Competition between Online Suppliers of Cultural Goods*

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May 21, 2003

Abstract

We study competition between two online suppliers of cultural goods (like books, CDs, or DVDs), when the suppliers can introduce software tools which allow consumers to search for and evaluate products. Using a sequential entry game, we show that one supplier offers only "star" goods (i.e., the goods whose quality is known by all consumers), whereas its competitor provides only "non star" goods (i.e., the goods whose quality is uncertain). We study the incentives of the suppliers to introduce three types of tools - samples, search tools, and a customer review system - and their effect on the market equilibrium.

Keywords: Cultural goods; Internet; E-commerce; Search.

JEL codes: L86; L1; D83.

*We are grateful to Anne Duchêne, François Moreau and David Bounie for helpful comments and suggestions. We also thank Nicolas Curien, Gilbert Laffont, Jean Lainé for useful remarks.

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1 Introduction

We study competition between two online suppliers of cultural goods (like books, CDs, or DVDs), when the suppliers can introduce software tools which allow consumers to search for and evaluate products. Using a sequential entry game, we show that one supplier offers only "star" goods, whereas its competitor provides only "non star" goods. "Star" goods are the goods whose quality is known by all consumers, while "non star" goods are the goods whose quality is uncertain (i.e., non star goods are experience goods).[1] We study the incentives of the suppliers to introduce three types of tools - samples, search tools, and a customer review system - and their effect on the market equilibrium.

Since the beginning of the world wide web, some e-commerce sites have been selling cultural goods online, like CDs, books or DVDs. The competition between providers of cultural goods has two interesting features. First, suppliers strongly differentiate their catalogues. Some sites, like Deepdiscountcd in the US or Cdiscount in France, offer a limited number of goods and mainly "star" goods. Other sites, like Amazon, propose a large catalogue of goods, hence a high proportion of "non star" goods. Second, some suppliers of cultural goods provide software *tools* to help consumers choose a product. Four types of tools are available. *Samples* of music or excerpts of books allow consumers to evaluate the quality of goods before purchasing. *Search* tools allow consumers to search for a specific product. *Topology* tools indicate which goods are the nearest to a specific product, hence provide information about the type of cultural goods. Finally, *customer reviews* provide information both on the quality and location of cultural goods.

Web site	Samples	Search tool	Topology tool	Customer reviews
Amazon.com	Yes	Yes	Yes	Yes
Barnes and Noble	Yes	Yes	No	Yes
FNAC (French)	Yes	Yes	No	Yes
Cdnow.com	Yes	Yes	Yes	Yes
Playcentric	Yes	Yes	No	No
CD Universe	Yes	Yes	Yes	Yes
Buy.com	Yes	Yes	Yes	Yes
CDconnection	Yes	Yes	Yes	No
Deepdiscountcd	No	Yes	No	No
Cheap Or What!	No	Yes	No	No
Alphacraze.com	No	No	No	No
Cdiscount (French)	No	No	No	No

Table 1: software tools provided by online suppliers

As table 1 shows, suppliers which offer a large catalogue of goods, like Amazon or FNAC, often propose different tools, whereas discounters like Deepdis-

[1] Star goods are not necessarily "bestsellers". Star goods may fail to attract consumers, whereas non star goods may become bestsellers.

countcd or Cdiscount propose only a search tool or no tool at all. The reason seems to be that the latter suppliers offer mainly star goods whereas the former propose non star goods. As the founder and CEO of Amazon.com, Jeff Bezos (1998), states:

> "There are more than 3 million different titles available and active in print worldwide. Music is the number two category, and there are about 300,000 active music CDs. When you have this huge number of titles, a couple of things start to happen. First of all, you can use computers to sort, search and organize. Second, you can create a super-valuable customer proposition that can only be done online, and that is selection."

The main objective of our paper is to unveil this logic.

Our work deals with the competition between online suppliers of cultural goods. Since the early work of Bailey (1998), a large body of empirical literature has analysed electronic commerce of books or CDs (Bailey, 1998; Brynjolfsson and Smith, 2000; Clay, Krishnan and Wolff, 2001; Friberg, Ganslandt and Sandström, 2001; Larribeau and Pénard, 2002). This literature compares electronic and traditional markets. The more recent works (e.g., Brynjolfsson and Smith, 2000) show that online prices are lower on average than prices in traditional shops. Another key feature of electronic markets is price dispersion. However, the impact of software tools -e.g., samples or customers reviews- on competition has received scant attention. Our goal is to begin to fill this gap.

The paper is organized as follows. We begin by setting up the model in Section 2. In Section 3, we derive the equilibrium and study the catalogue choice of two competing online suppliers. In Section 4, we analyze the incentives of these suppliers to introduce samples and search tools. In Section 5, we study the impact of customer reviews on the competitive equilibrium. In Section 6 we conclude.

2 The model

2.1 Cultural goods

There are two categories of cultural goods: "star" (S) goods and "non star" (NS) goods. S goods are goods whose type and quality are known to all consumers. NS goods are such that consumers know their type, but not their quality.[2] One interpretation of the difference between S goods and NS goods is that S goods benefit from intensive marketing campaigns, which make consumers learn their type and quality, while NS goods do not.

The "type" of a cultural product is a horizontal differentiation feature, which corresponds to a location on a circle of unit length. The type might represent the "genre" of a cultural product (for music: classical, pop, rock, jazz, etc.).

[2] In Section 5 we study a different setting in which consumers are uncertain about the type of NS goods but not about their quality.

Another interpretation is that the circle of cultural types represents different styles in a given genre. For instance, if the circle represents jazz music, jazz fans trade-off between different genres (smooth jazz, bebop, etc.).

The "quality" of a cultural product is a continuous variable, which corresponds to a vertical differentiation feature. The idea is that for a given type, there are low quality products and high quality products. For instance, a consumer might be uncertain about the quality of the new album of its favourite band.

We assume that there are n S goods, which are uniformely distributed along the circle; the number of S goods is limited because of marketing budget constraints. There is an infinite number of NS goods, which are uniformely distributed along the circle.[3]

The quality q_S of S goods is fixed and known to all consumers. The quality q_{NS} of a NS product might be either high ($q_{NS} = q^H$) with probability α or low ($q_{NS} = q^L$) with probability $1-\alpha$, where $\alpha \in (0,1)$ and $0 \leq q^L < q^H$. The quality levels of NS goods are independent. We denote $\widehat{q}_{NS} = E[q_{NS}]$ the expected quality of NS goods and $\Delta = q_S - \widehat{q}_{NS}$ the quality difference between S goods and NS goods.

We assume that $\Delta > 0$, which means that S goods have an *expected quality advantage* over NS goods: consumers prefer to purchase a S product of their preferred type than a NS product of the same type. This assumption states that when it selects NS goods to create S goods through intensive marketing campaigns, the music industry (i.e., the "majors") picks products whose average quality (q_S) is greater than the average quality of cultural goods ($\widehat{q}_{NS}$).

2.2 Consumers

Consumers have varying tastes, which are uniformely distributed along the circle of cultural "types". When a consumer buys a cultural product which is not of its preferred type, it incurs a loss of utility proportional to the distance between the type of the product, x_i, and its preferred type, x, that is $t \times |x - x_i|$, where $t > 0$.

