Product design and decision rights in vertical structures

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Abstract

The paper argues that the emergence of private labels can be partially explained by the new information technologies available at the retail level. In our approach, the owner of a brand has "decision rights" on product design, while the details of the production and the distribution are left to contractual negotiation. Manufacturers have privileged information about the cost of improving quality, while distributors have private information on the impact of quality on demand. We show that ownership of the brand should be allocated to the party with a relative informational advantage. In particular, if the information of the distributor improves due to a technological shock on data collection and information management, it may become optimal for the distributor to introduce its own brand, rather than to distribute a manufacturer's brand.

Keywords: store brand, private label, asymmetric information, vertical structures, product design, decision rights

1 Introduction

The development of distributor brands over the past decade has raised several issues concerning the notion of brand ownership. Several factors may contribute to explain why large distributors have decided to develop their own brands (see the survey of Berges-Sennou, Bontems and Réquillart, 2004). For

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instance, well established distributors with large distribution networks may leverage their position by developing reputation effects over a large range of products. This incentive to intervene as a producer may be reinforced in contexts where concentration is high at the upstream level, because the distributor controlling its own brand increases its bargaining position in a negotiation with dominant producers.[1] Actually, Scott Morton and Zettelmeyer (2004) show evidence of the positive correlation between private label introduction and the market share of leading national brands.[2] Notice however that while distributors have developed brands under their name for mass consumption goods, or standardized products, they also have opted for the creation of new brands with an initially unknown name. This is particularly true for high quality brands. Clearly while the distributors position matters for the promotion of new brands, it is not clear why it is more profitable to create and promote its own brand, rather than promoting an independent brand under a long term agreement. This remark is reinforced by the fact that the bargaining position of the producer of the new brand would be small since the distributor needs not rely on main incumbents for production.

In this paper we wish to stress an aspect which is complementary and provides some light on the economics of distributor brands, namely the interaction between product design and brand ownership under incomplete contracting. In an incomplete contract setting, brand ownership allocates various decision rights to the owner, and in particular the right to decide on

[1] Contributions along this line include Comanor and Rey (2000), Chintagunta et al. (2002), Kadiyali et al. (2000), Gabrielsen and Sorgard (2007), Meza and Sudhir (2010).

[2] See also Bontemps, Orozco and Réquillart (2008) for a similar conclusion using the price level of national brands.

the design of product characteristics (Grossman and Hart, 1986). By owning the brand, a distributor can effectively control the evolution of the products under a particular brand. In this context, answering the question of whether the distributor would more profitably distribute its own brand rather than promote a brand owned at the upstream levels amounts to identifying the potential inefficiencies and conflicts that may arise in the product design process.

We then develop on the fact that, in an optimal relationship, the agent with the most relevant information should be allocated the right to decide on the evolution of the products characteristics.[3] Notice that the development of computerized technologies has changed the balance on this respect in a dramatic way, as distributors have now access to fast, reliable and essential information through sales records, as well as the ability to treat this huge data. The idea demonstrated below is that the better informed party should be the one who chooses the characteristics of the product, a decision that belongs to the owner of the brand. Thus a shift in the information structure can justify a shift in the ownership of brands (with an idea similar to Schmalensee, 1982, that the informational advantage is used in the design of products).

Another aspect that one should bear in mind is that there may be a conflict of interest between large producers and distributors that can hardly be resolved at the development stage. Producers and distributors do not face the same objective for two reasons. First, distributors may be more concerned

[3] The view that an organization may "delegate" decisisions to informed party is developed by Dessein (2002), among others.

about the potential cannibalization of competing brands by one brand, as they distribute several brands. Second the markets are not the same, as large producers serve several markets through several distributors. While contracts help to resolve these issues concerning prices and marketing, this is more problematic at the development stage. In this context, a distributor may prefer to develop its own brand if it appears that the choices of large producers in terms of product design are too far from their needs.

In the article we present a model of vertical structure with bilateral asymmetric information (section 2). We analyze successively the case where the distributor owns the brand and designs the product (section 3) and the case where the producer owns the brand (section 4). In section 5, we compare the aggregate profit of the vertical structure under the two ownership structures. Section 6 discusses a variant in which the bargaining power and the ownership do not coincide. The last section concludes.

