's profit is still equal to the channel profit and yields: $\pi^u = \Pi = p_0 q_{01}$. After having substituted the equilibrium retailer demand in the inverse demand function and then in the manufacturer's profit function, we are in a position to optimally determine v, which turns out to be zero (marginal cost pricing). Consequently, the optimal values for quantity and price are both $1/2$. The equilibrium national brand manufacturer profit, equal to the channel profit, is equal to $1/4$.

Comparing the two-retailer case with that of a monopoly retailer, it emerges that final price and industry sales remain unchanged when the number of active retailers increases from one to two. Consequently the equilibrium manufacturer profit, the retailer profit and the channel profit also do not change. The only change involves the wholesale price, which is decreased under downstream monopoly to the marginal cost level. This however produces no further effect.

4. Private Labeling with Linear Pricing

As shown in section 3, when there is no private labeling and with linear pricing, both channel profit and welfare increase when the number of active retailers increases from one to two. No conflict of interest arises between the channel and consumers. Is this result still true with private labeling?

We deal with this question in this section. Let us assume what often occurs in practice: both retailers are ready to market a private label. We first focus on linear uniform pricing; we will relax this assumption in the next section. As already done with no private labeling, we start by studying the model under a downstream duopoly; we will then study it under a downstream monopoly; finally, we will compare the outcomes of the two cases studied.

Applying backward induction, we start at the last stage subgame. Retailers, given v and anticipating consumers' demands, simultaneously choose the national brand and their private label quantities to offer, with the aim of maximizing their own profit. They thus solve the following problem: $\max_{(q_{0j}, q_j)} \pi_j^d \; s.t.(2),(3),(4)$ with $j = 1,2$. The four reaction functions obtained can be expressed in the following matrix equation: $\mathbf{Aq} = \mathbf{v}$, where:

$$\mathbf{A} = \begin{bmatrix} 2 & 1 & 2\beta\delta & \beta \\ 1 & 2 & \beta\delta & 2\beta \\ 2\beta\delta & \beta\delta & 2 & \delta \\ \beta & 2\beta & \delta & 2 \end{bmatrix} \qquad \mathbf{q} = \begin{bmatrix} q_{01} \\ q_{02} \\ q_1 \\ q_2 \end{bmatrix} \qquad \mathbf{v} = \begin{bmatrix} 1-v \\ 1-v \\ 1 \\ 1 \end{bmatrix}$$

By inverting matrix $\mathbf{A}$ and post-multiplying it with vector $\mathbf{v}$, we get the four equilibrium product demands by the two retailers, all dependent on v, which we report in the Appendix as (A1)-(A4). In stage 1, the monopoly manufacturer sets v by solving the following problem: $\max_{(v)} \pi^u \; s.t.(A1),(A2)$. After some easy algebra, the solution turns out to be

$$v^* = \frac{(1-\beta)\left\{2(4+\beta) - 3\beta\delta(1+\beta) - \delta^2(2-\beta+3\beta^2)\right\}}{4\left\{4-\beta^2-\delta^2(1+2\beta^2)\right\}} \tag{7}$$

Substituting (7) in (A1), (A2), (A3) and (A4) we find the solutions for quantities reported in Appendix as (A5)-(A8). Then, substituting the latter in (2), (3) and (4), we find the solutions for prices. Lastly, substituting all the solutions found in the profit functions, we get the solutions for profits. Summing up the three profits, we find the solution for the channel profit, reported in the Appendix as (A9).

Substituting the equilibrium quantities in (1), we can find the equilibrium welfare, also reported in the Appendix as (A10). Comparing the solutions obtained under private labeling with those prevailing under no private labeling, we see that private labeling is always profitable for retailers.[15] The national brand manufacturer loses from

[15] This does not always occur in other models: in Mills (1995) for example, private labeling is profitable for a monopoly retailer only for a given parameter range. This difference however is not due to the assumed type of product differentiation (vertical vs. horizontal) but to the marginal cost normalization. If we indeed

private labeling but since retailers' gains largely offset the manufacturer's loss, channel profit increases with private labeling. Consumers gain from private labeling and hence welfare increases.

Let us now study the model with a monopoly retailer. Suppose for instance that retailer 2 is the only active retailer. Only products 0 and 2 are then on the market. Product 1, retailer 1's private label, is gone. Hence we have: $q_{01} = q_1 = 0$. The inverse product demands are thus the following two: (a) $p_0 = 1 - q_{02} - \beta q_2$ and (b) $p_2 = 1 - q_2 - \beta q_{02}$. At stage 2, the retailer chooses both the national brand and his private label quantities on offer with the aim of maximizing his own profit: $\max_{(q_{02}, q_2)} \pi_2^d \; s.t.(a),(b)$.

Substituting the two first order conditions in each one, we get the following retailer's equilibrium product demands: (c) $q_{02} = (1 - \beta - v)/2(1 - \beta^2)$ and (d) $q_2 = (1 - \beta + \beta v)/2(1 - \beta^2)$. In stage 1, the national brand manufacturer chooses his wholesale price to maximize his profit: $\max_{(v)} vq_{02} \; s.t.(c)$. The solution is $(1 - \beta)/2$. Substituting the latter in (c) and (d), we find the following solutions for exchanged quantities: $q_{02} = 1/4(1 + \beta)$ and $q_2 = (2 + \beta)/4(1 + \beta)$. Equilibrium prices are then: $p_0 = (3 - \beta)/4$ and $p_2 = 1/2$. The retailer's profit is thus equal to $(5 + 3\beta)/16(1 + \beta)$, while the manufacturer's profit is equal to $(1 - \beta)/8(1 + \beta)$. Hence the channel profit is equal to $(7 + \beta)/16(1 + \beta)$. Consequently, welfare is in equilibrium equal to $(19 + 5\beta)/32(1 + \beta)$.

Having solved the model under private labeling with some downstream competition (duopoly) and with no downstream competition (monopoly), we can now compare these two cases. Being aware of the results of this comparison under no private labeling, we are in a position to study the effect of private labeling on individual and social desirability of some downstream competition.