Consumers can buy either a S product, a NS product or no product at all. As we already mentioned, consumers are aware of the location and quality of S goods. Consumers are unaware of the quality of NS goods, but know location. To summarize, if it buys a S product located at x_i from supplier i, the indirect utility function of a consumer located at x is

$$u_i^S = v + q_S - t \times |x - x_i| - p_i^S,$$

while it gets

$$u_j^{NS} = v + \widehat{q}_{NS} - t \times |x - x_j| - p_j^{NS},$$

[3] This assumption is consistent with empirical evidence: there is a large number of cultural goods but only a few are heavily advertised (cf. the citation of Bezos (1998) in the introduction).

if it buys a NS product offered by supplier j at location x_j, where v is a fixed utility obtained from consuming cultural goods, p_i^S is the price of S goods charged by firm i and p_j^{NS} is the price of NS goods charged by firm j. We assume that v is sufficiently large so that every consumer is served at the equilibrium.

To clarify the exposition, we denote $h = t/n$. We assume that $h > q_S - q^L$. This assumption ensures that vertical differentiation does not dominate horizontal differentiation too much.[4] It implies that $h > \Delta$.

Last but not least, we assume that consumers can visit the two suppliers - and hence, compare prices and offers - at no cost.

In the present setting, S goods and NS goods are imperfect substitutes. However, assuming that demands for S goods and NS goods are distinct would not change the essence of the analysis.[5]

2.3 Online stores

There are two online stores, 1 and 2, which provide cultural goods. Marginal costs of providing cultural goods are constant and normalized to zero. There is a sunk cost $f > 0$ of selling goods online. We suppose that f is sufficiently low so that there is entry.[6]

Supplier $i = 1, 2$ has two decisions. First, it must decide on the *catalogue*, G_i, it offers online. It may sell no goods ($G_i = \emptyset$), only S goods ($G_i = S$), only NS goods ($G_i = NS$) or both S and NS goods ($G_i = S + NS$). Second, supplier i must decide on the *prices* of S goods and/or NS goods, p_i^S and p_i^{NS}. For simplicity, we assume that prices are uniform in each category (S and NS).

Finally, once the suppliers have chosen their catalogues and observed their rival's catalogue choice, each one can decide to remove part of its catalogue (i.e., S goods and/or NS goods) at a very low but strictly positive *removal cost* $\epsilon > 0$ (we shall discuss this assumption below).

2.4 The timing

The timing of the game is as follows.

1. Supplier 1 chooses its catalogue.
2. Supplier 2 chooses its catalogue.
3. Supplier 1 and supplier 2 decide simultaneously whether to remove parts of their catalogues or not.
4. The two sites choose prices simultaneously and consumers buy goods.

[4] We use this assumption in appendix A to show that consumers which are far from a S product prefer to purchase a low quality NS product than the S product.

[5] Nonetheless, if demands were distinct, a supplier of S goods would not compete any more with a supplier of NS goods.

[6] f represents the fixed cost of servers and software for selling cultural goods online. It is independent of the number of goods offered online.

We are looking for the Nash equilibrium of this four-stage game.

There are two key assumptions in this setting. First, suppliers choose their catalogues sequentially, not simultaneously. This assumption is consistent with the observed entry strategies of cultural e-commerce sites: there were leaders (like Amazon) and laggards (like Barnes and Noble). Amazon went online in July 1995 and pioneered the online bookstore market. Barnes and Nobles launched its online store later, in 1997. As for music, CDnow was the pioneer in 1996, whereas Amazon introduced music products in June 1998.[7]

Second, we assume that once the suppliers have chosen their catalogues, each one can remove part of its catalogue before setting prices and selling to consumers. The reason why we insert this stage is the following. If we do not allow suppliers to remove part of their catalogue, the game has a unique Nash equilibrium, in which supplier 1 provides both S goods and NS goods and supplier 2 remains out of the market. Indeed, if it provides S goods and NS goods, supplier 1 deters entry from supplier 2 since competition between the same type of goods drives supplier 2's profit to zero - and zero profit does not cover the entry cost f. However, as Judd (1985) points out, preemption is an equilibrium only if exit costs are very high, i.e., only if preemption is credible. We claim that in the present setting, as suppliers have electronic catalogues, the cost of removing some references from the existing catalogue, hence exit costs, are very low but positive. Therefore, we allow online suppliers to remove part of their catalogues.

3 The equilibrium

In this section, we solve our model of competition between providers of cultural goods. We use the subgame-perfect equilibrium in pure strategies as the solution for the game. We show that competition for cultural goods leads suppliers to differentiate their catalogues, i.e., the type of goods they provide. At the equilibrium, one supplier provides S goods only, while its competitor provides NS goods only.

3.1 Stage 4: price competition

We begin by determining the price equilibrium in the fourth stage, for different catalogue configurations. Each supplier has four possible catalogue choices: $\emptyset$, S, NS, and $S + NS$. We denote $\pi^*_{k,l}$ the equilibrium profit of a supplier which provides a catalogue denoted k when its competitor provides a catalogue

[7] If the suppliers choose their catalogues simultaneously and cannot remove part of the catalogue after their choices, there are four possible Nash equilibria: (S, NS), (NS, S), $(\emptyset, S + NS)$ and $(S + NS, \emptyset)$. If we allow suppliers to remove part of their catalogue in a third stage, the two last equilibria disappear. Hence, we end up with the same differentiated equilibrium as in the sequential game. However, in the simultaneous game, we cannot tell which equilibrium is selected. Besides, suppliers may be better off if they play mixed strategies. Therefore, we think that a sequential game describes better the essence of competition between suppliers of cultural goods, as well as it simplifies the analysis.

denoted l. In theory we have 16 different configurations. However, it is possible to concentrate on a few of them.

3.1.1 S vs. S or NS vs. NS

If the two suppliers provide the same catalogues, competition drives prices down to marginal cost, hence to zero. This is because suppliers propose the same goods and compete with respect to prices. Therefore, at the equilibrium,

$$\pi^*_{S,S} = \pi^*_{NS,NS} = -f.$$

In this setting, offering the same catalogues yields the Bertrand outcome, as there is neither capacity constraint nor locked-in customers.

3.1.2 S vs. NS

Assume that supplier S provides S goods at price p_S, while supplier NS provides NS goods at price p_{NS}. If it buys a S product located at x_S from supplier S, a consumer of type x gets

$$u^S = v + q_S - t \times |x - x_i| - p_S,$$

while it gets

$$u^{NS} = v + \widehat{q}_{NS} - p_{NS},$$

if it buys from supplier NS. Remark that for the NS product we ignore the loss of utility which is due when the consumer does not buy its preferred cultural type. Indeed, if it decides to purchase a NS product, a consumer of type x is better off by consuming the NS product which is at its feet, i.e., at x. This is because there is an infinity of NS goods along the circle whose expected quality is the same.

