When and How Is the Internet Likely to Decrease Price Competition?

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Abstract

Conventional wisdom seems to claim that, by lowering the cost of distribution and by making search easier for consumer, the introduction of the Internet is likely to intensify price competition. This paper intends to challenge this view by asking: When and how is the Internet likely to decrease the level of price competition between firms? To answer this question, we develop an analytic model with the following characteristics. On the demand side, consumers need to gather information on two types of product attributes: *digital attributes* (which can be communicated on the Web at very low cost) and *nondigital attributes* (for which physical inspection of the product is necessary). Consumers choose between two brands but are familiar with the nondigital attributes of only the brand purchased on the last purchase occasion. On the supply side, firms use traditional stores and the Internet to inform consumers about their products' attributes and to sell their products. In this setup, we show that the impact of the Internet on competition will be radically different depending on the relative importance of parameters describing the relevant shopping and distribution context. Specifically, we find that the introduction of the Internet might lead to monopoly pricing when (1) the proportion of Internet users is high enough, (2) when nondigital attributes are relevant but not overwhelming, (3) when consumers have a more favorable prior about the brand they currently own, and (4) when the purchase situation can be characterized by "destination shopping". More surprising, we also show that in such cases, the use of the Internet not only leads to higher prices but can also discourage consumers from engaging in search. As such, an important message of the paper is that under some conditions the Internet might represent an opportunity for firms to leverage their brand loyalty and increase their profits.

The intuition behind our results is the following. The Internet allows consumers to evaluate digital attributes easily, i.e., without visiting the stores. However, nondigital attributes can only be evaluated through physical presence. As such, for goods where both types of attributes are important, the introduction of the Net changes the effective cost of search for consumers. Without the Internet the cost of search is *the cost of visiting more than one store*. With the introduction of the Net however, nonsearching consumers do not have to undertake the shopping trip at all because they can order products on the Net. Thus, in the presence of the Internet the cost of search is related to *the cost of undertaking the entire shopping trip*. In the case of destination shopping (i.e. when the fixed cost of undertaking the shopping trip is higher than the cost of visiting an additional store), the presence of the Internet creates higher effective search costs for consumers. Given this shift of paradigm in search costs due to the Internet, consumers may not take the risk of searching for products with better nondigital attributes, but instead, remain with the product they are familiar with. This results in increased consumer loyalty, which induces firms to increase their prices.

Our results have important managerial implications. First, they provide guidelines for firms on when (i.e. for which product categories) they should consider expanding their distribution network to the Internet. In this respect, an important additional insight of the paper is that the Internet can lower price competition and lead to reduced consumer search *even* if it is more expensive than the traditional distribution channel. This can easily be the case if distribution through the Internet represents additional costs such as the costs associated with shipping and handling and return policies. Second, the paper also provides guidelines on how to plan the firm's Internet strategy. Interestingly, the results suggest that with the general availability of the Internet the role of stores might actually become more important. While we do not explicitly model a dynamic market, our findings together with Klemperer's (1987) results suggest that stores might have a key role in consumer acquisition, while the Internet can help leverage the acquired customer base through demand fulfillment. This might imply that for certain product categories, firms should actually allocate additional resources to improve their in-store environment when considering the Internet as a complementary distribution channel.

(*Internet*; *Consumer Search*; *Digital/Nondigital Attributes*; *Competition*; *Game Theory*)

0732-2399/99/1804/0485/$05.00
1526-548X electronic ISSN

1. Introduction

Marketers all over the world agree that the Internet will have a major impact on the way firms do business. What changes will exactly occur however, is hard to predict as the Internet is in a phase of rapid growth and constant change. Patterns are difficult to isolate, especially since despite its explosive growth, today, the Net is still in its infancy, only being available to a small proportion of people. In spite of this general lack of reliable patterns one consensus among managers seems to be that the Internet is likely to intensify price competition. This viewpoint is reflected in the following quotes:

> "Surf's up, skinflints: The World Wide Web is fast becoming the best place to shop for bargains" . .[. .] Soon buying many things on the Web will be easier, cheaper and more secure than going to stores or flipping through catalogs, credit card in hand. (*Fortune,* Dec. 9, 1996, p. 159)