2 A base model

We consider a distributor and a producer of some product, who have different information about the cost and the demand for such a product. This difference in information may lead to different choices in terms of product design.

The distributor is the sole distributor in the area. They produce/distribute a branded product, where the brand may belong to the distributor or the producer. Expected demand is $D(p, x, \alpha) = D(p - \alpha x)$ where $x \in \mathbb{R}$ is the product characteristic – referred to as quality – and α is a demand shifter. The distributor gross profit is $pD(p, x, \alpha)$, where the price is normalized for distribution cost. The inverse of D is denoted P so that the retail price is $p = P(Q) + \alpha x$.

The production cost is $C(Q, x, \beta) = Q + \phi(\beta, x)$ and is supported by the producer. Hence, the unit variable cost is independent of quality, while there is a fixed cost that varies with the product characteristics (as Mills, 1995, does for national brands versus private labels[4]) and depends on the producer's type β.[5] Thus we assume that the main cost for the producers is caused by the need to reshape the production line so as to adjust to the new product design. Once this is done the unit cost is basically the same for all levels of quality.[6]

We assume that α belongs to $\{\alpha_1, \alpha_2\}$, where $\alpha_1 < \alpha_2$, with a cumulative distribution function $F(\alpha)$ (and probabilities $f(\alpha)$), and β belongs to $\{\beta_1, \beta_2\}$, where $\beta_1 < \beta_2$, with a cumulative distribution function G (and probabilities $g(\beta)$). Let's denote $\theta = (\alpha, \beta)$. Information is soft and therefore cannot be transmitted. Demand and cost functions are supposed to verify

$$\begin{aligned}
\frac{\partial}{\partial Q} QP'(Q) &< 0 \\
\phi(\beta, 0) &= 0 \text{ and } \frac{\partial \phi}{\partial x}(\beta, 0) = 0 \\
\Delta(x) &= \phi(\beta_2, x) - \phi(\beta_1, x) \text{ is increasing.}
\end{aligned}$$

[4] Contrary to Mills (1995) who justifies that the production of national brands involves a higher fixed cost due to advertising, here we do not impose the ad hoc assumption that private labels would not incur a fixed cost but assume that the fixed cost is related to quality (x) which implies the same correlation between fixed cost national brand versus private label as for Mills (1995) given that he considers that national brands are of better quality than private labels.

[5] In what follows, some results depend on the fact that the marginal cost is known. It could depend on x also with no changes in the main conclusions.

[6] An alternative interpretation is that the fixed cost is an opportunity cost supported by the producer, due the effect of the quality distributed on his profits on other markets.

We also assume that ϕ is convex enough so that an interior solution always exists for the product design stage (profits are convex in x). These assumptions simply mean that the parameter β is an index of efficiency of the firm in the fixed cost of production (the higher the lower the fixed cost) and that the inverse demand function is not too convex.

If the information θ were verifiable and the parties were able to sign a complete contract on the product characteristic, the quantity and the wholesale price, then the industry profit maximizing production and design would be implementable. Denote $Q^m(\alpha, x)$ the monopoly quantity and $V^m(\alpha, x)$ the monopoly profit (variable) characterized by

$$\frac{P(Q^m(\alpha, x)) + \alpha x - 1}{P(Q^m(\alpha, x)))} = \frac{1}{\varepsilon^P(Q^m(\alpha, x))}$$

where $\varepsilon^P(Q) = -\frac{P(Q)}{QP'(Q)}$.

The monopoly solution is

$$\left(x^M(\theta), Q^M(\theta)\right) = \arg\max_{x,Q} \{Q\left(P(Q) + \alpha x\right) - Q - \phi(\beta, x)\}$$

and is characterized by

$$\begin{aligned} Q^M(\theta) &= Q^m(\alpha, x^M(\theta)), \\ \alpha Q^M(\theta) &= \frac{\partial \phi}{\partial x}(\beta, x^M(\theta)). \end{aligned}$$

To fix ideas, consider the case where demand is linear and the cost is quadratic:

$$\begin{aligned} P(Q) &= 1 + \bar{Q} - Q \\ \phi &= \beta \frac{x^2}{2} \; with \;\; 2\beta > \alpha^2 \end{aligned}$$