Therefore, the type x of the consumer who is indifferent between purchasing from S and purchasing from NS is given by $|x - x_i| = d$, where

$$d = \frac{\Delta + p_{NS} - p_S}{t}.$$

If $d < 1/(2n)$, demands for suppliers S and NS are $D_S = 2nd$ and $D_{NS} = 1 - D_S$, respectively. Assume that this condition is satisfied. The first-order condition for profit maximization gives the best responses of suppliers S and NS,

$$R_S(p_{NS}) = \frac{p_{NS} + \Delta}{2},$$

and

$$R_{NS}(p_S) = \frac{h}{4} + \frac{p_S - \Delta}{2}.$$

Solving for the Nash equilibrium of the subgame then leads to equilibrium prices

$$p^*_S = \frac{h}{6} + \frac{\Delta}{3}, \tag{1}$$

and

$$p_{NS}^* = \frac{h}{3} - \frac{\Delta}{3}, \tag{2}$$

and equilibrium profits

$$\pi_S^* = \frac{(h + 2\Delta)^2}{18h} - f,$$

and

$$\pi_{NS}^* = \frac{2(h - \Delta)^2}{9h} - f. \tag{3}$$

This equilibrium is valid if the value of d at the equilibrium is lower than $1/(2n)$. Inserting p_S^* and p_{NS}^* into d shows that $d < 1/(2n)$ if and only if $\Delta < h$. This condition is always satisfied as $h > q_S - q^L$ (by assumption) implies that $h > \Delta$.

Equations (1) and (2) show that competition between supplier S and supplier NS is structured by a *horizontal differentiation effect* and a *vertical differentiation effect*. The first term in the equilibrium prices represents horizontal differentiation; it is all the higher as consumers have strong preferences for a given type (high t) or as there are only a few S goods (low n).[8] The second term represents vertical differentiation: it is proportional to the expected quality advantage of S goods. Note that the horizontal differentiation effect benefits supplier NS more than supplier S, whereas the vertical differentiation effect favors supplier S.

3.1.3 S vs. S+NS or NS vs. S+NS

When supplier i provides S goods (resp. NS goods), prices, hence profits, of the two suppliers are lower if supplier j provides S+NS goods than if supplier j provided only NS goods (resp. S goods).

For instance, consider that supplier i provides S+NS goods while supplier j provides S goods. Competition for S goods leads prices of S goods to zero, i.e., $p_S^* = 0$. Indeed, if p_S^* were above marginal cost (0), each supplier would have an incentive to lower its S price slightly to capture all demand for S goods. Since at the equilibrium $p_S^* = 0$, the equilibrium price of NS goods is given by $p_{NS}^* = R_{NS}(0)$, which is lower that than $R_{NS}(p_S)$ for any $p_S > 0$. Hence,

$$\pi_{S+NS,S}^* < \pi_{NS}^*,$$

which means that competition for S goods cannibalizes the sale of NS goods. Similarly, we find that

$$\pi_{S+NS,NS}^* < \pi_S^*.$$

[8] In its circular model of differentiation, Salop (1979) finds that equilibrium prices are equal to $h = t/n$ when the marginal cost is equal to zero. In our setting, when Δ approaches zero, the equilibrium prices are proportional to h.

3.2 Stage 3: removal decisions

Suppose that the two suppliers have chosen their catalogues, G_1 and G_2. They can now choose simultaneously to remove part of it.

Lemma 1 *Supplier i removes part of its catalogue only if it provides $S + NS$ goods and supplier $j \neq i$ provides either S or NS goods.*

Proof. If there is no overlap between the two catalogues, i.e., if $G_i \cap G_j = \emptyset$, then the suppliers have no incentive to remove part of their catalogues. Indeed, a supplier makes no profit after removal, whereas it makes profit without removing references.

If there is an overlap between the two catalogues, i.e., if $G_i \cap G_j \neq \emptyset$, there are two different cases. First, suppose that $G_i = G_j$, with $G_i \in \{S, NS\}$. Then, the incentive of supplier i to remove its catalog is equal to $-\epsilon$, hence negative. Indeed, it makes zero profit whether it removes its catalogue or not, but incurs a removal cost ϵ if it chooses to remove part of its catalog. Second, suppose that $G_i = S + NS$ and $G_j \in \{S, NS\}$. In this case, supplier i has an incentive to remove the same type of goods as supplied by supplier j, i.e., G_j, while supplier j has none. Hence, the equilibrium of the third stage is such that supplier i removes G_j from its catalogue, whereas supplier j keeps on offering G_j. ■

When a supplier offers both types of goods and faces a competitor within one of these types, say S, there are two competitive effects. First, competition for consumers of S goods leads S prices, hence profits from S goods, to zero. Second, as the prices of S goods are very low, the sale of NS goods is cannibalized; hence, profits from NS goods also decrease. This is why it is not credible to provide both S and NS goods, if the removal cost is sufficiently low.[9]

3.3 Stages 1 and 2: catalogue decisions

Now, we determine the optimal catalogue choices of suppliers 1 and 2. To begin with, remark that supplier 2 enters the market if f is sufficiently low. Indeed, lemma 1 shows that supplier 1 cannot deter its rival's entry by providing the two types of goods. Hence, supplier 1 offers at most one type of goods. Then, since suppliers make zero profit if they provide the same goods, supplier 2 should provide the other type of goods.

Since supplier 2 will choose to differentiate to soften competition, supplier 1 chooses the type of goods which provides the highest profit.

Proposition 1 *Supplier 1 provides S goods when $\Delta > h/4$ and NS goods when $\Delta \in (0, h/4)$. Supplier 2 provides the other type of goods.*

Proof. Supplier 1 makes higher profit when it offers S goods than when it offers NS goods if and only $\pi^*_S > \pi^*_{NS}$, which is satisfied if and only $\Delta > h/4$. ■

[9] This is the standard result of Judd (1985).

This proposition highlights that suppliers of cultural goods have strong incentives to differentiate their catalogues, when consumers are able to compare prices and offers on both sites. The intuition is standard: suppliers differentiate their products to soften price competition. In the present setting, suppliers differentiate their catalogues of cultural goods. Hence, differentiation incentives suffice to explain why suppliers of NS goods can coexist with suppliers of S goods.

At the equilibrium, no supplier provides both types of goods. In reality, suppliers of NS goods like Amazon.com propose also S goods. However, Amazon.com does not compete fiercely with discounters for S goods; it merely sells S goods to its own locked-in customers. Hence, the equilibrium configuration we find is a reasonable approximation of the market equilibrium. In our setting, a configuration with a S supplier on the one hand and a S+NS supplier on the other hand could emerge if we assumed that a proportion ρ of consumers had very high search or switching costs so that they would be effectively locked in.[10]

Competition between S and NS goods is shaped by the consumer trade-off between getting higher expected quality (which favors S goods) and getting better matched goods (which favors NS goods). If the vertical differentiation effect dominates the horizontal differentiation effect, the leader provides S goods; otherwise it provides NS goods.

Note that when the leader proposes NS goods, the price of S goods is lower than the price of NS goods, as $\Delta < h/4$. Leaders -like Amazon or Fnac.com in France- focus on NS goods and charge higher prices than discounters.