> Because buyers now have access to suppliers worldwide, competition between suppliers is heightened, costs are driven down, and product quality increases. Furthermore, buyers can do head-to-head comparison of suppliers quickly and easily (*Information Systems Management,* Summer 1996, p. 91)

> The Net's fans argue that its expanding influence—along with the growth of other forms of cheap communication—will eventually allow consumers to bypass intermediaries while increasing their choices and finding better bargains. (*The Economist*, March 2, 1996, p. 72)

> . . Bill Gates . .[. .]. . regale the world's leaders with the promise of 'friction-free capitalism': the idea that ubiquitous and equal access to information will create the closest thing yet to Adam Smith's perfect market. (*The Economist,* May 10, 1997, p. S3)

> There will likely be heavy price and marketing competition as retailers try to dominate the various retailing categories on the Web. And revenue growth should be easier to nab than profits. (*The Internet Retailing Report,* Morgan Stanley, May, 1997)

In essence, the conventional wisdom seems to be that the Internet lowers the cost of distribution and the cost of consumer search, thereby lowering barriers to entry, and thus "creating the closest thing yet to Adam Smith's perfect competition". Likewise, many academics seem to reach similar conclusions:

> [Hal Varian, the dean of the School of Information Management and Systems at the University of California-Berkeley] . . . notes that because there doesn't appear to be a lot of demand for multiple players offering the same services on the Web, many of these markets are shaping up to be winner-take-all battlegrounds. (*The Wall Street Journal,* April, 23, 1997, p. CA2)

> For many retailers the most significant threat posed by IHS [Interactive Home Shopping] is that profits will be eroded drastically by intensified price competition that will ensue as consumers' search costs are lowered. (Alba et. al. 1997, *Journal of Marketing,* p. 45)

> "The main threat facing companies is that prices will be driven down by consumers' ability to shop around using the Internet." (Interview with Gary Hamel in the *Financial Times,* October 22, 1998, p. 13)

Recently a few academic papers have begun to reflect on these issues more formally. In their conceptual paper, Alba et. al. (1997) point to the fact that "IHS can reduce the cost and increase the discriminatory power of information regarding merchandise quality" (p. 45). This may lead to increased product differentiation and potentially lower price competition. In a more formal paper, Bakos (1997) explores the impact of different types of search costs on competition when each seller has only one store. The implications for e-commerce are drawn by analyzing comparative statics with respect to different search costs. He finds that, when the cost of searching for prices is lower than the cost of searching for product attributes, competition increases. To the extent that the Internet allows consumers to search for prices more easily, this result is consistent with the point of view that the Internet will intensify price competition. Bakos also notes (p. 1689) that when the cost of searching for prices is high relative to the cost of searching for product attributes, competition is reduced. While this peculiar case does not really apply to the case of Internet shopping (where prices are posted), it has important implications for the level of competition between firms marketing over the Internet. To the extent that firms can influence the degree to which different types of information are accessible on websites or transparent to search engines, firms might be able to influence the level of competition. In fact, Lynch and Ariely (1999) find empirical support for Bakos's result in a Weblike experimental setting. Another formal paper by Zettelmeyer (1998a) explores a scenario where firms compete with two distribution channels and control the amount of product information provided to consumers who are uncertain about their preferences. He shows that firms can achieve finer consumer segmentation across channels and reduce competition by strategically influencing search costs.

The present paper also belongs to this literature and asks the question: *When and how is the Internet likely to lower the level of price competition?* Asked differently: Under what conditions can firms raise prices and increase profits by using the Internet as a *complementary* channel of distribution, despite its lower costs of distribution and search? Furthermore, should the Internet ever be used if the cost of distribution is higher? Our results indicate that, in contrast to Alba et. al. (1997), even when the Internet reduces the discriminatory power of information regarding merchandise quality, it might decrease price competition and consumer search. Similarly, in contrast to Bakos (1997), in a setting where firms compete with multiple distribution channels, we show that even when the cost of searching for prices is lower than the cost of searching for product attributes, the Internet can lead to lower levels of price competition and reduce consumer search. Moreover, even if the cost of distribution is higher on the Internet, it might be profitable to use it as a complementary distribution channel to existing stores. Finally, in contrast to Zettelmeyer (1998a), we analyze a context where firms do not have complete control over the amount of information provided to consumers. In particular, we show that prices might increase and competition is reduced *even* if firms cannot differentiate themselves in search costs. More importantly, we show that the introduction of the Net may reduce consumer search even if a priori it means lower search costs for consumers.