Then we have

$$\begin{aligned}
Q^M(\theta) &= Q^m(\alpha, x^M(\theta)) = \frac{\bar{Q} + \alpha x^M(\theta)}{2}; \\
\alpha\left(\frac{\bar{Q} + \alpha x^M(\theta)}{2}\right) &= \beta x^M(\theta),
\end{aligned}$$

which yields

$$\begin{aligned}
Q^M(\theta) &= \frac{\beta \bar{Q}}{2\beta - \alpha^2} \\
x^M(\theta) &= \frac{\alpha \bar{Q}}{2\beta - \alpha^2}.
\end{aligned}$$

We wish to contrast the situations where ownership belongs to the upstream producer to the situation where it belongs to the distributor. The owner of the brand is assigned the right to decide on all variables that are related to the product: the parameter x, and whether the good is distributed or not. In the context of a brand, we assume that the ownership provides also bargaining power.[7] Typically, we see the situation as follows. The distributor has no brand, while the producer is a large well know brand producer. Then the producer has a large bargaining power as it bargains on the distribution of his product and there are no existing alternatives. Only the distributor can provide an alternative by creating its own brand. This is a long-run decision. Then the distributor stops the distribution of the national brand and introduce his brand. He then turns to the producer to produce the brand. Here the negotiation is only on the production of the product, where the producer has less bargaining power. To complete the analysis, we shall

[7] As we will see, this assumption facilitates the analysis, although ultimately we may wish to separate the right to decide on the products characteristics and the bargaining power.

also examine the case where ownership only affects the right to design the product, and the bargaining power remains to the distributor in any case.

We consider the following timing for the game between the producer and the distributor.

1. The distributor learns α, the producer learns β.

2. The owner chooses x, which is publicly observed.

3. The owner proposes a contract (Q, T) where Q is production and T a transfer from the distributor to the producer.

4. Production takes place and profits are realized.

The respective profits are $\Pi_D = Q\,(P(Q) + \alpha x) - T$ for the distributor, and $\Pi_P = T - Q - \phi(\beta, x)$ for the producer.

3 The distributor owns the brand

Consider the case where the distributor is the owner of a brand. The distributor chooses x and proposes a contract to the producer. Given that the variable production cost is known, we can see the contract as follows. First, the distributor sets a wholesale price $w = 1$, then he proposes a fixed payment in exchange of production. The fixed payment is equal to $T - Q$. Faced to such a contract, the producer accepts if the fixed payment $T - Q$ covers his fixed costs $\phi(\beta, x)$. Clearly, it is suboptimal to set a fixed payment above $\phi(\beta_2, x)$ or below $\phi(\beta_1, x)$ as no producer accepts. Denote by β_D the critical level such that $\phi(\beta_D, x) = T - Q$.

The distributor then obtains

$$((P(Q) + \alpha x - 1)\, Q - \phi(\beta_D, x))\, G(\beta_D).$$

Clearly if the production takes place, the quantity should be set at its monopoly level $Q^D(\alpha) = Q^m(\alpha, x_D(\alpha))$. The distributor then chooses x to maximize its profits. Given our assumption that $\Pi^m(\alpha, x) - \phi(\beta, x)$ is quasi-concave in x, the choice of characteristic is uniquely defined by

$$\alpha Q^m(\alpha, x_D(\alpha)) = \frac{\partial \phi}{\partial x}(\beta_D(\alpha), x_D(\alpha))$$

The allocation is the same as with a monopoly having a cost $\phi(\beta_D, x)$ and knowing α from the outset. As this is not the object of the paper we assume that the product is offered with probability 1. This is the case for instance if on the relevant range

$$(\Pi^m(\alpha, x) - \phi(\beta_2, x))\, \frac{g(\beta_2)}{g(\beta_1)} > \Delta(x) \tag{1}$$

where $\Delta(x) = \phi(\beta_2, x) - \phi(\beta_1, x)$. We assume that this property holds. Then the distributor chooses $\beta_D = \beta_2$. We conclude that

Proposition 1 *Assume that (1) holds. When the distributor owns the brand, the allocation is the same as for a monopoly with public information and the least efficient production technology ($\beta = \beta_2$).*

One immediate consequence of the fact that the cost of quality perceived by the distributor is larger than the true one is the quality is distorted downward:

Corollary 2 *In the case $\beta = \beta_1$, the quality level is smaller than the symmetric information level: $x_D(\alpha) = x^M(\alpha, \beta_2) < x^M(\alpha, \beta_1)$.*

Thus the main cost of having distributor's ownership is that the quality choice will be distorted downward.