Finally, we have assumed that f is sufficiently low so that there is entry. Notice that there are higher values of f such that entry with the most profitable type of goods (NS or S) is viable, whereas entry with the less profitable type of goods is not. Hence, for such values of f, the leader could preempt the market.

4 Samples and search tools

In this section, online suppliers can install *samples* and *search tools.* A consumer can evaluate the quality of a given cultural product by using *samples.* For instance, the consumer can listen to a sample of a CD or read an excerpt of a book. Samples are provided by the suppliers.

We assume that consumers know one NS product of their preferred type. A *search tool* enables a consumer to find another NS product, if it discovers that the quality of the NS product is low.[11] Without a search tool, consumers are unable to find another NS product.[12] The search function, which propose

[10] This is a possible and interesting extension of our work. The same equilibrium configuration could emerge if suppliers had capacity constraints due to delivery delays. In this case, competing head-to-head would not be as harmful as it is in our setting, since each supplier would not be able to serve all demand.

[11] If it gets a high quality NS product of his preferred type, the consumer stops searching.

[12] As NS goods are not advertised, consumers are unaware of most of them. Hence, consumers know a very few NS goods. For simplicity, we assume that they know only one NS product, but our analysis would remain valid if we had assumed that consumers know k NS

some NS products of the same type as a given NS product, can be provided by topology tools or customer reviews.

Starting from the benchmark equilibrium determined in the previous section, we study the incentives of the two competing suppliers to introduce samples and search tools at the same time as they choose their catalogues. Since consumers are aware of the quality of S goods, a supplier of S goods has no incentive to introduce samples. Hence, we focus the analysis on NS goods.

Assume that a consumer evaluates the quality of a NS product he considers purchasing. If he finds that quality is low, there are two possibilities. First, the consumer can decide to search for another NS product and then evaluate the quality of the new NS product. Second, he can decide not to search and trade off between the low quality NS product and its nearest S product. The choice between these two strategies depends on the search cost.

To begin with, we assume that the search cost is sufficiently high so that consumers never search, hence consider only one NS product. Under this assumption we study the effect of non costly sampling and costly sampling. The search cost might be high because there is no search tool or because its quality is very low (e.g., it makes irrelevant proposals). Then, we assume that the search cost is nil and study the impact of a search tool on the competitive equilibrium. We ignore the costs for the suppliers of providing samples and search tools.[13]

4.1 Non costly sampling

To begin with, assume that consumers incur no cost when using samples. Since using samples is costless, consumers always use samples to evaluate the quality of a NS product. After using the sample, a consumer of type x knows the quality of the NS product he considers buying. With probability α, the quality of the NS product is high. If so, the consumer decides to purchase the NS product if and only if it gets more surplus with it than with the nearest S product, which is the case if and only if

$$v + q^H - p_{NS} > v + q_S - t \times |x - x_i| - p_S,$$

or $|x - x_i| > d^H$, where

$$d^H = \frac{q_S - q^H + p_{NS} - p_S}{t}.$$

With probability $1 - \alpha$, quality is low. In this case, the consumer purchases the low quality NS product if and only if

$$v + q^L - p_{NS} > v + q_S - t \times |x - x_i| - p_S,$$

goods, with k very low.

[13] It would be interesting to introduce these costs in the analysis. The cost of samples is a variable cost, which is borne by the supplier. The cost of the search tool is rather a fixed cost. Indeed, in an interview, Jeff Bezos stated: "When we open a new category, it's basically the same software. We get to leverage the same customer base, our brand name, the infrastructure. It's very low-cost for us to open a new category, whereas to have a pure-play [single-line] store is very expensive." (Hof, 2001).

or $|x - x_i| > d^L$, where

$$d^L = \frac{q_S - q^L + p_{NS} - p_S}{t}.$$

Since $d^H < d^L$, demand for S goods is composed of two parts. First, consumers which are very near to a S product, i.e., such that $|x - x_i| \leq d^H$, (if any) will always purchase the nearest S product whatever the quality of the NS product. Second, consumers which are farther from a S product, i.e., such that $|x - x_i| \in \left(d^H, d^L\right]$, will purchase the nearest S product if the quality of the NS product is low while they will purchase the NS product if its quality is high. We first study the case in which $d^H < 0$. If $d^L < 1/2n$, when samples are available the demand for S goods and NS goods are

$$D^{S|s} = 2n\left(1 - \alpha\right) d^L$$

and

$$D^{NS|s} = 1 - D^S,$$

respectively. The equilibrium prices are

$$p^*_{S|s} = \frac{h}{6\left(1 - \alpha\right)} + \frac{q_S - q^L}{3}, \tag{4}$$

and

$$p^*_{NS|s} = \frac{h}{3\left(1 - \alpha\right)} - \frac{q_S - q^L}{3}. \tag{5}$$

In Appendix A we show that the equilibrium is valid (i.e., $0 < d^L < 1/2n$ and $d^H \leq 0$ at the equilibrium) if and only if $\alpha \in (0, \overline{\alpha})$. We start by studying this equilibrium. At the end of section, we shall discuss the other case, $\alpha > \overline{\alpha}$.

Lemma 2 *If $\alpha \in (0, \overline{\alpha})$, introducing samples increases the price of S goods; it increases the price of NS goods if α is sufficiently high.*

Proof. We proceed in two steps. First, we compare

$$p^*_{S|s} = \frac{h}{6\left(1 - \alpha\right)} + \frac{q_S - q^L}{3}$$

to

$$p^*_S = \frac{h}{6} + \frac{q_S - \widehat{q}_{NS}}{3}.$$

Since $1 - \alpha \in (0, 1)$ and $q_S - q^L > q_S - \widehat{q}_{NS}$, then $p^*_{S|s} > p^*_S$. Hence, the price of S goods is higher when consumers can evaluate the quality of NS goods.

Second, we compare

$$p^*_{NS|s} = \frac{h}{3\left(1 - \alpha\right)} - \frac{q_S - q^L}{3},$$

to

$$p^*_{NS} = \frac{h}{3} - \frac{q_S - \widehat{q}_{NS}}{3}.$$

Computations show that $p^*_{NS|s} > p^*_{NS}$ if and only if $\alpha > \widetilde{\alpha}$, where

$$\widetilde{\alpha} = 1 - \frac{h}{q^H - q^L}.$$

Comparison of $\widetilde{\alpha}$ and $\overline{\alpha}$ shows that $\widetilde{\alpha}$ may be either lower or greater than $\overline{\alpha}$. Therefore, if $\widetilde{\alpha} > \overline{\alpha}$, $p^*_{NS|s} < p^*_{NS}$ for all $\alpha \in (0, \overline{\alpha})$. ■

Allowing consumers to evaluate the quality of NS goods through samples has two effects on equilibrium prices. First, the introduction of samples increases the expected quality advantage of supplier S. The expected quality advantage of S goods is equal to Δ when there is no sample, whereas it jumps to $q_S - q^L$ when samples are available. The idea is that, when samples are available (and $d^H < 0$), everything is as if S goods competed only with low quality NS goods, not high quality NS goods, hence the quality advantage of S goods increases. It follows that the supplier of S goods tends to serve consumers which find low quality NS goods, while the supplier of NS goods tends to serve consumers which find high quality NS goods. The second effect of samples on the competitive equilibrium is to reinforce "horizontal" differentiation. The idea is that as the probability α that the quality of NS is high increases, the supplier of NS goods sells more high quality NS goods than low quality NS goods on average. Hence, competition between low quality NS goods and S goods is softened.