In the next section, we briefly describe the type of products and the key features of the Internet that may generate such outcomes. In §3, we present a model that formally describes these product/situation characteristics. We analyze the model and characterize the conditions under which the proposed outcomes might be possible. Section 4 provides a general discussion of the results while §5 explores a number of critical extensions. The paper ends with suggestions for future research and a summary of the results.

2. The Internet

While the Internet might affect the way firms do business in many ways, in this paper, we focus on three key aspects that are likely to have a major impact on distribution. First, we recognize that the Net represents tremendous convenience for consumers in that consumers can cheaply search and compare products and, as a result, have the opportunity to place orders without visiting the stores.

Second, on the supply side, we recognize that the Internet represents a channel of distribution with a different cost structure. Clearly, if firms manage to replicate the rich store environment on the Internet without having to incur the cost of expensive personel and retail outlets, then distribution costs might significantly decrease. However, the Internet might not necessarily mean lower distribution costs. This is because retailers are likely to face new costs including, for example, the cost of shipping and handling or the cost associated with return policies. Thus, in what follows we do not a priori assume that distribution costs are lower on the Internet.

Third, we recognize that the Internet represents a new medium in which the type of information that consumers can acquire differs significantly from that of the traditional retail environment.[1] In particular, we distinguish between two types of product attributes, which we call *digital* and *nondigital* attributes. We define digital attributes as all product attributes that can be communicated through the Internet.[2] The majority

[1]An exception might be mail order catalogs which have similar characteristics to the ones discussed below (see §3 for a more detailed discussion).

[2]Our concepts of digital/nondigital attributes (goods) is related to the concept of "search" and "experience" attributes (goods) introduced by Nelson (1970, 1974). Our definition however, differs in several ways. First, in our case consumers do not need to consume the product to discover its nondigital attributes; they only need to inspect it physically. Second, our definition is at the attribute level recognizing that the vast majority of products fall along a continuum between digital and nondigital goods incorporating both types of attributes (Alba et. al. 1997, p. 43).

of digital attributes are those that can be assessed through visual inspection and that traditionally have been evaluated by consumers in the store. In the context of clothing, for instance, manufacturers always need to update their product lines to reflect recent trends in fashion even for relatively standard items such as jeans, shirts, or suits. Similarly, the assortment of produce regularly changes in supermarkets. Such changes in style, or assortment can be communicated to consumers through a Web page. The Web however, also presents an opportunity for enlarging the set of digital attributes, including attributes communicated through sound, for instance. When purchasing CDs consumers can listen to samples from the music of their choice. The second category of attributes are those that can only be evaluated through physical inspection of the products. In the context of clothing, for instance, texture and "fit" are key product features that can only be explored through physical presence. Other categories where nondigital attributes are important include produce in a supermarket (smell, taste, freshness), wine (taste, color), or flowers (freshness). It is important to note that while nondigital attributes are important for these categories, digital attributes remain critical for product choice.

Given this distinction between digital and nondigital attributes, one might quickly conclude that since the conventional wisdom that we challenge is mostly applicable to markets dominated by digital attributes the Internet is less likely to intensify competition in markets dominated by nondigital attributes. The surprise that we offer in this paper is that, under certain conditions the Internet *reduces* price competition resulting in higher prices and profits. Moreover, we show that under some conditions, the Internet reduces customer search. In this way, *an important message of the paper is that under some conditions the Internet might represent an opportunity for firms to leverage their brand loyalty and increase their profits.*

The intuition behind our results is the following. The Internet allows consumers to evaluate digital attributes easily without visiting the stores. Thus, for digital goods the introduction of the Net results in higher levels of competition. For goods where nondigital attributes are also significant however, the introduction of the Net changes the effective cost of search for consumers. Without the Internet the cost of search is the cost of visiting more than one store, and with the introduction of the Net nonsearching consumers do not have to undertake the shopping trip at all. Thus, in the presence of the Internet the cost of search is related to the cost of undertaking the entire shopping trip. With higher effective search costs, consumers may not take the risk of searching for products with better nondigital attributes, but instead, remain with the product they are familiar with. In the next section, we present a model that formalizes these ideas and characterizes the conditions under which such outcomes may occur.