4 The producer owns the brand

We consider now the case where the producer has the control rights on the product. Given that information about the demand is private for the distributor, the producer will offer a non-linear contract. From the revelation principle, for a given x, the contract at stage 3 is a menu $(Q(\alpha), T(\alpha))$ designed so that the distributor chooses $(Q(\alpha), T(\alpha))$ when the demand shifter value is α. The distributor obtains

$$\begin{aligned} U(\alpha) &= Q(\alpha)\left(P(Q(\alpha)) + \alpha x\right) - T(\alpha) \\ &= \arg\max_{s} Q(s)\left(P(Q(s)) + \alpha x\right) - T(s) \end{aligned}$$

where we check that

$$\begin{aligned} \frac{\partial Q\left(P(Q) + \alpha x\right)}{\partial \alpha} &= xQ > 0 \\ \frac{\partial^2 Q\left(P(Q) + \alpha x\right)}{\partial \alpha \partial x} &= x > 0 \end{aligned}$$

Following standard methods (see Salanié (1997) or Laffont and Martimort (2002)), the optimal contract $(Q(\alpha), T(\alpha))$ proposed by the producer under incentive compatibility and individual rationality constraints is such that the constraints can be replaced by

$$\begin{aligned} FOC &: U(\alpha_2) = U(\alpha_1) + xQ(\alpha_1)(\alpha_2 - \alpha_1) \\ SOC &: Q(\alpha_2) \geq Q(\alpha_1) \\ P &: U(\alpha_2) = 0 \end{aligned}$$

which amounts to solve

$$\max_{(Q(\alpha),U(\alpha))} \sum_{\alpha\in\{\alpha_1,\alpha_2\}} \{Q(\alpha)\left(P(Q(\alpha))+\alpha x\right)-Q(\alpha)-U(\alpha)\} f(\alpha)-\phi(\beta,x)$$

$$\text{s.t. } FOC,\, SOC,\, P.$$

where F is the cumulative distribution function of the a priory belief of the producer about the demand parameter α. This can be rewritten as

$$\max_{Q(\alpha)} \sum_{\alpha\in\{\alpha_1,\alpha_2\}} \{\left(P(Q(\alpha))+\alpha x-1-\lambda(\alpha)x\right)Q(\alpha)\} f(\alpha)-\phi(\beta,x)$$

$$s.t.\ FOC,\ SOC,\ P.$$

$$\text{where } \lambda(\alpha_1) = \frac{f(\alpha_2)}{f(\alpha_1)}(\alpha_2-\alpha_1) \text{ and } \lambda(\alpha_2)=0.$$

Finally, we get that

$$\frac{P(Q(\alpha))+(\alpha-\lambda(\alpha))\,x-1}{P(Q(\alpha))}=\frac{1}{\varepsilon^P(Q(\alpha))}$$

The quantity is the monopoly quantity for the *virtual marginal cost* $1+\lambda(\alpha)x > 1$. Notice that this implies that the production is distorted downward compared to the case where α is known.

An alternative interpretation is that the solution corresponds to the optimal quantity for a value of the demand shifter $\hat{\alpha}=\alpha-\lambda(\alpha)<\alpha$. The solution is monotonic.