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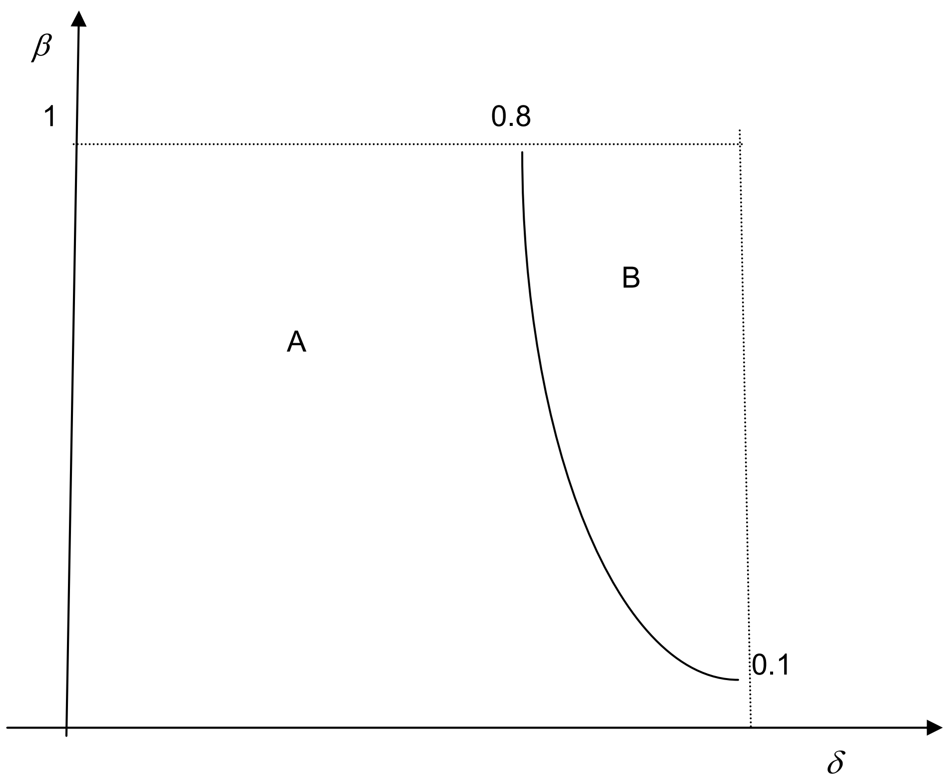
normalized the constant marginal cost to zero in the Mills' model (as we did in our model), we would find that private labeling would become always profitable.

While, under private labeling, welfare with some retailer competition is always higher than that with no retailer competition -just compute the difference between (A10) and welfare under downstream monopoly and study its sign - this is not the case for channel profit. Channel profit with a monopoly retailer can be greater than that with a duopoly. Everything depends on parameter values. We need to make a numerical analysis to identify the parameter conditions under which this occurs. Computing the difference between (A9) and the channel profit under downstream monopoly, it is indeed shown that the channel profit is greater with a downstream monopoly than with a duopoly, provided that either all products are very close substitutes (β and δ both close to one) or that, with the two private labels close substitutes ($\delta > 0.8$), the national brand and the private label are not too differentiated. The higher δ, the lower β can be, to ensure that the channel profit is greater under downstream monopoly than under duopoly. This occurs in region B in the following figure



A=Channel profit higher with downstream duopoly
B= Channel profit higher with downstream monopoly

Figure 1- Comparing Channel Profit with a Downstream Duopoly Against Downstream Monopoly under Private Labeling and Linear Pricing.

Region B disappears with no private labeling. The downward-sloping convex curve in the graph represents the iso-channel-profit curve, such that: $\Pi(duop)=\Pi(monop)$.The following proposition has thus been demonstrated

Proposition 1. With private labeling and under linear pricing, channel profit with a downstream monopoly is higher than with a downstream Cournot duopoly, provided that we are in region B in figure 1. Welfare, however, is always higher with a downstream duopoly.

To help grasp the economic intuition behind the proposition, let us look at table 1, which presents a numerical simulation taken both with private labeling (for specific cases both in region A and B) and without private labeling . The table shows that, with no private labeling, the national brand manufacturer strongly prefers a downstream duopoly to a downstream monopoly (π^{u} equal to 0.1667 rather than 0.125) because he can sell much more ($q_{01}+q_{02}$ equal to 0.3334 rather than 0.25) at the same wholesale price ($v=0.5$ in both cases). The downstream industry, on the contrary, prefers to be organized as a monopoly (a profit of 0.0625 being better than 0.0556) because the retail price and thus its profit margin would increase and this prevails on the induced reduction in sales. We know that the former effect prevails on the latter so that the vertical channel, with no private labeling, prefers to have downstream competition (0.2223 better than 0.1875). But when private labels as very close substitutes to each other are marketed ($\delta=0.99$), the downstream industry's profit is much higher under a downstream monopoly (0.2708) than under a downstream duopoly (0.2421). Furthermore, the national brand sales increase due to downstream competition (0.1114+0.1107-0.1667=0.0544) is smaller in this case than that under no private labeling (0.1667+0.1667-0.25=0.0831). This brings about an increase in the national brand manufacturer profit due to downstream competition (0.0556-0.0417=0.0139) that is smaller than that obtained with no private labeling (0.1667-0.125 = 0.0417). It follows that the small gain made by the national brand manufacturer when some downstream competition is introduced is certainly not sufficient to convince retailers to go on competing with each other, giving up the opportunity of a horizontal merger or a cartel (a loss of 0.2708-0.2421 = 0.0285). So, when private labels as very close substitutes to each other are marketed, channel profit is larger with a downstream monopoly than with a downstream duopoly. Consumers, however, always prefer some downstream competition to a downstream monopoly, because of reduced prices and more product variety. This gain always prevails on the possible channel profit loss and hence welfare is higher with a downstream duopoly, both with and without private labeling, as confirmed in table 1.

Table 1 - A Numerical Simulation under Linear Pricing

	Private Labeling		($\beta = 0.5$)	No Private Labeling	
	DUOP $\delta = 0.99$ ($\gamma = 0.495$)	MON	DUOP $\delta = 0.5$ ($\gamma = 0.25$)	DUOP	MON
q_{01}	0.1114	0	0.1506	0.1667	0.25
q_{02}	0.1107	0.1667	0.0775	0.1667	0
q_1	0.2797	0	0.3699	0	0
q_2	0.2784	0.4167	0.3311	0	0
v	0.2504	0.25	0.2708	0.5	0.5
p_0	0.5003	0.625	0.5139	0.6667	0.75
p_1	0.3348	/	0.4075	/	/
p_2	0.3337	0.5	0.3699	/	/
π_1^d	0.1215	/	0.1873	0.0278	0.0625
π_2^d	0.1206	0.2708	0.1413	0.0278	0
π^u	0.0556	0.0417	0.0618	0.1667	0.125
Π	0.2977	0.3125	0.3904	0.2223	0.1875
W	0.5389	0.4479	0.6598	0.2778	0.2188

Thus, with private labeling, in region B in figure 1, firms might well reach an agreement to consolidate the retail industry and promote a downstream monopoly, even if this is not in the interest of consumers and society as a whole. Since this conflict of interests does not occur with no private labeling -more retail competition is in everybody's interest in this case- it is right to claim that private labeling may well induce the consolidation of the retail industry.

With private labeling, the channel makes the highest profit in table 1 under duopoly, when the products are all highly differentiated ($\delta = 0.5$). If the national brand manufacturer could choose product differentiation through advertising, he would wish to promote maximal differentiation (provided that the price of advertising is sufficiently low, as we will see in more detail few lines below). This result is not surprising, given that it aims at mitigating quantity competition between retailers. However, offsetting effects, not considered yet, may well be working in reality and convince the retailer to imitate the national brand rather than to offer a highly differentiated product. For example the cost savings of imitation in packaging and/or the negotiation motivation of the imitation strategy illustrated by Scott Morton-Zettelmeyer (2004) can produce this. Also, ineffective advertising by national brand manufacturers and/or an advertising unit cost too high can produce this. To illustrate the latter point, suppose now that, in a new stage at the beginning, the national brand manufacturer could optimally choose β (and hence γ) through his advertising Z with a unit cost equal to s. His profit will now become: $\pi^u = v(q_{01} + q_{02}) - sZ$. Then he will advertise insofar as: $d\pi^u / dZ = (\partial\pi^u / \partial\beta)(d\beta / dZ) - s > 0$. If $d\beta / dZ$ is low or if s is very high, very little advertising will be made. For these reasons, it is not to take for granted that, when a national brand manufacturer can freely choose advertise, he does it heavily and make products very differentiated. Proposition 1 could thus hold even when national brand manufacturers can choose advertising.