3. Model

Imagine two vertically integrated firms competing in a market for a good for which both digital and nondigital attributes are important (e.g. jeans or other staple clothes, produce, or flowers). In this market, consumers still need to explore the products' digital attributes as products undergo regular modifications. In the case of clothing, for instance, regular changes in fashion are incorporated in the products. Similarly, wines are different every year even from the same region depending on the weather and other factors.[3] These modifications can be communicated to consumers in the store or through the Internet, which we assume to be available to all consumers (Alba et al. 1997). This assumption is relaxed in §5. Beyond digital attributes, consumers' utility also depends on nondigital attributes, that is on how well the product "fits" them. We assume that the firms are undifferentiated in the sense that both firms' product lines can satisfy consumers along digital attributes. To model the impact of nondigital attributes or "fit" on product success we will assume that consumers represent two distinct segments of equal size. Without loss of generality we normalize the size of each segment to 1. Based on their current usage, the two segments are assumed to be familiar with the nondigital attributes of either firm 1's

[3]A French wine distribution chain, *Chez Nicholas*, seems to recognize the importance of nondigital attributes. Famous for its high quality service, it allows customers to taste several bottles of wines before purchase. It seems that the Internet is not compatible with this business model. We will see, however, that under some conditions a business such as *Chez Nicholas* could benefit from the Net.

or firm 2's products. Said differently, consumers are heterogenous with respect to their knowledge about the goods' respective nondigital attributes. Current consumers of, say firm 1, know that a product chosen from firm 1's product line will fit them and have a reservation price r for buying it.[4] It may be the case however, that firm 2 has a corresponding product with even better fit. In that case, consumers of firm 1 get utility $r + f$ ($f > 0$) from buying that product. It is also possible that firm 2's product will fit worse, in which case consumers obtain $r - f$ utility from buying it. We will assume that the expected utility of the good purchased on the previous occasion is greater than that of the good not purchased. It directly follows from this difference in expected utility, that if "fit" is positive ($+f$) with probability q and negative ($-f$) with probability $1 - q$, then $q < 1/2$. Said differently, without trying the other firm's product, consumers expect that the product they are familiar with (they currently use) will fit them better. Another way to think about this assumption is to interpret it as consumer risk aversion. While the *expected* fit of the unfamiliar product is worse, consumers can go and try it in that firm's store and upon finding out that it fits them better, buy it.[5] The cost of such search will be the cost associated with visiting the other firm's store. In summary, a key assumption in this paper is that in the case of nondigital goods, buying through the Internet does not allow consumers to evaluate certain customer specific product attributes.

To illustrate the setup described above consider the following purchase situation. Imagine a consumer who considers buying a new pair of jeans. She considers two brands: Gap, the brand she currently wears, and Limited, a brand she remembers having tried on the last purchase occasion several months ago. Both brands have a product line which reflect recent trends in fashion. First, the consumer has to find out which SKUs correspond to the style (cut) of her choice within the product lines. To do so, she can either go to the stores or look up the pictures of the different styles on the firms' respective Web pages. Next, she has to figure out if she can find a size that fits her. She is familiar with the sizes for Gap (she just has to look at the label on the jeans she is wearing), but she is quite uncertain about the Limited sizes and without going to the store, she cannot find out which Limited size will fit her (Limited has a different way of assigning numbers to sizes). Once in the Limited store however, she can try a number of sizes and with some luck find one that fits. In fact, it is even possible that she finds a better fitting jean at Limited than the one she currently wears. However, ex ante this is not likely to happen (after all she decided to choose Gap a few months ago).

This example highlights the reason for a static nature of the model in the sense that it captures only one shopping decision for a given consumer. The meaning of this assumption is that the products considered are "not too frequently purchased". Said differently, consumers are more certain about the nondigital attributes of the brand that they are currently using. In the case of clothing for instance, it is easier to figure out the correct size to be ordered from the brand currently owned by the consumer. It is also reasonable to assume however, that the consumer will not find it equally easy to order from another brand, possibly owned/ tried several months ago. Thus our model excludes permanent consumer learning about the market. Similarly, the example also explains why all consumers are familiar with one of the competing brands. The underlying assumption is that people have been exposed to these products previously.