Since both "horizontal" differentiation and the expected quality advantage increase, the equilibrium price of supplier S increases. As for the NS supplier, its price increases if the "horizontal" differentiation effect dominates the "vertical" differentiation effect.

As we show below, samples have a third effect: they reduce demand for NS goods.

Lemma 3 *If $\alpha \in (0, \overline{\alpha})$, introducing samples reduces demand for NS goods.*

Proof. At the equilibrium, the demand for NS goods is

$$D^{NS|s} = \frac{2}{3} - \frac{2}{3}\frac{(1-\alpha)\left(q_S - q^L\right)}{h}, \tag{6}$$

when there are samples, whereas it is

$$D^{NS} = \frac{2}{3} - \frac{2}{3}\frac{\Delta}{h}, \tag{7}$$

when there are no samples. Comparing (6) and (7) shows that $D^{NS|s} = D^{NS} - 2\alpha\left(q^H - q_S\right)/(3h)$, hence $D^{NS|s} < D^{NS}$. ■

To understand this result, assume that Δ goes to zero. Without samples, only horizontal differentiation matters and demand for NS goods is equal to 2/3. With samples, consumers can evaluate the quality of NS goods. For those customers who find low quality NS goods, it reintroduces a trade-off between a better match with NS goods and a higher quality with the nearest S product (as $q_S > q^L$). Hence, the supplier of NS goods loses some consumers.

Now, we study whether the supplier of NS goods has incentives to introduce samples. Intuitively, this is the case if and only the horizontal differentiation effect dominates the vertical differentiation and demand reducing effects.

Lemma 4 *Assume that $\alpha \in (0, \overline{\alpha})$. If $h < 2q^H - q^L - q_S$, then for small values of α, hence large values of Δ, the supplier of NS goods has no incentive to introduce samples.*

Proof. The equilibrium profit of the NS supplier is

$$\pi^*_{NS|s} = \frac{2\left[h - (1-\alpha)\left(q_S - q^L\right)\right]^2}{9h(1-\alpha)} - f.$$

It gains from introducing samples if and only $\pi^*_{NS|s} > \pi^*_{NS}$. First remark that $\pi^*_{NS|s} - \pi^*_{NS}$ goes to 0 when α approaches 0, as $\Delta(\alpha = 0) = q_S - q^L$. Second, we find that

$$\lim_{\alpha \to 0^+} \frac{\partial\left(\pi^*_{NS} - \pi^*_{NS|s}\right)}{\partial \alpha} = \frac{2\left(h - \left(q_S - q^L\right)\right) \times \left(2q^H - q^L - q_S - h\right)}{9h}. \quad (8)$$

As $h - \left(q_S - q^L\right) > 0$ by assumption, (8) is strictly positive if and only if $h < 2q^H - q^L - q_S$. If this condition holds, then for low values of α, $\pi^*_{NS|s} < \pi^*_{NS}$. ∎

When α is sufficiently low, the supplier of NS goods loses more from revealing its low quality products than it gains by revealing its high quality products. Hence, the supplier has no incentive to introduce samples. Inversely, when α is sufficiently high, the supplier of NS goods has incentives to introduce samples. If $h > 2q^H - q^L - q_S$, the supplier always gains from introducing samples, as the horizontal differentiation effect dominates the vertical differentiation effect.

Notice also that for $\alpha \in (0, \overline{\alpha})$, the condition given in proposition 1 is modified. Some computations show that the leader chooses to provide NS goods if and only if $h > 4(1-\alpha)\left(q_S - q^L\right)$. Since $\Delta < (1-\alpha)\left(q_S - q^L\right)$, this shows that when samples are available, the leader chooses NS goods less often than when there are not. However, if the leader provides NS goods, then the price of S goods is lower than the price of NS goods.

We have assumed so far that $\alpha \in (0, \overline{\alpha})$, which implies that $d^H < 0$ at the equilibrium. We now study the case in which $d^H > 0$.

Lemma 5 *If h is sufficiently high, there exists $\overline{\overline{\alpha}} > \overline{\alpha}$ such that if $\alpha > \overline{\overline{\alpha}}$ then at the equilibrium $d^H > 0$ and everything is as if there were no samples.*

Proof. Assume that $d^H > 0$. Demands for S goods and NS goods are

$$D^{S|s} = 2n \times \left[d^H + (1-\alpha)\left(d^L - d^H\right)\right]$$

and

$$D^{NS|s} = 1 - D^S,$$

respectively, provided that $2n(1-\alpha)d^L < 1$. Inserting the values of d^L and d^H into D^S reveals that $D^{S|s} = 2n \times [p_{NS} - p_S + \Delta]/t$. Hence, $D^{S|s} = D^S$, which means that the case we are studying is similar to the case without samples. Therefore, equilibrium prices are $p^*_{S|s} = p^*_S$ and $p^*_{NS|s} = p^*_{NS}$. Inserting the values of p^*_{NS} and p^*_S into d^H shows that $d^H > 0$ if and only if

$$\Delta < \frac{h - 6\left(q^H - q_S\right)}{4}. \tag{9}$$

There exists values of Δ which satisfy this condition if and only the right-hand side is positive, which is the case if $h > 6\left(q^H - q_S\right)$. Condition (9) is equivalent to $\alpha > \overline{\overline{\alpha}}$, where

$$\overline{\overline{\alpha}} = \frac{2\left(3q^H - 2q^L - q_S\right) - h}{4\left(q^H - q^L\right)}.$$

Remark that $\overline{\overline{\alpha}} > \overline{\alpha}_2$ if and only if $h < 2\left(3q^H - q_S - 2q^L\right)$. When $h \geq 2\left(3q^H - q_S - 2q^L\right)$, we have $\overline{\overline{\alpha}} \leq 0$ and $\overline{\alpha}_2 \leq 0$. Therefore, since $\alpha \in (0,1)$, we always have $\overline{\overline{\alpha}} > \overline{\alpha}_2$. Since $\overline{\alpha} \leq \overline{\alpha}_2$, then $\overline{\overline{\alpha}} > \overline{\alpha}$. ■

Lemma 5 means that if the degree of horizontal differentiation, h, is sufficiently high and if the degree of vertical differentiation, Δ, is sufficiently low, introducing samples does not modify demands for S goods and NS goods. Suppliers keep part of their captive customers and share the rest of the demand as if there were no samples.

Lemmas 4 and 5 can be summarized as follows.