But when downstream monopolization brings about a strong increase in the retailer's bargaining power, the national brand manufacturer can find it profitable to avoid downstream monopolization. See Colangelo (2006) for a more detailed analysis in this direction.[16] Proposition 1 thus holds only when the latter event does not occur.

5. Private Labeling with Wholesale Price Discrimination

Now we study how private labeling affects the individual and social desirability of downstream competition under wholesale price discrimination. This more complex pricing is often observed in vertical contracting between manufacturers and retailers and hence the analysis now becomes more realistic. Furthermore, it is interesting to see whether private labeling can coexist with nonlinear pricing. Mills (1999, pag.135) has indeed pointed out that private labeling could not occur when a wholesale two-part tariff is feasible given that, with this form of wholesale pricing, double marginalization could be absent. This conjecture is however at variance with empirical evidence.

[16] A noncooperative bilateral bargaining model like the famous Rubinstein's (1982) would give the same result under appropriate parameter conditions.

Wholesale price discrimination could be used by a leading national brand manufacturer as a countermove to retailers' private labeling.[17] Remaining in a perfect and complete information environment as with linear pricing, this section will focus on wholesale perfect price discrimination. This gives the manufacturer the maximal ability to defend him from private labeling by choosing wholesale pricing optimally.[18] They do however face a limit in their ability to exploit retailers through wholesale price discrimination: due to a retailer's ability to market a private label, the retailer could indeed refuse the sales proposal, sell only her private label and still make a profit. Private labeling thus represents an outside option for retailers, which guarantees them a strictly positive reservation profit, even when the manufacturer has the ability of practicing wholesale perfect price discrimination.[19] A retailer's equilibrium reservation profit is thus equal to the profit made by them when selling only their private label while their rival sells both the national brand and the private label.

In section 2, it was shown that, under no private labeling, and with wholesale perfect price discrimination, the manufacturer profit, the retailer profit, the channel profit and welfare are all unchanged when downstream competition is introduced. Hence all parts are, under these conditions, indifferent to downstream competition. What happens with private labeling? To see this, following the same methodology used with linear pricing, first the case with downstream competition (a Cournot duopoly) is solved, then with no downstream competition (a monopoly retailer), making it possible to draw some interesting conclusions by comparing the two equilibrium outcomes.

When there are two retailers, a system of two retailer-specific two-part tariffs (v_1, v_2, F_1, F_2) is sufficient to implement wholesale perfect price discrimination. In the last stage of the game, retailers will choose quantities according to a Cournot subgame. We must then reanalyze this subgame allowing possibly discriminatory wholesale unit prices: $v_1 \neq v_2$. When this is done, the same analytical procedure as

[17] Let us assume that vertical contracts are public and non renegotiable: if there was a lack of commitment by the national brand manufacturer not to renegotiate with a retailer in an attempt to exploit the unobservability of a third party contract along the lines highlighted among others by Hart-Tirole (1990) and McAfee-Schwartz (1994), wholesale price discrimination would not be a good manufacturer countermove to private labeling.

[18] The comparison between our results, illustrated later, and those obtained by Avenel-Caprice (2006) in a different but related model under a single two-part tariff suggests that our assumption of wholesale perfect price discrimination is not driving the obtained results. They should indeed hold qualitatively even under more restricted wholesale pricing schemes.

[19] We can see in numerical simulations that, in these circumstances, retailer profit may well be higher than that of the national brand manufacturer.

under linear pricing leads to the following matrix equation: $\mathbf{Aq} = \mathbf{w}$, where:

$$\mathbf{w} = \begin{bmatrix} 1 - v_1 \\ 1 - v_2 \\ 1 \\ 1 \end{bmatrix}.$$

By inverting matrix $\mathbf{A}$ and post-multiplying it with vector $\mathbf{w}$, we get the four equilibrium product demands by retailers that we report in the Appendix as (A11)-(A14) and that solve the last stage subgame. In stage 1 the two retailer-specific fixed fees will be optimally set by the manufacturer with the aim of leaving each retailer respectively only their reservation profit. They will then be determined as follows: $\pi_j^d - F_j = \bar{\pi}_j$ with $j = 1,2$, where $\bar{\pi}_j > 0$ represents the j-th retailer's strictly positive reservation profit. In turn, the manufacturer profit results in: $v_1 q_{01} + v_2 q_{02} + F_1 + F_2$. Substituting for F_j the former equation in the latter, the manufacturer profit can be expressed as follows: $p_0(q_{01} + q_{02}) + p_1 q_1 + p_2 q_2 - \bar{\pi}_1 - \bar{\pi}_2$. The (national brand) manufacturer will get the channel profit net of the reservation profits paid to retailers. He chooses v_1 and v_2 with the aim of maximizing his profit under the constraint of (2), (3), (4), (A11), (A12), (A13), (A14). Before proceeding to their determination, however, we need to find the retailers' equilibrium reservation profits. We find them in the Appendix (see B.b). It turns out that: $\bar{\pi}_1 = 1/(2+\delta)^2 > 0$; and $\bar{\pi}_2 = \left[G - \beta(1-\delta^2)(1-v_1)\right]^2 / \left[4 - \delta^2 - \beta^2(1+2\delta^2)\right]^2 > 0$ where $G = 2 - \delta + \beta^2 \delta(1-2\delta)$. While retailer 1's reservation profit does not depend on wholesale unit prices, retailer 2's reservation profit does depend on v_1. The higher v_1, the higher $\bar{\pi}_2$. This strictly depends on $\delta < 1$. As already noted, some asymmetry in the demand functions has been introduced through this (realistic) assumption and this affects the reservation profits, which have become asymmetric too. Notice that, when $\delta = 1$, symmetry is restored: $\bar{\pi}_1 = \bar{\pi}_2 = 1/9$. When $\delta < 1$, the manufacturer will consider this asymmetry in determining their optimal wholesale pricing. In particular, they will want to make a wholesale price discrimination against retailer 2 based on a low v_1, with the aim of controlling the size of retailer profit.

Having obtained the retailers' equilibrium reservation profits, we are in a position to determine the optimal wholesale unit prices. Unfortunately the solutions appear very cumbersome and only an implicit formulation is provided in the Appendix [see (A18)-(A19)]. We focus instead on numerical analysis that nevertheless allows us to study retailers' product line decisions induced by the national brand manufacturer's wholesale pricing and product substitutability.

As it emerges clearly from figure 2, we have identified two different equilibrium product line patterns. When the brands are not close substitutes (area A in figure 2), the manufacturer practices a highly discriminatory wholesale pricing and induces retailer 2 not to offer the national brand. Only retailer 1 offers both brands. When instead the brands are close substitutes (area B in figure 2), the manufacturer practices a rather flat wholesale pricing and hence both retailers offer both brands. The following proposition follows:

Proposition 2. With private labeling, under wholesale perfect price discrimination, in case of a downstream Cournot duopoly, the national brand manufacturer sets highly discriminatory wholesale unit prices and hence induces only one retailer to sell his brand, provided that we are in region A in figure 2. When we are in region B, he prefers to practice almost no price discrimination and as a result both retailers offer a complete product line (national brand and their own private label).