Two additional characteristics of the model need further discussion. First, beyond the Internet our model is also applicable to mail order catalogs. Here, consumers can also learn about digital attributes at no cost but remain largely uninformed about nondigital attributes. While these distribution channels have many common aspects there are also some differences. First, for catalogs the process of information search by consumers is initiated by the firm (consumers search in response to the arrival of the catalog in the mail) and firms have access only to a subset of the consumer

[4]It might be the case that consumers also have some uncertainty about the nondigital attributes of the brand being consumed currently. In essence, we assume that consumers have *less* uncertainty about the fit of their current firm's product than the fit of the other vendor's and for simplicity, we set this uncertainty to be zero for the familiar brand (see Alba et al. (1997, p. 43) for a discussion on how consumers learn to infer a particular brand's fit through product usage).

[5]See Zettelmeyer (1998a, b) for similar models of consumer search.

population (to whom the catalog has been sent to). In contrast, in our model, consumers initiate search and *all* consumers who have access to the Net can learn about digital product attributes at practically no cost. Second, notice that on the Internet, the marginal cost of reaching an additional customer is practically 0. That is, once a website has been built by the firm, all consumers can access it for free. In contrast, as for most marketing variables, the marginal cost of reaching a customer with a catalog is significant and may often be the central concern of the marketer. Thus a proper model of mail order needs to explicitly take such marginal costs into account. While our main findings certainly apply to mail order catalogs, we believe that they are of added relevance in the context of the Internet, because of the explosive growth and low marginal cost of electronic commerce.

Finally, the model assumes a specific distribution structure, namely vertically integrated firms. Many examples (including the one described above) correspond to such a situation. In addition to branded goods sold in the firms' distribution channels this case also applies to department stores, each of which carries a unique assortment even when these assortments are supplied by the same designer. Our model captures the competitive scenario of such department stores. Clearly, under a different distribution structure our results might not hold. However, our goal is to point to a specific (although plausible) context where the introduction of the Internet might lead to higher prices and profits. We caution against generalizing our results to other setups without due consideration.

In what follows we explore two scenarios. In the first, firms sell their products in their respective stores at cost c_1. The two stores are located at some distance from each other and we assume that in dollar terms, it costs the consumer k_2 to go from one store to the other. We also assume that the cost to the consumer to make the shopping trip is k_1, where $k_2 < k_1$. Notice that we assume that the cost of undertaking the shopping trip is higher than the cost of visiting an additional store. While this may not hold in certain special cases it is a reasonable assumption in many situations. One concrete example is destination shopping (e.g. shopping in a mall). However, k_1 and k_2 can be interpreted more broadly than the physical cost of traveling to and between stores. k_1 might include the cost of searching for the location of appropriate stores to visit and/or the cost of scheduling the shopping trip; these can be significant for families with children, for instance. $k_2 < k_1$ means that once these fixed costs in making the shopping trip are incurred, the cost of visiting another distribution outlet is small. In the second scenario, the stores sell their products through their stores *and* the Internet. Selling through the Net costs c_2, and as in Alba et. al. (1997, p. 46), is assumed to include the cost of delivering the product to the customer.

It is easy to see that in the case of undifferentiated digital goods (i.e. when nondigital attributes are nonexistent or $f = 0$) both distribution channels will lead to marginal cost pricing. In this case, if the cost of distribution is higher on the Net, then it is not a viable distribution channel. If the cost of sales through the Net is lower than the cost of selling in the stores, then there is no reason to have stores and the introduction of the Net will result in lower prices. The efficiency gains achieved through the introduction of the Internet benefit the consumer rather than firms. In what follows, we will show that for nondigital goods ($f > 0$) under some conditions, there are equilibria in which firms can benefit from the use of the Net. Moreover, this might happen even if the Net does not lead to efficiency gains in distribution ($c_2 > c_1$).