Proposition 2 *The supplier of NS goods has no incentives to introduce samples when h is sufficiently low and α is small or when h is sufficiently high and α is high.*

4.2 Costly sampling

In this section, we introduce a cost c of using samples, which corresponds to the opportunity cost of evaluating the quality of a NS product. We interpret the sampling cost as an endogenous choice for online suppliers. Indeed, an online supplier can decide on the quality of its samples. As consumers find it more difficult to evaluate quality with low quality samples than with high quality samples, we assume that the cost c of using samples increases as the quality of samples becomes lower. For instance, low quality samples work only part of the time, hence consumers spend more time at using them. Note that the cost c of using samples could also be interpreted as an exogenous variable.

We begin by determining the demand for S and NS goods. If a consumer of type x chooses not to use a sample, it purchases the nearest S product located at x_i if and only if $|x - x_i| \leq d$, where

$$d = \frac{\Delta + p_{NS} - p_S}{t},$$

otherwise it purchases the NS product at its feet. If the consumer chooses to use a sample, it incurs a cost c and discovers the quality of the NS product he is testing. In section 4.1 we have shown that when $|x - x_i| \geq d^L$, the consumer buys the NS product whatever its quality; hence it has no incentive to use a sample. Therefore, we focus on consumers of type x such that $|x - x_i| \in \left[0, d^L\right)$.

Assume further that $d^H \leq 0$. When $|x - x_i| \in \left[0, d^L\right)$, the consumer of type x purchases the nearest S product if the quality of the NS product is low whereas it purchases the NS product if its quality is high; hence its expected utility is

$$\alpha \times \left[v + q^H - p_{NS}\right] + (1 - \alpha) \times \left[v - t \times |x - x_i| + q_S - p_S\right].$$

Note that $d < d^L$, as $\widehat{q}_{NS} > q^L$. If $|x - x_i| \in [0, d)$, the consumer purchases the S product if it does not use samples. Hence, its incentive to use a sample is equal to the gain it would get if the quality of the NS product is *high*. If $|x - x_i| \in \left[d, d^L\right)$, the consumer purchases a NS product when it does not use samples. Hence, its incentive to use a sample is equal to the loss it would avoid if the quality of the NS product is *low*. Let $G(x)$ denote the expected utility gain of using samples for consumer x. $G(x)$ is composed of two parts:

$$G(x) = \begin{cases} \alpha \times \left[q^H - q_S + t \times |x - x_i| - (p_{NS} - p_S)\right] & \text{if} \quad |x - x_i| \in [0, d) \\ (1 - \alpha) \times \left[q_S - q^L - t \times |x - x_i| + (p_{NS} - p_S)\right] & \text{if} \quad |x - x_i| \in \left[d, d^L\right) \end{cases}.$$

A consumer of type x decides to use a sample if and only $G(x) \geq c$. If $|x - x_i| \in [0, d)$, we have $G(x) \geq c$ if and only if $|x - x_i| \geq \widetilde{d}_1$, where

$$\widetilde{d}_1 = \frac{c}{\alpha t} + \frac{q_S - q^H + p_{NS} - p_S}{t}.$$

If $|x - x_i| \in \left[d, d^L\right)$, we have $G(x) \geq c$ if and only if $|x - x_i| \leq \widetilde{d}_2$, where

$$\widetilde{d}_2 = \frac{q_S - q^L + p_{NS} - p_S}{t} - \frac{c}{(1 - \alpha) t}.$$

We assume that $\alpha \in (0, \overline{\alpha})$ and that c is strictly positive but very low. When c approaches zero, the equilibrium is given by equations (4) and (5). Besides, $\widetilde{d}_1$ approaches d^H and $\widetilde{d}_2$ approaches d^L, hence $\widetilde{d}_1 < 0$ and $\widetilde{d}_2 \in (0, 1/2n)$ as $\alpha \in (0, \overline{\alpha})$. If c is sufficiently low so that $\widetilde{d}_1 < 0$ and $\widetilde{d}_2 > 0$, the demand for S goods is $D_S = 2n(1 - \alpha)\widetilde{d}_2$ and the demand for NS goods is $D_{NS} = 1 - D_S$. Computing the Nash equilibrium yields

$$p^*_{S|s}(c) = \frac{h}{6(1 - \alpha)} + \frac{q_S - q^L}{3} - \frac{c}{3(1 - \alpha)}, \tag{10}$$

and

$$p^*_{NS|s}(c) = \frac{h}{3(1 - \alpha)} - \frac{q_S - q^L}{3} + \frac{c}{3(1 - \alpha)}. \tag{11}$$

The condition $\widetilde{d}_1 < 0$ holds at the equilibrium if and only if $c < \widetilde{c}_2$, where

$$\widetilde{c}_2 = \frac{\left[2(1-\alpha)\left(3q^H - 2q^L - q_S\right) - h\right]\alpha}{2(3-\alpha)}.$$

Note that $\widetilde{c}_2 > 0$ as $\alpha < \overline{\alpha}$. We always have $\widetilde{d}_2 > 0$.

Proposition 3 *Assume that $\alpha \in (0, \overline{\alpha})$ and that the NS supplier introduces non costly samples. A small increase of the cost of samples, c, increases the profit of the NS supplier and decreases the profit of the S supplier.*

Proof. At the equilibrium given by equations (10) and (11), profits are

$$\pi^*_{S|s}(c) = \frac{\left[h - 2c + 2(1-\alpha)\left(q_S - q^L\right)\right]^2}{18h(1-\alpha)} - f,$$

and

$$\pi^*_{NS|s}(c) = \frac{2\left[h + c - (1-\alpha)\left(q_S - q^L\right)\right]^2}{9h(1-\alpha)} - f.$$

Hence, $\pi^*_{NS|s}(c)$ increases with c, whereas $\pi^*_{S|s}(c)$ decreases with c. ■

This proposition states that if consumers cannot search for NS goods, the NS supplier has incentives to degradate the quality of its samples, by increasing the cost of using samples. The intuition is the following. When $\alpha \in (0, \overline{\alpha})$ and c approaches 0, the S supplier has no captive demand (since $\widetilde{d}_1 < 0$), whereas the NS supplier has captive customers (since $\widetilde{d}_2 < 1/2n$). Increasing c by a sufficiently small amount increases the captive demand of the NS supplier, as $\widetilde{d}_2$ decreases with c, while $\widetilde{d}_1$ remains negative. This is why the profit of the NS supplier increases.

4.3 Searching for NS goods

In this subsection, we allow consumers to search for NS products. For simplicity, we assume that it is not costly for consumers to search for NS goods and to use samples. Under this assumption, consumers search and use samples until they find a high quality NS product. Once it has found a high quality NS product, a consumer of type x gets

$$u^S = v + q_S - t \times |x - x_i| - p_S$$

if it buys a good i located at x_i from supplier S, while it gets

$$u^{NS} = v + q^H - p_{NS},$$

if it buys the high quality NS product from supplier NS. Therefore, the consumer of type x who is indifferent between purchasing from S and purchasing from NS is such that $|x - x_i| = d^H$.