Then x is chosen so as to maximize

$$\max_{Q(.)} \sum_{\alpha\in\{\alpha_1,\alpha_2\}} \{\left(P(Q(\alpha))+\alpha x-1-\lambda(\alpha)x\right)Q(\alpha)\} f(\alpha)-\phi(\beta,x)$$

which gives

$$\begin{aligned}\sum_{\alpha\in\{\alpha_1,\alpha_2\}}(\alpha-\lambda(\alpha))\,Q^P(\alpha,\beta)f(\alpha) &= \frac{\partial\phi}{\partial x}(\beta,x^P(\beta)) \\ Q^P(\alpha,\beta) &= Q^m(\alpha-\lambda(\alpha),x^P(\beta))\end{aligned}$$

Proposition 3 *When the producer owns the brand, the allocation is the same as if there were an integrated monopoly knowing β, choosing the characteristic x before knowing α and facing a demand with virtual parameter $\hat{\alpha}=\alpha-\lambda(\alpha)$.*

Clearly, for fixed quality levels, producer ownership introduces a double marginalization problem leading to higher prices and lower quantities. This effect is due to the bargaining power of the producer. It would disappear if the distributor had the bargaining power (see below).

Regarding the level of quality, given that $\alpha_2>\alpha_1-\lambda(\alpha_1)$, the comparison with full information or with distributor ownership is ambiguous. There are two effects. If the information on α were made public after the producer has designed the product, we would have $\lambda(\alpha_1)=0$ and $x^M(\alpha_1,\beta)<x^P(\beta)<x^M(\alpha_2,\beta)$, which would imply that $x^D(\alpha_1)<x^P(\beta_2)<x^D(\alpha_2)$. This reflects the fact that the producer designs the product before knowing the demand characteristic. To this we must add two effects. First, the producer's incentives to invest are hindered by the necessity to leave an informational rent to the distributor, hence a reduction of the quality level for all values of β. Second, the producer perceives the true cost of quality so that investment may be higher than with distributor's ownership when $\beta=\beta_1$.

5 Who should own the brand?

To discuss the question whether the control right should be owned by the distributor of by the producer, we compare total profit in the two previous cases. We denote by V^P the total industry profit when the producer owns the brand. It is given by:

$$V^P = \sum_{\beta \in \{\beta_1, \beta_2\}} \left\{ \begin{array}{c} \max_x \left\{ \sum_\alpha \Pi^m \left(\alpha - \lambda(\alpha), x\right) f(\alpha) - \phi(\beta, x) \right\} \\ +(\alpha_2 - \alpha_1) x^P(\beta) Q^m(\alpha_1 - \lambda(\alpha_1), x^P(\beta)) f(\alpha_2) \end{array} \right\} g(\beta).$$

The total profit V^D when the distributor owns the brand is given by:

$$V^D = \sum_{\alpha \in \{\alpha_1, \alpha_2\}} \left\{ \max_x \left\{ \Pi^m(\alpha, x) - \phi(\beta_2, x) \right\}) + \Delta(x^D(\alpha)) g(\beta_1) \right\} f(\alpha).$$

The interpretation is the following. There is some ex-ante stage at which the parties can agree on whether the retailer will distribute its own brand or the brand of the producer. At this stage, contracts are incomplete so that only brand ownership can be decided upon. But the two parties can still agree on some ex-ante transfer as a compensation for not owning the brand. In this context they will choose the ownership structure that maximizes total profit accounting for the fact that the owner will gain decision rights.

Clearly if β is known, total profit is maximal when the distributor owns the brand. Reversely when α is known total profit is higher when the producer owns the brand.

In order to better assess the impact of retailers information on brand ownership, we model more explicitly how this information is determined by considering the following model. Suppose w.l.o.g. that the true demand shifter value α can take two values, 1 or 2, with equal probabilities. It is never observed but the distributor observes a signal s that can take values 1 or 2. Suppose that the probability that the signal takes the same value as the true demand shifter is the same for both values, denoted $1/2+\gamma > 1/2$, where $\gamma \in [0, 1/2]$. Then let α_s be the expected value of the demand shifter given the signal s. Then

$$\begin{aligned}
\alpha_1 &= \frac{3}{2} - \gamma,\ f(\alpha_1) = \frac{1}{2} \\
\alpha_2 &= \frac{3}{2} + \gamma,\ f(\alpha_2) = \frac{1}{2} \\
\lambda(\alpha_1) &= 2\gamma
\end{aligned}$$