When goods are very close substitutes (e.g. $\beta = \delta = 0.99$) the national brand manufacturer practices almost no wholesale price discrimination and induces the two retailers to sell both brands, because this increases the national brand sales while the corresponding national brand price decrease is very small, given the strong cross-effect on inverse demands. Retailers' reservation profits are small so it is good to have both active. But when goods are looser substitutes (e.g. $\beta = \delta = 0.5$), the national brand manufacturer finds it profitable to set highly discriminatory pricing against retailer 2, inducing the retailer not to offer the national brand and so decreasing their reservation profit. Both national brand sales and prices will decrease slightly but with the advantage of reducing retailer 2's reservation profit -this latter effect is the driving factor in this case.

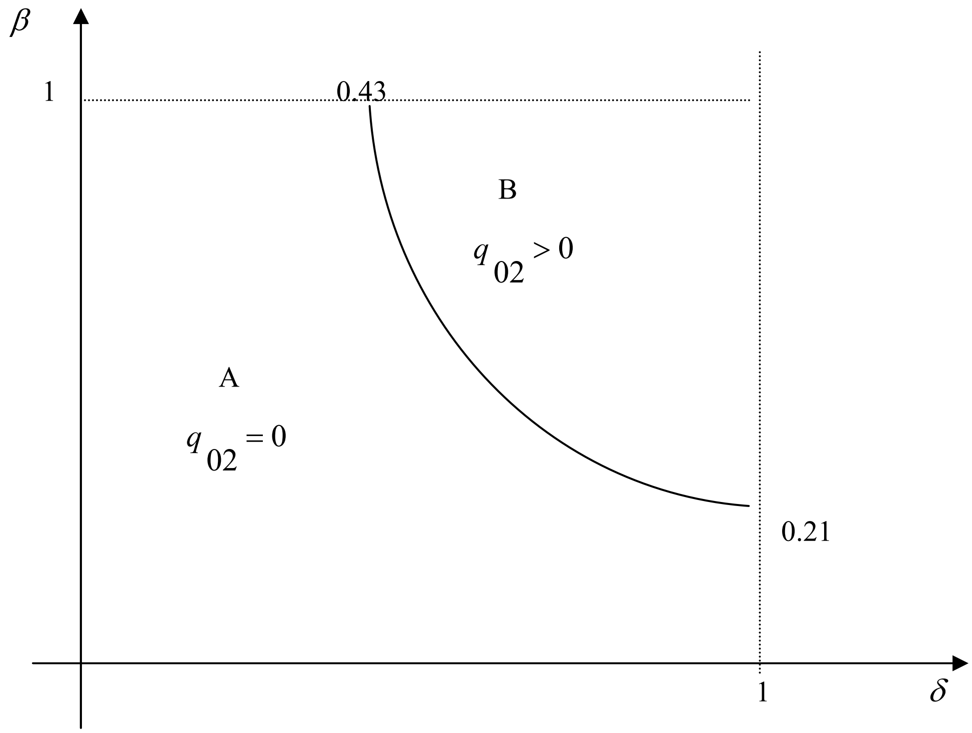


Figure 2 – Retailers' Equilibrium Product Lines with Wholesale Price Discrimination in Case of a Downstream Duopoly.

We can now proceed to the study of the two relevant cases not yet analyzed: the case with two retailers in which only one sells the national brand ($q_{02} = 0$) that occurs in area A of figure 2 and the monopoly retailer case. Only after that will it be possible to evaluate the impact of private labeling on downstream competition under wholesale price discrimination.

When retailer 2 does not sell the national brand ($q_{02} = 0$), the inverse demand equations become the following: $p_0 = 1 - q_{01} - \beta\delta q_1 - \beta q_2$, $p_1 = 1 - q_1 - \beta\delta q_{01} - \delta q_2$ and $p_2 = 1 - q_2 - \beta q_{01} - \delta q_1$. The profit functions are thus equal to: $\pi_1^d = (p_0 - v)q_{01} + p_1 q_1 - F$, $\pi_2^d = p_2 q_2$ and $\pi^u = vq_{01} + F$.

Again, the national brand manufacturer will set F to leave retailer 1 only his reservation profit: $\pi_1^d = \bar{\pi}_1$. The national brand manufacturer profit is thus equal to: $p_0 q_{01} + p_1 q_1 - \bar{\pi}_1$. The latter term is determined as the profit retailer 1 would make if they refused the sales proposal from the national brand manufacturer. In this case both retailers would sell only their private labels. It is easy to show that retailer 1's reservation profit is unchanged as compared with the previous case: $\bar{\pi}_1 = 1/(2+\delta)^2$. From the retailers' optimization problem in stage 2, substituting the reaction functions with each other and after some algebraic manipulations, we get their equilibrium demand functions, which are entered as (A15)-(A17) in the Appendix. In stage 1 the national brand manufacturer sets the wholesale price with the aim of maximizing his profit under the constraint of the above expressed inverse demand functions and of (A15)-(A17). It is straightforward to calculate that optimal v is given by (A20). The solutions for quantities, manufacturer profit, channel profit and welfare are all reported in the Appendix as (A21)-(A26).

Let us now study private labeling under wholesale perfect price discrimination in the case of a monopoly retailer. Assume that only retailer 1 is active (then we have: $q_{02} = q_2 = 0$). The inverse product demand equations in this case are: $p_0 = 1 - q_{01} - \beta\delta q_1$ and $p_1 = 1 - q_1 - \beta\delta q_{01}$. The profit equations are respectively: $\pi_1^d = (p_0 - v)q_{01} + p_1 q_1 - F$ and $\pi^u = vq_{01} + F$. The national brand manufacturer will set the fixed fee so as to leave the retailer only their reservation profit. The national brand manufacturer profit is thus equal to: $p_0 q_{01} + p_1 q_1 - \bar{\pi}_1$. It is clear that $\bar{\pi}_1 = \frac{1}{4}$. In the final stage, the retailer decides how much of the two brands to offer; the following equilibrium demand functions are easily established: $q_{01} = (1 - \beta\delta - v)/2(1 - \beta^2\delta^2)$ and $q_1 = [1 - \beta\delta(1 - v)]/2(1 - \beta^2\delta^2)$. In stage 1 the national brand manufacturer will set v to maximize his profit under the constraint of the above defined inverse demand functions and the retailer's equilibrium product demands. It is clear that wholesale marginal cost pricing is optimal: $v^* = 0$. Hence a simple computation shows that: $q_{01}^{*} = q_{1}^{*} = \Pi^{*} = 1/[2(1+\beta\delta)]$, $p_{01}^{*} = p_{1}^{*} = 1/2$, $\pi^{u}* = (1-\beta\delta)/[4(1+\beta\delta)]$ and $W^{*} = 3/[4(1+\beta\delta)]$.