Assume that $d^H < 1/(2n)$. Demands for suppliers S and NS are $D_S = 2nd^H$ and $D_{NS} = 1 - D_S$, respectively. Solving for the Nash equilibrium of the subgame leads to equilibrium prices

$$p^*_{S|s\&s} = \frac{h}{6} - \frac{q^H - q_S}{3},$$

and

$$p^*_{NS|s\&s} = \frac{h}{3} + \frac{q^H - q_S}{3}.$$

This equilibrium is valid if $d^H \in (0, 1/(2n))$ at the equilibrium. First, one can verify that $d^H < 1/(2n)$ holds always at the equilibrium. Second, we find that $d^H > 0$ if and only if $h > 2\left(q^H - q_S\right)$. If $h < 2\left(q^H - q_S\right)$, the supplier of NS goods excludes the supplier of S goods.

Proposition 4 *Assume that the search and sampling costs are equal to zero. Then, the supplier of NS goods has strong incentives to introduce samples and a search tool.*

Proof. If $h > 2\left(q^H - q_S\right)$, the supplier of NS goods gets

$$\pi^*_{NS|s\&s} = \frac{2\left[h + \left(q^H - q_S\right)\right]^2}{9h} - f \tag{12}$$

at the equilibrium. Comparison of equations (12) and (3) shows that the supplier of NS goods always gets higher profit with samples and a search tool than without them.

If $h < 2\left(q^H - q_S\right)$, the supplier of NS goods excludes the supplier of S goods. Its profit is greater than the value of $\pi^*_{NS|s\&s}$ when h approaches $2\left(q^H - q_S\right)$, i.e. $\left(q^H - q_S\right)^2/h$. Hence, $\pi^*_{NS|s\&s} > \pi^*_{NS,S}$. ■

The intuition is straightforward. If consumers can search and evaluate the quality of NS goods costlessly, the supplier of NS goods gets a quality advantage over the supplier of S goods.

This result contrasts with the results obtained in sections 4.1 and 4.2. To summarize, when search costs are high, the supplier of NS goods has low incentives to provide samples when the proportion of low quality NS goods is high. This is because consumers have relatively high chances of picking a low quality NS goods; hence, the quality advantage of the S supplier increases. If search costs are very low, even though consumers pick a low quality NS product in the first place, they are able to search until they find a high quality NS product. The intuition is that, as the search costs increase, the quality advantage of the S supplier decreases.

5 Customer reviews

In this section, online suppliers can introduce a *review system*, which allows *experience communities* to emerge and operate. We define experience communities as groups of consumers which share information about experience goods, through anonymous electronic relations. With a review system, consumers can write *customer reviews* about cultural goods to provide other consumers with information about the quality and/or location of NS goods.

To simplify the analysis, we assume that the quality of NS goods is certain and that the quality of S and NS goods is the same, i.e., that $q_{NS} = q_S$. Hence, we ignore the vertical differentiation dimension. At the end of the section, we shall discuss the effect of vertical differentiation in this setting.

Customer reviews inform consumers about the *location* of NS goods. A customer of type x is aware of his location, x, and of the location of S goods. However, he is imperfectly informed about the location of NS goods. The supplier of NS goods can provide customer reviews which help to locate NS products. When a consumer of type x searches for a NS product and browses reviews, he can make up his mind and choose a NS product which is on average at a distance δ from x, i.e. whose type belongs to the interval $\{x-2\delta, x+2\delta\}$, where $\delta \in (0, 1/4)$. The variable δ can be interpreted as a measure of the accuracy of the review system.

The consumer compares the utility he gets with the nearest S product located at x_i,

$$u^S = v - t\,|x - x_i| - p_S,$$

to the utility he gets from picking a NS product,

$$u^{NS} = v - t\delta - p_{NS}.$$

The consumer chooses to purchase the S product if and only if $|x - x_i| < (p_{NS} - p_S)/t + \delta$, and the NS product otherwise. Therefore, the demand for S and NS goods are

$$D_S = 2n\left(\frac{p_{NS} - p_S}{t} + \delta\right),$$

and

$$D_{NS} = 1 - D_S,$$

respectively. Supplier $i \in \{S, NS\}$ maximises its profit, $\pi_i = p_i.D_i$ with respect to p_i. At the equilibrium, prices and demands are

$$p_S^* = \frac{h}{6} + \frac{t\delta}{3} \text{ and } p_{NS}^* = \frac{h}{3} - \frac{t\delta}{3}, \tag{13}$$

$$D_S^* = \frac{1}{3} + \frac{2n\delta}{3} \text{ and } D_{NS}^* = \frac{2}{3} - \frac{2n\delta}{3}, \tag{14}$$

and equilibrium profits are

$$\pi_{NS}^* = \frac{2h}{9}(1 - n\delta)^2 - f \tag{15}$$

and

$$\pi_S^* = \frac{h}{18}(1 + 2n\delta)^2 - f. \tag{16}$$

This equilibrium is valid if $D_S^* \in [0,1]$, which requires that $\delta \in (0, 1/n)$. When $\delta = 0$ the accuracy of the review system is maximum. By reading reviews, consumers are able to locate NS products perfectly. When $\delta = 1/n$, the review system provides no valuable information and no consumer purchases from the NS supplier.

Lemma 6 *The supplier of NS goods always has incentives to increase the accuracy of its review system. Increasing the accuracy of the review system reduces the profit of the supplier of S goods.*

Proof. Equation (15) shows that π_{NS}^* increases with δ, whereas equation (16) shows that π_S^* decreases with δ. ■

Lemma 6 shows that if consumers locate NS goods imperfectely, the "matching" advantage of NS goods is mitigated, but that it increases as the quality of the review system increases (i.e., as δ decreases).

Proposition 5 *Increasing the accuracy of the review system reduces industry profits if the quality of the system is low ($\delta > 1/4n$) whereas it increases industry profits if the quality of the system is high ($\delta < 1/4n$). In addition, it increases social welfare, unless the accuracy of the system is low ($\delta > 7/10n$).*

Proof. Industry profits are $\pi^* = \pi_S^* + \pi_{NS}^*$. This function has a minimum $(h/4)$ when $\delta = 1/4n$.

As production and distribution costs are ignored, social welfare is

$$W = 2n \left(\int_0^{(p_{NS}^* - p_S^*)/t + \delta} (v - tx)dx + \int_{\left(p_{NS}^* - p_S^*\right)/t + \delta}^{1/2n} (v - t\delta)dx \right) - 2f.$$

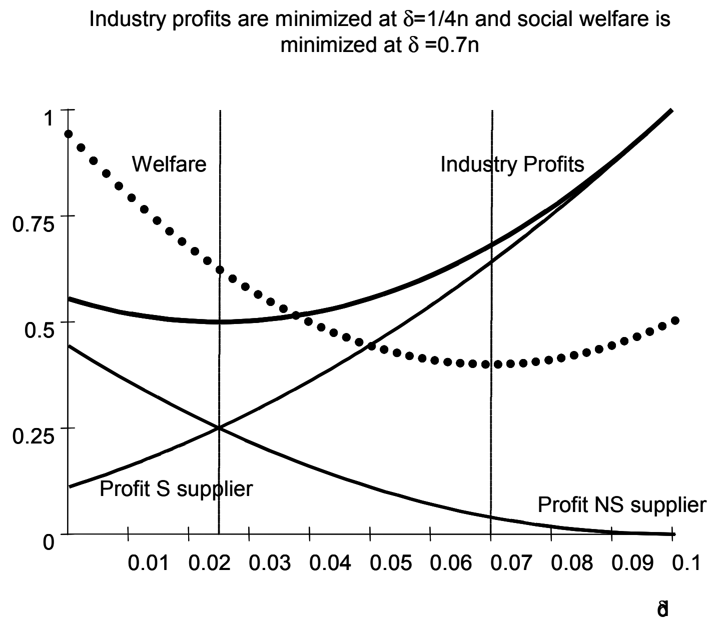
As $\partial W / \partial \delta = t(10n\delta - 7)/9$, W has a minimum at $\delta = 7/10n$. When $0 < \delta < 7/10n$, W is decreasing with δ whereas it is increasing with δ when $7/10n < \delta < 1/n$. ■