Then:

$$V^P(\gamma) = \sum_{\beta \in \{\beta_1, \beta_2\}} \left\{ \begin{array}{c} \max_x \left\{ \frac{\Pi^m\left(\frac{3}{2} - 3\gamma, x\right)}{2} + \frac{\Pi^m\left(\frac{3}{2}+\gamma, x\right)}{2} - \phi(\beta, x) \right\} \\ +\gamma x^P(\beta) Q^m(\frac{3}{2} - 3\gamma, x^P(\beta)) \end{array} \right\} g(\beta).$$

$$\begin{aligned}
V^D(\gamma) &= \frac{1}{2}\left\{ \max_x \left\{ \Pi^m(\frac{3}{2} - \gamma, x) - \phi(\beta_2, x) \right\} + \Delta\left(x^D(\frac{3}{2} - \gamma) \right) g(\beta_1) \right\} \\
&\quad + \frac{1}{2}\left\{ \max_x \left\{ \Pi^m(\frac{3}{2} + \gamma, x) - \phi(\beta_2, x) \right\} + \Delta\left(x^D(\frac{3}{2} + \gamma) \right) g(\beta_1) \right\}.
\end{aligned}$$

For $\gamma = 0$, the distributor has no information and we find that V^P is equal to the aggregate monopoly profit, while V^D is smaller than the monopoly profit since the distributor doesn't design the product optimally. Thus $V^D(0) < V^P(0)$. In other words, if the distributor has no information, the producer should own the brand.

The same evaluation at $\gamma = \frac{1}{2}$ yields for producer ownership

$$\begin{aligned}
V^P(\frac{1}{2}) &= g(\beta_1) \left\{ \max_x \left\{ \frac{\Pi^m(0, x)}{2} + \frac{\Pi^m(2, x)}{2} - \phi(\beta_1, x) \right\} + \frac{1}{2} x^P(\beta_1) Q^m(0, x^P(\beta_2)) \right\} \\
&\quad + g(\beta_2) \left\{ \max_x \left\{ \frac{\Pi^m(0, x)}{2} + \frac{\Pi^m(2, x)}{2} - \phi(\beta_2, x) \right\} + \frac{1}{2} x^P(\beta_2) Q^m(0, x^P(\beta_2)) \right\}
\end{aligned}$$

and for distributor ownership:

$$
\begin{aligned}
V^D(\frac{1}{2}) &= \frac{1}{2}\left\{\max_x \{\Pi^m(1,x)-\phi(\beta_2,x)\}+\Delta\left(x^D(1)\right)g(\beta_1)\right\} \\
&\quad +\frac{1}{2}\left\{\max_x \{\Pi^m(2,x)-\phi(\beta_2,x)\}+\Delta(x^D(2))g(\beta_1)\right\}.
\end{aligned}
$$

Let us define

$$
\begin{aligned}
\delta &= \frac{1}{2}\max_x \{\Pi^m(1,x)-\phi(\beta_2,x)\}+\frac{1}{2}\max_x \{\Pi^m(2,x)-\phi(\beta_2,x)\} \\
&\quad -\max_x\left\{\frac{\Pi^m(1,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)\right\}.
\end{aligned}
$$

It corresponds to the value for the industry of learning the true demand parameter before choosing the design that maximizes total profit. It is thus an upper bound on the value of information under symmetric information.

Proposition 4 *Assume that (1) holds. Then* $V^P(\frac{1}{2}) < V^D(\frac{1}{2})$ *if* $\Delta(x^M(\beta_1,\alpha_2))g(\beta_1) < \delta$.

Proof. see appendix ■

Thus if the asymmetry of information on costs is not too large, distributor ownership will generate more profit in aggregate than producer ownership. The reason is that distributor ownership better exploit the distributor's information by avoiding the quantity distortion when demand is high. Thus if the asymmetry of information on the product cost is not too large, it will be more profitable to accept a suboptimal design under distributor ownership than a suboptimal supply under producer ownership.