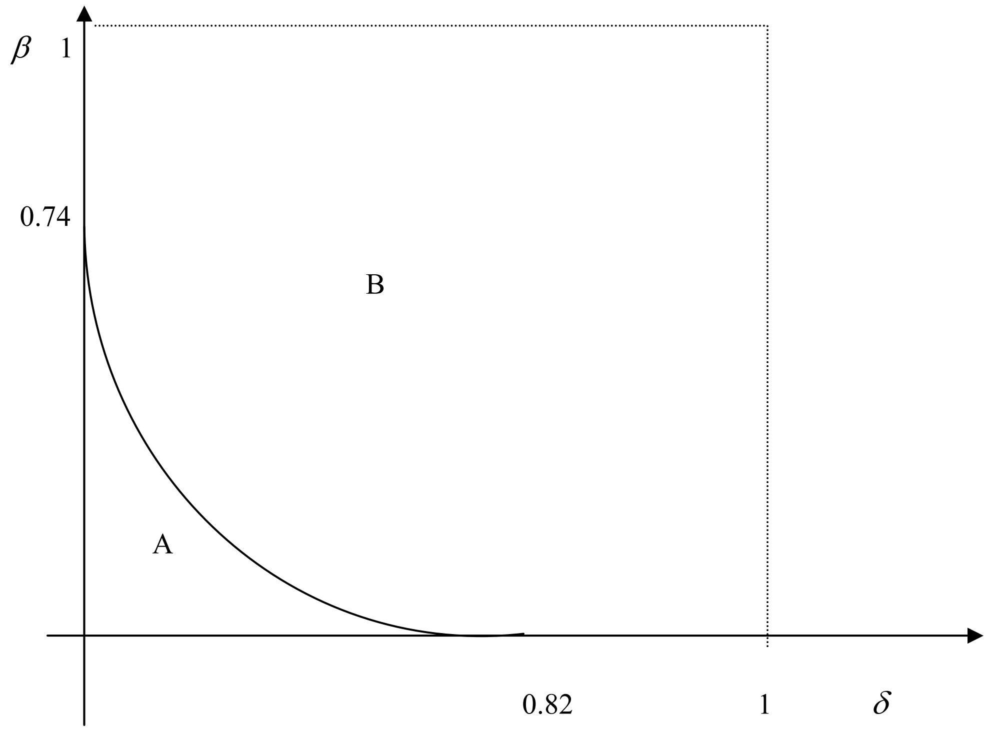
Having solved the monopoly retailer case, it is now possible to compare the two cases studied. While manufacturer profit is always higher with a downstream monopoly, welfare is always higher with a downstream duopoly. As for channel profit, everything depends on parameter values. Figure 3 shows the two existing regions (obtained by numerical simulations), in which channel profit is higher respectively with a downstream duopoly and with a downstream monopoly.The following proposition thus holds:

Proposition 3. When both retailers can market their own private labels and there is wholesale perfect price discrimination, the national brand manufacturer prefers to have a monopoly retailer. The vertical channel prefers a downstream monopoly only when goods are not loose substitutes (area B in figure 3). When they are loose substitutes, the vertical channel prefers a downstream duopoly (area A in figure 3). Welfare is always higher with a downstream duopoly.

The conflict of interest between firms and consumers is stronger with wholesale price discrimination than with linear pricing, because in the former case, unlike the latter, a downstream monopoly is preferable for the vertical channel for a larger range of product substitutability and because the national brand manufacturer is always in favor of a downstream monopoly. Thus, private labeling has an even stronger role in the consolidation of the retail industry under wholesale pricing. The national brand manufacturer (and often the vertical channel) finds it profitable to restrict the number of retailers, with the aim of mitigating product competition from private labels and thus increasing retail prices significantly. Only when products are loose substitutes can the vertical channel accept the (slightly) lower retail prices given by downstream competition, to achieve a strong sales increase both for the national brand and private labels.

Even in the absence of a double mark-up, as might happen with wholesale perfect price discrimination, private labeling remains profitable for the vertical channel. This applies both with a monopoly retailer and with a downstream duopoly (but, in the latter case, provided that products are not too close substitutes).Thus, with wholesale perfect price discrimination, the rationale for private labeling does not rely necessarily on mitigating the double mark-up, as it was in Mills (1995), but rather on offering a more satisfactory product line to customers, by increasing product variety. This makes consumer surplus higher and gives the vertical channel the chance of more fully appropriating it. Private labeling can thus easily coexist with (wholesale) nonlinear pricing.

As a further by-product, comparing the equilibrium product lines under linear pricing with those under wholesale perfect price discrimination, it has also been demonstrated that the available wholesale pricing scheme plays a crucial role in determining the equilibrium product line. Ceteris paribus, linear pricing makes identical and complete equilibrium product lines more probable, while, with wholesale perfect price discrimination, different and partial product lines are more likely.



A: Channel profit higher with downstream duopoly
B: Channel profit higher with downstream monopoly

Figure 3 - Comparing Channel Profit with a Downstream Duopoly Against a Downstream Monopoly under Private Labeling and with Wholesale Price Discrimination

6. Conclusions

We have seen that private labeling may well have anticompetitive effects in the retail industry, favoring a monopoly retailer, while without it, some competition between retailers would take place. This occurs regardless of the available wholesale pricing scheme: either with linear pricing or with price discrimination. However, wholesale price discrimination makes a downstream monopoly more likely than linear pricing, because, unlike the latter case, in the former case the national brand manufacturer is in favor of a single retailer for any kind of product substitutability and the vertical channel is more often in favor of a downstream monopoly.

The data collected by ACNielsen (2005), in showing a strong positive correlation between country-level private label shares and retailer concentration (measured by CR5), seem consistent with the explanation offered in the paper. Of the 38 countries studied, all fit the above mentioned correlation with the exception of the four Scandinavian countries (e.g. Norway, Finland, Sweden and Denmark), where the retail industry is highly concentrated but private label penetration is small.

A cumulative process thus seems likely: if high concentration in the retail industry fosters private labeling (indeed, only large retailers can afford to market private labels), there are also reasons to believe that this phenomenon in turn brings about more concentration in the industry.

Because of this negative long-run effect of private labeling, antitrust authorities should be more severe with large grocery retailers, in particular through a careful scrutiny of their Merger & Acquisition operations, especially in countries where private labeling is highly developed.

Two additional results were reached on the theme of private labeling and equilibrium product lines: (i) even in the absence of a double mark-up problem, which is common with (wholesale) nonlinear pricing, private labels may well arise in equilibrium: they represent in this case an instrument to offer a better product line; (ii) in determining the equilibrium product line, the available wholesale pricing scheme plays a crucial role: ceteris paribus, with linear pricing, identical and complete product lines occur in equilibrium; with wholesale perfect price discrimination, different and incomplete product lines are more likely.

Two issues have proved important in obtaining these results: advertising and bargaining power. When advertising is very effective in increasing product differentiation and is not very costly, firms prefer to have downstream competition between very differentiated products, even under private labeling. Also, when a bilateral monopoly would bring too much negotiation power to the retailer, the national brand manufacturer prefers to have more downstream competition even with private labels. Furthermore, the magnitude of the effects we study could change if we started from a higher number of retailers. Results have been reached by comparing equilibrium outcomes respectively with one and with two retailers. Analytical complexity prevented us from investigating a more general situation.