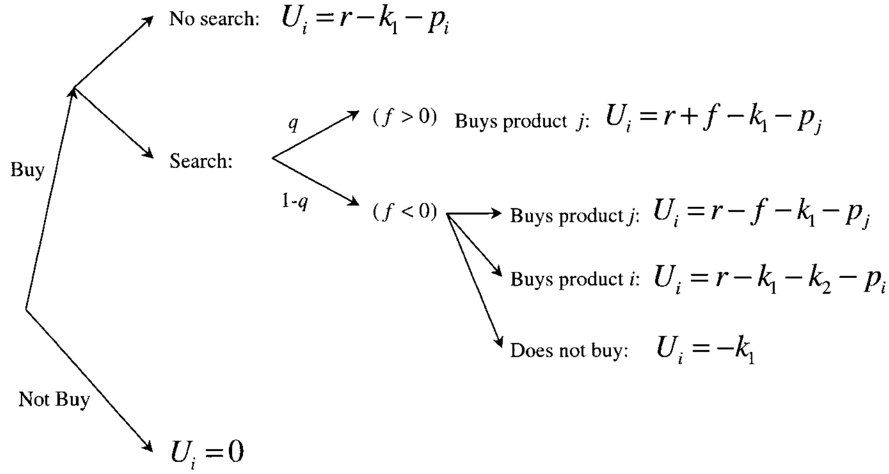
3.1. Distribution Through Stores

Consider the first scenario, when firms sell their nondigital products through their own stores and advertise their prices. In the next section, we will explore how the outcomes of this setup are altered by the introduction of the Internet.

Given the advertized prices, Figure 1 summarizes consumers' possible shopping strategies and the corresponding payoffs. The consumer, say of firm i (i = 1, 2) has three basic strategies: (1) to stay home, (2) to buy the familiar brand, and (3) to "search", that is, to check if the other brand has a superior fit.[6] Under the first strategy the consumer earns 0 utility. Under the

[6]Throughout the discussion, we define "search" to mean when the consumer physically evaluates the unfamiliar brand. In this sense, consumers *do not* search when they order the unfamiliar brand on the Net without trying it.

Figure 1 Consumers' Strategies and Corresponding Payoffs—Stores Only Case



second strategy the consumer earns a payoff of $r - k_1 - p_i$ (assume $p_i \leq r - k_1$). Finally, under the third strategy there are further decisions to make depending on the outcome of the search process. With probability q, fit is positive $(+f)$ and the consumer buys the new product earning surplus $r + f - k_1 - p_j$ ($j = 1, 2, j \neq i$). If the fit of the alternative brand turns out to be worse, $(-f)$ then the consumer has three options: (a) she can decide to purchase the product anyway, getting $r - f - k_1 - p_j$, (b) she can decide to go back to the store of the original brand, getting $r - k_1 - k_2 - p_i$, and finally (c) she can decide not to make a purchase at all, ending up with surplus $-k_1$, the cost of the shopping trip.[7]

Having outlined consumers' options, we next characterize all potential equilibria in pure strategies. There can be three types of such equilibria: (1) consumers do not search, (2) consumers search to evaluate the fit of the unfamiliar brand, and buy the familiar brand after a bad search outcome, and (3) consumers search but do not buy anything in case of a bad search outcome.[8]

[7]In what follows, we will assume that when the consumer compares the options "search" and "no search" and finds that they provide the same utility then the consumer weakly prefers not to search, i.e. stay at home. We also assume that if the consumer initiates search, then she weakly prefers to own the product versus not buying anything even if both outcomes provide the same utility. None of these assumptions drive the results.

[8]In the Appendix, we show that such an equilibrium never exists.

The following propositions describe the set of potential equilibria and the conditions under which they exist.

3.1.1. No-Search Equilibrium.

Proposition 1. *There is a unique equilibrium where consumers do not search and buy the familiar brand in that brand's store if and only if*

$$f + k_2 \leq \frac{k_2}{q}, \tag{1}$$

$$(1 + q)\left[r + f - k_1 - \frac{1 - q}{q} k_2 - c_1\right] < r - k_1 - c_1, \tag{2}$$

$$2(r - f - k_1 + k_2 - c_1) < r - k_1 - c_1. \tag{3}$$

In this equilibrium prices are $p_1 = p_2 = r - k_1$, firms' profits are $r - k_1 - c_1$, and consumer surplus is 0.