Corollary 5 *Assuming* $\Delta(x^M(\beta_1,\alpha_2))g(\beta_1) < \delta$*, then distributor's ownership generates more aggregate profits than producer's ownership if the information of the distributor is precise enough (*γ *is large enough).*

To gain more insight, we now discuss the effect of the precision of the distributor's information on profit. To this purpose, let us differentiate the profits. Then we have

$$\begin{aligned}\frac{dV^D(\gamma)}{d\gamma} &= \frac{1}{2}\left(x^D(\alpha_2)Q^m(\alpha_2, x^D(\alpha_2)) - x^D(\alpha_1)Q^m(\alpha_1, x^D(\alpha_1))\right) \\ &\quad + \frac{1}{2}\left(\Delta'(x^D(\alpha_2))\frac{\partial x^D(\alpha_2)}{\partial \alpha} - \Delta'(x^D(\alpha_1))\frac{\partial x^D(\alpha_1)}{\partial \alpha}\right)\end{aligned}$$

The first term is positive and reflects the value of information. For the second term we find in the linear-quadratic case

$$(\beta_2 - \beta_1)\,\beta_2 \bar{Q}\left(\frac{\alpha_2\left(2\beta_2 + (\alpha_2)^2\right)}{\left(2\beta_2 - (\alpha_2)^2\right)^3} - \frac{\alpha_1\left(2\beta_2 + (\alpha_1)^2\right)}{\left(2\beta_2 - (\alpha_1)^2\right)^3}\right)$$

which can be shown to be positive.[8]

Hence under distributor's ownership, the industry profit increases with the precision of the distributor's information.

Concerning the producer ownership, we have:

$$\frac{dV^P(\gamma)}{d\gamma} = \sum_{\beta \in \{\beta_1, \beta_2\}} \left\{ \begin{array}{c} \frac{x^P}{2}\left(Q^m\left(\frac{3}{2}+\gamma, x^P\right) - Q^m\left(\frac{3}{2}-3\gamma, x^P\right)\right) - 3\gamma x^P \frac{\partial Q^m}{\partial \alpha}\left(\frac{3}{2}-3\gamma, x^P\right) \\ +\gamma\left(Q^m\left(\frac{3}{2}-3\gamma, x^P\right) + x^P \frac{\partial Q^m}{\partial x}\left(\frac{3}{2}-3\gamma, x^P\right)\right)\frac{\partial x^P}{\partial \gamma} \end{array} \right\} g(\beta)$$

The sign of $\frac{\partial x^P}{\partial \gamma}$ is the same as the sign of $-3Q^m\left(\frac{3}{2}-3\gamma, x^P\right) + Q^m\left(\frac{3}{2}+\gamma, x^P\right)$ which we can reasonably assume to be negative.

The sign of the derivative of V^P is ambiguous as it captures two effects. On the one hand the information of the distributor is valuable as it allows to better match supply with demand. On the other hand, asymmetric information implies distortions in the product design and supply that are costly.

[8] We have $\frac{\partial}{\partial \alpha}\frac{\alpha\left(2\beta+\alpha^2\right)}{\left(2\beta-\alpha^2\right)^3} = \frac{\left(2\beta+\alpha^2\right)}{\left(2\beta-\alpha^2\right)^3} + \frac{2\alpha^2}{\left(2\beta-\alpha^2\right)^3} + 6\frac{\alpha^2\left(2\beta+\alpha^2\right)}{\left(2\beta-\alpha^2\right)^4} > 0$ if $2\beta - \alpha^2 > 0$.

6 When ownership does not give bargaining power

We have assumed so far that due to the nature of branded products (their necessity) in the large distribution, the owner of the brand had a large bargaining. We discuss briefly the case where the owner of the brand has the right to design the product but has no bargaining power.

Consider the case where the producer owns the brand, but once x is chosen the distributor offers a contract on a take-it or leave it basis. The game has to be analyzed as a signalling game, where the choice of product characteristic signals the type of the producer. It is then immediate to see that given that revealing himself as having a low costs would result in no rent in the contracting stage, the only equilibria of this signalling games are pooling equilibria. The choice of characteristic x is the same for both values of β. Then there is a continuum of equilibria. Given x, the distributor then chooses the monopoly quantity and would cover the fixed cost $\phi(\beta_2, x)$.

A similar argument would show that if the distributor were to choose x, while the producer chooses the contract, then the choice of x would be the same for α_1 and α_2. The contract would then be designed as in the case above of production ownership.