Appendix

A. Private Labeling with Linear Pricing: the Duopoly Case

a. The retailers' equilibrium demand functions

$$q_{01} = \frac{\left[\alpha(1-v) - 3\beta\delta(2-\delta)\right]}{3(\alpha - 3\beta^2\delta^2)} \tag{A1}$$

$$q_{02} = \frac{\alpha - 3\beta(2-\delta) + \beta^2(2-5\delta^2) + 3\delta\beta^3(2\delta-1) - \left\{\alpha + \beta^2(2-5\delta^2)\right\}v}{3(1-\beta^2)(\alpha - 3\beta^2\delta^2)} \tag{A2}$$

where $\alpha = 4 - \delta^2$.

$$q_1 = \frac{2 - \delta(1+\beta) + \beta\delta v}{\alpha - 3\beta^2\delta^2} \tag{A3}$$

$$q_2 = \frac{(1-\beta)\left\{2 - \delta(1+\beta) + \beta\delta^2(1-\beta)\right\} + \beta\left\{2 - \delta^2(1+\beta^2)\right\}v}{(1-\beta^2)(\alpha - 3\beta^2\delta^2)} \tag{A4}$$

b. The solutions

$$q_{01}^* = \frac{2\alpha^2 - 3\alpha\beta(2-\delta)(3\delta-1) - 2\alpha\beta^2(1+2\delta^2) + 3\beta^3\delta(2-\delta)f}{12(\alpha - 3\beta^2\delta^2)\left\{\alpha - \beta^2(1+2\delta^2)\right\}} \tag{A5}$$

where $f = 2 - 3\delta + 7\delta^2$.

$$q_{02}^{*} = \frac{\begin{aligned}&32-16\delta^{2}+2\delta^{4}-5\beta(8-12\delta+2\delta^{2}+3\delta^{3}-\delta^{4})-\beta^{2}(32-60\delta+\\ &68\delta^{2}+15\delta^{3}-19\delta^{4})+\beta^{3}(4-6\delta+28\delta^{2}-39\delta^{3}+13\delta^{4})\\ &-3\beta^{4}\delta(2-10\delta+13\delta^{2}-11\delta^{3})\end{aligned}}{12(1+\beta)(\alpha-3\beta^{2}\delta^{2})\left\{\alpha-\beta^{2}(1+2\delta^{2})\right\}} \tag{A6}$$

$$q_{1}^{*} = \frac{2\alpha\{2(2-\delta)-\beta\delta\}-\beta^{2}(2-\delta)(4+3\delta+11\delta^{2})+\delta\beta^{3}h}{4(\alpha-3\beta^{2}\delta^{2})\left\{\alpha-\beta^{2}(1+2\delta^{2})\right\}} \tag{A7}$$

where: $h=2(1+2\delta^{2})+3\beta\delta(1+\delta)$.

$$q_{2}^{*} = \frac{\begin{aligned}&4(8-4\delta-2\delta^{2}+\delta^{3})+2\beta(8-8\delta+2\delta^{2}+2\delta^{3}-\delta^{4})-\beta^{2}(4+2\delta+\\ &32\delta^{2}-11\delta^{3}-3\delta^{4})-\beta^{3}\delta(2+18\delta-11\delta^{2}+3\delta^{3})+\beta^{4}\delta^{2}(2+3\delta+7\delta^{2})+\\ &3\beta^{5}\delta^{3}(1+\delta)\end{aligned}}{4(1+\beta)(\alpha-3\beta^{2}\delta^{2})(\alpha-\beta^{2}(1+2\delta^{2}))} \tag{A8}$$

$$\Pi^* = \frac{\begin{array}{l} 16(2-\delta)^2\alpha^2(26+8\delta+2\delta^2+11\beta-10\beta\delta-\beta\delta^2)-4\beta^2(2-\delta)\alpha \\ (464+4\delta+1772\delta^2-161\delta^3-292\delta^4-59\delta^5)-4\beta^3(2-\delta)\alpha(188-296\delta+ \\ 803\delta^2-902\delta^3+89\delta^4+118\delta^5)+\beta^4(2-\delta)(952+1028\delta+12222\delta^2+ \\ 2349\delta^3+20382\delta^4-60\delta^5-5044\delta^6-725\delta^7)+\beta^5(2-\delta)(328-508\delta+ \\ 4698\delta^2-6543\delta^3+8466\delta^4-7800\delta^5-532\delta^6+1891\delta^7)-6\beta^6\delta(56+ \\ 340\delta+432\delta^2+1773\delta^3-78\delta^4+1986\delta^5-842\delta^6-211\delta^7)-6\beta^7\delta^2 \\ (104-180\delta+657\delta^2-1044\delta^3+1056\delta^4-936\delta^5+343\delta^6)+27\beta^8\delta^3(12+ \\ 13\delta+46\delta^2+44\delta^3+38\delta^4+39\delta^5)+27\beta^9\delta^4(1+\delta)^3(1-\delta) \end{array}}{(1+\beta)H} \qquad \text{(A9)}$$

where: $H = 144(\alpha-3\beta^2\delta^2)\left\{\alpha-\beta^2(1+2\delta^2)\right\}\left\{\alpha(\alpha-\beta^2-5\beta^2\delta^2)+ 3\beta^4\delta^2(1+2\delta^2)\right\}.$

$$W^* = \frac{\begin{array}{l}16(2-\delta)\alpha(74+38\delta+5\delta^2)(2\alpha-4\delta+\delta^3)+16\beta(2-\delta)\alpha(41-7\delta \\ -7\delta^2)(2\alpha-4\delta+\delta^3)-8\beta^2(2-\delta)\alpha(580+284\delta+2503\delta^2+107\delta^3 \\ -572\delta^4-94\delta^5)-4\beta^3(2-\delta)\alpha(596-308\delta+2669\delta^2-1535\delta^3-403\delta^4 \\ +277\delta^5)+\beta^4(2-\delta)(2200+4244\delta+31302\delta^2+18585\delta^3+59694\delta^4 \\ +3936\delta^5-16084\delta^6-2789\delta^7)+\beta^5(2-\delta)(1000-172\delta+14706\delta^2 \\ -4563\delta^3+28770\delta^4-13308\delta^5-6244\delta^6+3139\delta^7)-6\beta^6\delta(152+820\delta \\ +1584\delta^2+4689\delta^3+1650\delta^4+5352\delta^5-2198\delta^6-817\delta^7)-6\beta^7\delta^2(344 \\ -36\delta+2133\delta^2-900\delta^3+2838\delta^4-2196\delta^5+409\delta^6)+27\beta^8\delta^3(28+41\delta \\ +134\delta^2+144\delta^3+150\delta^4+127\delta^5)+27\beta^9\delta^4(1+\delta)^2(13+23\delta^2)\end{array}}{288(1+\beta)(\alpha-3\beta^2\delta^2)^2\left\{\alpha-\beta^2(1+2\delta^2)\right\}^2} \quad \text{(A10)}$$