When a provider of NS goods competes with a provider of S goods, there are three different cases:

1. If the accuracy of the review system is low ($7/10n < \delta < 1/n$), increasing accuracy reduces industry profits and social welfare. In the figure below, drawn for $n = 10$ and $t = 20$, it corresponds to the interval $0.07 < \delta < 0.1$, in which industry profits, the profit of the supplier of S goods and social welfare increase with δ.

2. If the accuracy of the review system is intermediate ($1/4n < \delta < 7/10n$), increasing accuracy reduces industry profits but increases social welfare. This corresponds to the interval $0.025 < \delta < 0.07$ of the figure.

3. If the accuracy of the review system is high ($\delta < 1/4n$), increasing accuracy increases industry profits and social welfare. It is worth noting that this case occurs when "non star" goods provide a better match than "star" goods. Indeed, on average, consumer is at a distance $1/4n$ of the nearest S product.



So far we have assumed that the parameter δ was given *ex ante.* It remains to be seen how suppliers compete if the provider of NS goods can reduce the value of δ by investing in sophisticated software that enable people to share reviews and advice.

Proposition 6 *When a supplier of S goods competes with a supplier of NS goods, the NS supplier has incentives to increase the accuracy of his review system, even if it is costly.*

Proof. Assume that the supplier of NS goods incurs a cost $C(\delta)$ for designing and offering a software that enables potential customers to exchange expertise and advice of accuracy δ. We show that in this case the supplier of NS goods has always incentives to increase the quality of the system, i.e., to reduce δ.

To begin with, assume that the cost of providing quality δ is $C(\delta) = C_0(1 - n\delta)$, where $\delta \in (0, \min\{1/n; 1/4\})$. Indeed, $\delta \leq 1/4$ and a customer review system with quality $\delta \geq 1/n$ provides no valuable information to the potential buyer beyond the information he already got from the S system. In this setting, the supplier of NS goods maximises his profit $\pi^*_{NS} - C(\delta)$. We find that there exists δ_0 such that its profit is negative when the quality is low ($\delta_0 < \delta < 1/n$) and positive when the quality is high ($0 < \delta < \delta_0$). Profit is maximised at $\delta = 0$.

If $C(\delta) = C_0(1 - n\delta)^2$, the profit of the NS supplier is also maximised at $\delta = 0$. It is only for cost functions that increase faster with quality (e.g., a cost function like $C(\delta) = C_0(1 - n\delta)^3$) that the supplier of NS goods finds it profitable to restrict the quality of the review system to some value $\delta > 0$. ∎

This proposition states that the supplier of NS goods has strong incentives to improve its review system, even if it is costly. However, if the review system is costly, the supplier of NS goods makes profit only if the quality of the system is above a given threshold. This could constitute a very high barrier to entry, particularly if there is some specific knowledge and know-how, for building a review system software, that is very slow to acquire.

In this section, we have ignored vertical differentiation. Introducing vertical differentiation would have two effects. First, it would reinforce the strategic position of the supplier of S goods, as in section 3: the supplier of S goods (resp., NS goods) makes higher (resp., lower) profits as the expected quality advantage Δ increases. Second, as customer reviews reveal information about the quality of NS goods, the incentives of the NS supplier to introduce a review system might be reduced for low values of h and α, as in section 4.1.

6 Conclusion

This paper provides a formal analysis of competition between two online suppliers of cultural goods. Our analysis suggests that suppliers have strong incentives to differentiate their catalogues of cultural goods to soften competition. One supplier introduces “star” goods, i.e., those goods whose quality is known by all. The other supplier offers “non star” goods, i.e., those goods whose quality is uncertain.

We study the impact of two experience tools. First, suppliers can introduce samples, which allow consumers to evaluate the quality of “non star” goods. Second, suppliers can introduce a search tool, which allows consumers to search for “non star” goods. We show that samples tend to benefit the provider of “star” goods more than the supplier of “non star” goods. Besides, when it installs samples, the supplier of non star goods has incentives to propose low quality samples that consumers find costly to use. However, the supplier of non star goods has strong incentives to introduce a search tool together with samples.

This research could be extended in various directions. First, in our setting, we have assumed that when a supplier offers a type of goods, either S or NS goods, it offers all goods of this type. We could allow suppliers to offer only a part of all S or NS goods. Taking a proportion of NS goods uniformely along the circle would still give an infinity of NS goods, hence would not change the analysis. Another possibility would be to assume that a supplier can provide NS goods along a section of the circle. In that case, other equilibrium configurations could emerge, with each supplier offering some S and NS goods.

Second, the consumption of cultural goods is a dynamic process. In particular, once a consumer has bought the S goods which are not far from its preferred type, incentives to buy NS goods are increased. If a supplier provides both S and NS goods, it would also be interesting to study its incentive to educate its S consumers so that they buy NS goods. We aim at investigating these extensions in future research.

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A Appendix

Inserting the values of the equilibrium prices given by equations (4) and (5) yields that

$$d^{L*} = \frac{1}{t} \times \left(\frac{h}{6(1-\alpha)} + \frac{q_S - q^L}{3} \right) \tag{17}$$

at the equilibrium. Since $q_S > q^L$, then $d^{L*} > 0$ holds always. Besides, since $h > q_S - q^L$ by assumption, $d^{L*} < 1/2n$ for low values of α. Since d^{L*} increases with α, there exists $\overline{\alpha}_1$ such that $d^{L*} < 1/2n$ for all $\alpha < \overline{\alpha}_1$. We find that

$$\overline{\alpha}_1 = \frac{2\left[h - \left(q_S - q^L\right)\right]}{3h - 2\left(q_S - q^L\right)}.$$

Furthermore, we have $d^H < 0$ if and only if $\alpha < \overline{\alpha}_2$, where

$$\overline{\alpha}_2 = 1 - \frac{h}{2\left(3q^H - q_S - 2q^L\right)}.$$

Finally, $\Delta > 0$ is equivalent to $\alpha < \overline{\alpha}_3$, where

$$\overline{\alpha}_3 = \frac{q_S - q^L}{q^H - q^L}.$$

Let $\overline{\alpha} = \min\{\overline{\alpha}_1, \overline{\alpha}_2, \overline{\alpha}_3\}$. For all $\alpha < \overline{\alpha}$, $d^{L*} \in (0, 1/2n)$ and $d^H < 0$.