Thus when decision rights on product characteristics do not convey some bargaining power, the result is that the decision becomes non-reactive to any information. From the vertical structure perspective this is suboptimal, as no information is used to optimize the product design stage.

7 Conclusion

Our paper shows that the most profitable ownership structure for brands depends on the information structure. Whenever distributors have access to a superior information for branding strategies, it may be more profitable to have these choices delegated to the distributors. We have assumed that negotiations on ownership were done with no distortions, but the incentives of the distributor to introduce its own brand should be higher under imperfect bargaining over ownership. This is because, the distributor would have to care about the bargaining power that ownership would give to the producer.

The paper thus illustrates the fact that one element that may explain the recent trend towards the introduction by distributors of their own label, is the development of information technologies that has dramatically raised the amount of information that large distribution chains can collect and treat. As information improves in the downstream part of the market, then it becomes more profitable for the distributor to introduce its private label, rather than to continue to distribute producers' labels. This argument requires however to admit that the distributor is in a good position to impose its new label and thus can leverage reputation effects. Thus the argument is just one part of the story and is complementary to others arguments that can be advanced (as reputation effects, lower costs for in store promotion campaign..).

In terms of welfare, the effect of introducing the distributor private label is ambiguous. Distributors typically under-invest in quality in our model. With producer's brand ownership, there may be less or more under-investment, while there is a double marginalization problem due to the necessity to leave an informational rent to the distributor. Thus one cannot assess a priory whether the introduction of distributor labels reduces or raises consumers' welfare.

proof of proposition 1.

$$
\begin{aligned}
V^P(\frac{1}{2}) &= \left\{\max_x\left\{\frac{\Pi^m(0,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)\right\}+\frac{1}{2}x^P(\beta)Q^m(0,x^P(\beta_2))\right\}g(\beta_2)\\
&\quad+\left\{\max_x\left\{\frac{\Pi^m(0,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)+\Delta(x)\right\}+\frac{1}{2}x^P(\beta)Q^m(0,x^P(\beta_1))\right\}g(\beta_1)
\end{aligned}
$$

But

$$
\begin{aligned}
&\max_x\left\{\frac{\Pi^m(0,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta,x)\right\}+\frac{1}{2}x^P(\beta)Q^m(0,x^P(\beta_2))\\
<\ &\max_x\left\{\frac{\Pi^m(1,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta,x)\right\}
\end{aligned}
$$

Therefore

$$
\begin{aligned}
V^P(\frac{1}{2}) &< \left\{\max_x\left\{\frac{\Pi^m(1,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)\right\}\right\}g(\beta_2)\\
&\quad+\left\{\max_x\left\{\frac{\Pi^m(1,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)+\Delta(x)\right\}\right\}g(\beta_1)
\end{aligned}
$$

Using the fact that x is smaller than $x^M(\beta_1,\alpha_2)$ in all cases, and thus that $\Delta(x)<\frac{\delta}{g(\beta_1)}$, we have

$$
V^P(\frac{1}{2})-\Delta(x^M(\beta_1,\alpha_2))g(\beta_1)<\max_x\left\{\frac{\Pi^m(1,x)}{2}+\frac{\Pi^m(2,x)}{2}-\phi(\beta_2,x)\right\}.
$$

Moreover

$$
V^D(\frac{1}{2})>\frac{1}{2}\max_x\{\Pi^m(1,x)-\phi(\beta_2,x)\}+\frac{1}{2}\max_x\{\Pi^m(2,x)-\phi(\beta_2,x)\}.
$$

So let

$$
\delta=\mathbb{E}\left\{\max_x\{\Pi^m(\alpha,x)-\phi(\beta_2,x)\}\right\}-\max_x\{\mathbb{E}\{\Pi^m(\alpha,x)\}-\phi(\beta_2,x)\}
$$

where $\mathbb{E}\{.\}$ stands for the expectation operator.

Then we find

$$
V^P(\frac{1}{2})<V^D(\frac{1}{2})-\delta+\Delta(x^M(\beta_1,\alpha_2))g(\beta_1).
$$

Thus $V^P(\frac{1}{2})<V^D(\frac{1}{2})$ for $\Delta(x^M(\beta_1,\alpha_2))g(\beta_1)<\delta$. ■

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