B. Private Labeling with Wholesale Price Discrimination: the Duopoly Case

a. The equilibrium retailers' demand functions are:

$$q_{01} = \frac{\left[\alpha(1+v_2-2v_1)-3\beta\delta(2-\delta)\right]}{3(\alpha-3\beta^2\delta^2)} \quad \text{(A11)}$$

$$q_{02} = \frac{\begin{array}{c}\alpha - 3(2-\delta)\beta + \beta^2(2-5\delta^2) + 3\beta^3\delta(2\delta-1) + (1-\beta^2)\alpha v_1 \\ -2\left\{\alpha - \beta^2(1+2\delta^2)\right\}v_2\end{array}}{3(1-\beta^2)(\alpha - 3\beta^2\delta^2)} \qquad \text{(A12)}$$

$$q_1 = \frac{2-\delta(1+\beta) + 2\beta\delta v_1 - \beta\delta v_2}{\alpha - 3\beta^2\delta^2} \qquad \text{(A13)}$$

$$q_2 = \frac{(1-\beta\delta)\{2(1-\beta) - \delta(1-\beta(2-\beta))\} - \beta\delta^2(1-\beta^2)v_1 + 2\beta\eta v_2}{(1-\beta^2)(\alpha - 3\beta^2\delta^2)} \qquad \text{(A14)}$$

where: $\eta = 1 - \beta^2\delta^2$.

b. The retailers' reservation profit

A retailer's reservation profit is equal to the equilibrium profit earned by them when they sell only their private label and the rival sells both the national brand and their own private label. Hence, to determine $\bar{\pi}_1$, we need to solve the case where: $q_{01} = 0$ while $q_{02}, q_1, q_2 > 0$. When this is the case, the product demand equations given by (2)-(4) are modified as follows: $p_0 = 1 - q_{02} - \beta\delta q_1 - \beta q_2$; $p_1 = 1 - q_1 - \beta\delta q_{02} - \delta q_2$ and $p_2 = 1 - q_2 - \beta q_{02} - \delta q_1$. The retailers' profit functions are equal to: $\bar{\pi}_1 = p_1 q_1$; $\pi_2^d = (p_0 - v_2)q_{02} + p_2 q_2 - F_2$. Solving the last stage Cournot subgame, the following three reaction functions are easily obtained:

$q_1 = (1-\beta\delta q_{02} - \delta q_2)/2$, $q_{02} = (1 - v_2 - \beta\delta q_1 - 2\beta q_2)/2$,

$q_2 = (1 - 2\beta q_{02} - \delta q_1)/2$. Substituting, the following retailers' equilibrium demand equations are obtained: $q_1 = 1/(2+\delta)$,

$q_{02} = (1-\beta-v_2)/2(1-\beta^2)$,

$q_2 = \left[(1-\beta)(2-\beta\delta)+\beta(2+\delta)v_2\right]/\left[2(2+\delta)(1-\beta^2)\right]$. Substituting the latter three equations in the p_1 equation, it is easy to see that $p_1 = 1/(2+\delta)$. Hence, it follows: $\bar{\pi}_1 = p_1 q_1 = 1/(2+\delta)^2$.

As for determining $\bar{\pi}_2$, we need to solve the model when $q_{02} = 0$ while $q_{01}, q_1, q_2 > 0$. When this is the case, the product demand equations given by (2)-(4) are modified as follows: $p_0 = 1 - q_{01} - \beta\delta q_1 - \beta q_2$; $p_1 = 1 - q_1 - \beta\delta q_{01} - \delta q_2$ and $p_2 = 1 - q_2 - \beta q_{01} - \delta q_1$. The retailers' profit functions are equal to: $\pi_1^d = (p_0 - v_1)q_{01} + p_1 q_1 - F_1$; $\bar{\pi}_2 = p_2 q_2$. Solving the last stage Cournot subgame, the following three reaction functions are easily obtained: $q_{01} = (1 - v_1 - 2\beta\delta q_1 - \beta q_2)/2$, $q_1 = (1 - 2\beta\delta q_{01} - \delta q_2)/2$ and

$q_2 = (1 - \beta q_{01} - \delta q_1)/2$. Substituting, the following retailers' equilibrium demand equations are obtained:

$$q_{01} = \frac{\left[\alpha(1-v_1) - \beta(2-\delta)(1+2\delta)\right]}{2\left[\alpha - \beta^2(1+2\delta^2)\right]} \tag{A15}$$

$$q_1 = \frac{2(2-\delta) + \beta^2(2\delta - 1) - 3\beta\delta(1 - v_1)}{2\left[\alpha - \beta^2(1 + 2\delta^2)\right]} \qquad \text{(A16)}$$

$$q_2 = \frac{2 - \delta + \beta^2\delta(1 - 2\delta) - \beta(1 - \delta^2)(1 - v_1)}{\alpha - \beta^2(1 + 2\delta^2)} \qquad \text{(A17)}$$

Substituting these three equations in the price equation for p_2, it is shown that:

$p_2 = q_2$. It follows that: $\bar{\pi}_2 = q_2^2$.

c. Optimal wholesale unit prices when $q_{02} > 0$

Given the equilibrium retailer demand functions expressed as (A11)-(A14) and given the resulting equilibrium retailer reservation profits, the upstream monopolist in stage 1 chooses v_1 and v_2 with the aim of maximizing $\Pi - \bar{\pi}_1 - \bar{\pi}_2$. Computing the two first-order conditions, after some algebraic manipulations, we have:

$$v_2 = \frac{\left\{\alpha^2 - 2\beta^2(8 + 8\delta^2 - 7\delta^4) + 3\beta^4\delta^2(8 - 5\delta^2)\right\}(1 - 2v_1) + 9\beta\delta\left\{2\beta^2(2 - 2\delta + 3\delta^2 - 2\delta^3) - \beta^4\delta^2(5 - 4\delta) - (2 - \delta)^2\right\}}{2\left[\alpha^2 + \beta^2(20 - 43\delta^2 + 5\delta^4) - 3\beta^4\delta^2(7 - 10\delta^2)\right]} \qquad \text{(A18)}$$

$$\left[\alpha-\beta^{2}(1+2\delta^{2})\right]^{2}\left[\alpha^{2}(1-2v_{1}-2v_{2})-3\beta\delta^{2}\left\{3(2-\delta^{2})+(7\delta^{2}-4)\right.\right.$$
$$\left.\left.(\beta-2v_{1})-3\beta^{2}\delta(5\delta-4)-2\beta(8-5\delta^{2})v_{2}\right\}\right]-18\beta\left[\alpha^{2}-3\beta^{2}\delta^{2}\right]^{2}$$
$$(1-\delta^{2})\left[2-\delta-\beta(1-\delta^{2})(1-v_{1})-\beta^{2}\delta(2\delta-1)\right]=0 \qquad \text{(A19)}$$

Numerical analysis shows the results presented in figure 2. From there, proposition 2 follows.