Proof (sketch). In what follows, we show that $p_1 = p_2 = r - k_1$ is an equilibrium where consumers do not search. In the Appendix we show that the equilibrium is unique. At prices $p_1 = p_2 = r - k_1$ consumers do not search if $U^s \leq U^{ns} = 0$, that is

$$q(r + f - k_1 - r + k_1) + (1 - q)$$
$$(r - k_1 - k_2 - r + k_1) \leq 0$$

which leads to (1). (Notice that if consumers prefer to buy the unfamiliar brand even when fit is bad instead of going back to their own store, then $U^s = (2q - 1)f$. This is always smaller than 0 however.) In the proposed equilibrium there is no search so each firm sells to its segment (consumers familiar with its brand). Thus the demand of each firm is 1, profits are $r - k_1 - c_1$, and consumers have 0 surplus.

Next, we identify conditions under which all possible deviations from the proposed equilibrium are unprofitable. There are two possible deviations: (i) decreasing price to induce search of the other firm's customer, and (ii) decreasing price even further to retain the other firm's customer even in case of a bad search outcome.[9] Consider the first deviation and assume that the product does not fit the other firm's customer who was searching. Then she can choose to buy her original brand and end up with surplus: $r - k_1 - k_2 - r + k_1 = -k_2$. Alternatively, this customer can go home without buying anything making $-k_1$. Clearly the disappointed customer will always purchase the original brand. Knowing this we can calculate the price that will induce the search of the competing brand's customer. It has to fulfill:

$$EU^s_{\text{other}} = q(r + f - k_1 - p) + (1 - q)(-k_2) > U^{ns}_{\text{other}} = 0,$$

that is

$$p < r + f - k_1 - \frac{1 - q}{q} k_2.$$

For any such price the firm's own customer will not search (she does not have the incentive to search in the proposed equilibrium; now that her own firm decreased price she has even less incentive to search). Thus the total demand of the firm choosing deviation $p < r + f - k_1 - (1 - q)k_2/q$ will be $1 + q$ and its profits are less than $(1 + q)[r + f - k_1 - (1 - q)k_2/q - c_1]$ which have to be smaller than $r - k_1 - c_1$, the profits in the proposed equilibrium. This condition gives (2).

Next consider the deviation where the firm decreases price to retain the other firm's customer even if there is a bad search outcome. Following the same arguments as above the other customer is better off buying the familiar brand ($U = -k_2$) than not to buy at all ($U = -k_1$), in case of a bad outcome. So to keep this customer the deviating firm needs to charge a price such that: $r - f - k_1 - p \geq -k_2$ or $r - f - k_1 + k_2 \geq p$. Again, the customer of the deviating firm will not search. Thus, its demand is 2 and its maximum profits are $2(r - f - k_1 + k_2 - c_1)$ which have to be smaller than $r - k_1 - c_1$. This yields condition (3). Uniqueness of the equilibrium is proved in the Appendix. □

Essentially, conditions (1)–(3) in Proposition 1 state that f can neither be too large nor too small for the proposed equilibrium to exist. As seen in (1), f small compared to k_2 (and therefore k_1) does not provide enough incentive for consumers to search. Furthermore, f needs to be small compared to c_1 as well so as to deter firms from inducing search by dropping prices. Finally, f needs to be large enough so as to prevent firms from engaging in price competition (similarly to the case of digital goods).

3.1.2. Search Equilibrium.

Proposition 2. *There is a unique equilibrium in which consumers search if and only if*

$$f + k_2 > \frac{k_1}{q}, \tag{4}$$

$$q\left(r + f - \frac{1}{q} k_1 - c_1\right) < r - k_2 - c_1, \tag{5}$$

$$(1 + q)\left[r - f + \frac{1 - 2q}{q} k_2 - c_1\right] < r - k_2 - c_1, \tag{6}$$

$$2(r - f - c_1) < r - k_2 - c_1. \tag{7}$$

In case of a bad search outcome, consumers buy the familiar brand. In equilibrium, prices are $p_1 = p_2 = r - k_2$, firms profits are $r - k_2 - c_1 > 0$, and consumers are left with positive surplus equal to $qf - k_1 + qk_2$.