d. Solutions when $q_{02}=0$

$$v^{*}=\frac{2\beta(1-\delta^{2})\left[\beta^{2}(1+2\delta-2\delta^{2})-\delta(2-\delta)-2\beta(1-\delta^{2})\right]}{16-8\delta^{2}+\delta^{4}-\beta^{2}(8-\delta^{2}+2\delta^{4})} \qquad \text{(A20)}$$

$$q_{01}=\frac{\left[\alpha^{2}-\beta(2-\delta)(4+6\delta-\delta^{2})\right]}{2\left[16-8\delta^{2}+\delta^{4}-\beta^{2}(8-\delta^{2}+2\delta^{4})\right]} \qquad \text{(A21)}$$

$$q_{1}=\frac{(2-\delta)\left[8-2\delta^{2}-3\beta\delta(2+\delta)-\beta^{2}(4-3\delta-4\delta^{2})\right]}{2\left[16-8\delta^{2}+\delta^{4}-\beta^{2}(8-\delta^{2}+2\delta^{4})\right]} \qquad \text{(A22)}$$

$$q_{2}=\frac{\alpha\left[2-\delta-\beta(1-\delta^{2})\right]-\beta^{2}(2-4\delta+4\delta^{2}+\delta^{3})}{\left[16-8\delta^{2}+\delta^{4}-\beta^{2}(8-\delta^{2}+2\delta^{4})\right]} \qquad \text{(A23)}$$

$$\pi^{u}=\frac{\alpha(2+\delta)\left[8+4\delta-2\delta^{2}-\delta^{3}-2\beta(4+6\delta-\delta^{2})\right]+\beta^{2}S}{4(2+\delta)^{2}\left[16-8\delta^{2}+\delta^{4}-\beta^{2}(8-\delta^{2}+2\delta^{4})\right]} \qquad \text{(A24)}$$

where: $S = 16 + 48\delta + 28\delta^2 - 12\delta^3 + \delta^4$.

$$\Pi = \frac{\begin{aligned}&\alpha^2(12+4\delta+\delta^2) - 2\alpha^2\beta(2-\delta)^2(4+5\delta)\\ &-2\beta^2(2-\delta)^2\left[48-40\delta+14\delta^2+44\delta^3+11\delta^4-4\delta^5-\delta^6\right]\\ &+6\beta^3(2-\delta)\left[16+8\delta-4\delta^2+14\delta^3-\delta^4-4\delta^5-2\delta^6\right]\\ &+3\beta^4\left[16-64\delta+60\delta^2-32\delta^3+11\delta^4+6\delta^6\right]\end{aligned}}{4\left[16-8\delta^2+\delta^4-\beta^2(8-\delta^2+2\delta^4)\right]^2} \quad \text{(A25)}$$

$$W = \frac{\begin{aligned}&\alpha^2(2-\delta)^2(36+20\delta+3\delta^2) - 2\alpha^2\beta(2-\delta)(16+20\delta-7\delta^2-2\delta^3)\\ &-2\beta^2(2-\delta)^2(192-38\delta^2+54\delta^3+61\delta^4+18\delta^5+\delta^6)\\ &+2\beta^3(2-\delta)^2(56+96\delta+30\delta^2+21\delta^3+18\delta^4+18\delta^5+4\delta^6)\\ &+3\beta^4(80-160\delta+68\delta^2+12\delta^3+25\delta^4-28\delta^5+10\delta^6+8\delta^7)\end{aligned}}{8\left[16-8\delta^2+\delta^4-\beta^2(8-\delta^2+2\delta^4)\right]^2} \quad \text{(A26)}$$

References

ACNielsen. "The Power of Private Label, a Review of Growth Trends Around the World", mimeo, 2005.

Avenel E. and S.Caprice. "Upstream Market Power and Product Line Differentiation in Retailing." *International Journal of Industrial Organization* 24(2006):319-334.

Barsky R., Bergen M., Dutta S. and D. Levy. "What Can the Price Gap Between Branded and Private Label Products Tell Us About Markups?", NBER Working Paper 8426, 2001.

Bergès-Sennou F. "Store Loyalty, Bargaining Power and the Private Label Production Issue." *European Review of Agricultural Economics* 33(2006): 315-335.

Bergès-Sennou F., Bontems P. and V. Rèquillart. "Economics of Private Labels: a Survey of the Literature." *Journal of Agricultural & Food Industrial Organization*,2(2004), art.3.Available at http://www.bepress.com/jafio/vol2/iss1/art3.

Bergès-Sennou F. and M. Waterson. "Private Label Products as Experience Goods." *Journal of Agricultural & Food Industrial Organization* 3(2005), art.9. Available at http://www.bepress.com/jafio/vol3/iss2/art9.

Bontems P., Monier-Dilhan S. and V. Rèquillart. "Strategic Effects of Private Labels." *European Review of Agricultural Economics* 26(1999):147-165.

Clarke R., Davies D., Dobson P. and M. Waterson. *Buyer Power and Competition in European Food Retailing*, 2002, Edward Elgar.

Colangelo G. "Wholesale Pricing when Buyers are Asymmetric Cournot Competitors."*The Manchester School* 74(2006):156-169.

Dobson P. "The Economic Welfare Implications of Own Label Goods", University of Nottingham Working Paper, 1998.

Dobson P. and M.Waterson. "Product Range and Interfirm Competition." *Journal of Economics & Management Strategy* 5(1996):317-341.

Gabrielsen T.S. and Sorgard L. "Private Labels, Price Rivalry and Public Policy." *European Economic Review* 51(2007):403-424.

Hart O. and J.Tirole. "Vertical Integration and Market Foreclosure."" *Brookings Papers on Economic Activity*, *Special Issue on Microeconomics*, 1990, 205-276.

Katz M.L. "The Welfare Effects of Third-Degree Price Discrimination in Intermediate Good Markets." *American Economic Review* 77(1987):154-167.

Kreps D. and J. Scheinkman. "Quantity Precommitment and Bertrand Competition Yield Cournot Outcomes." *Bell Journal of Economics* 14 (1983):326-337.

McAfee P.and M. Schwartz. "Opportunism in Multilateral Vertical Contracting: Nondiscrimination, Exclusivity, and Uniformity." *American Economic Review* 84(1994):210-230.

Mills D. E. "Why Retailers Sell Private Labels." *Journal of Economics & Management Strategy* 4(1995):509-528.

Mills D. E. "Private Labels and Manufacturer Counterstrategies." *European Review of Agricultural Economics* 26(1999):125-145.

Narasimhan C.and R.T.Wilcox. "Private Labels and the Channel Relationship: a Cross-Category Analysis."*Journal of Business* 71(1998):573-600.

Raju J.S.-Sethuraman R. and S.K. Dhar. "The Introduction and Performance of Store Brands." *Management Science* 41(1995):957-978.

Rubinstein A. “Perfect Equilibrium in a Bargaining Model.“ *Econometrica* 50 (1982):97-109.

Scott Morton F.and F. Zettelmeyer. “The Strategic Positioning of Store Brands in Retailer-Manufacturer Negotiations.” *Review of Industrial Organization* 24(2004):161-194.

Soberman D.A.and P.M. Parker. “Private Labels: Psychological Versioning of Typical Consumer Products.” *International Journal of Industrial Organization* 22(2004):849-861.

Steiner R. “The Nature and Benefits of National Brand/Private Label Competition.” *Review of Industrial Organization* 24(2004):105-127.

Wolinsky A. “Brand Names and Price Discrimination.” *Journal of Industrial Economics* 35(1987):255-268.