The philosophy of the proof is similar to that of Proposition 1 and has been delegated to the Appendix. Conditions (4)–(7) of Proposition 2 again say that f has to be within some boundaries. In contrast to Proposition 1, f has to be large enough compared to k_1 and k_2

[9]Clearly, increasing price does not make sense. It does not induce the search of the other firm's customer and it deters the firm's own customer from buying.

to induce search by consumers. Moreover, f has to be large enough compared to c_1 so as to ensure that stopping consumer search by undercutting prices is unprofitable. Finally, f has to be small enough since an f too large would induce firms to choose prices higher than r because consumers would then search even if they remain without any product after a bad search outcome. Notice that in this equilibrium, where consumers search, prices are higher than in the no-search equilibrium of the previous section. This is not surprising however, as the total expected utility to consumers is now higher but firms can no longer extract all the consumer surplus as in the previous case.

3.2. Distribution Through Stores and the Net

Next consider the case when firms have dual distribution channels and charge the same price in both channels.[10] We are interested in evaluating how the results of the previous section change with the introduction of the Internet.

Figure 2 summarizes consumers' options when both distribution channels are available. There are two important differences compared to the stores-only case. First, now if consumers decide not to search they can directly order the product from the Net and, in this way save the cost, k_1 of the shopping trip. Also, a firm can stop the search of the other firm's customer and induce her to order its (unfamiliar) product on the Net by lowering price sufficiently.[11] Similarly, if search yields a negative fit and the consumer decides to buy the original product, she does not need to go to the other firm's store but can go home and order the product directly from the Net. These aspects are all taken into account in Figure 2.

We next characterize all equilibria in pure strategies. It is easily seen from the analysis presented in the previous section that there are only two types of possible equilibria in our model: (1) consumers do not search and buy the familiar brand on the Net, and (2) consumers search and buy the familiar brand on the Net in case of a bad search outcome. The set of potential equilibrium prices and the conditions under which they constitute an equilibrium are described in the following propositions.

3.2.1. No-Search Equilibrium.

PROPOSITION 3. *There is a unique equilibrium in which consumers do not search and order the familiar brand on the Net, if and only if,*

$$f \le \frac{k_1}{q} < 2(1 - q)f, \tag{8}$$

$$(1 + q)\left[r + f - \frac{k_1}{q}\right] - qc_1 - c_2 < r - c_2, \tag{9}$$

$$2\left[r - f + \frac{k_1}{1 - q} - c_2\right] < r - c_2, \tag{10}$$

or if

$$f < 2(1 - q)f \le \frac{k_1}{q}, \tag{11}$$

$$2[r - (1 - 2q)f - c_2] < r - c_2. \tag{12}$$

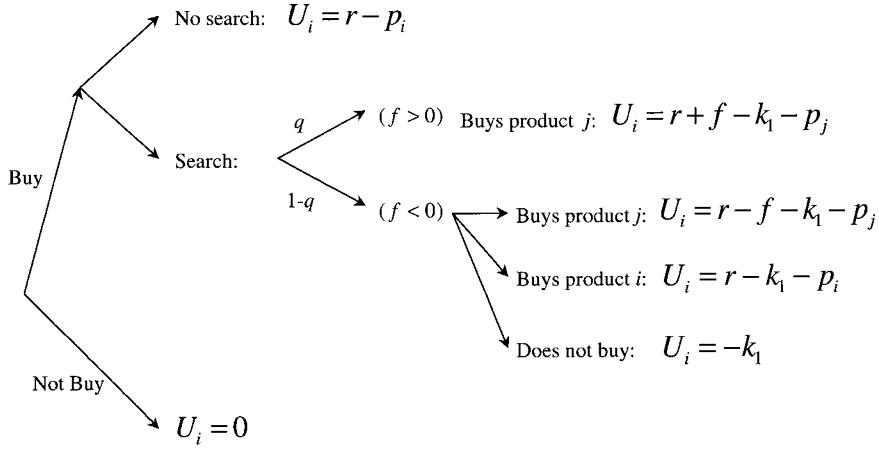
In this equilibrium, prices are $p_1 = p_2 = r$, firms' profits are $r - c_2$, and consumer surplus is 0.

The proof of Proposition 3 is in the Appendix. Conditions (8)–(12) have similar interpretations as in the previous section with the following difference. With the introduction of the Net, if consumers search, they never visit a second store. Hence, the benefit from search need to be compared only to the cost of the shopping trip, k_1 as seen in (8). As in Proposition 1, f has to be small compared to c_1 to deter firms from inducing search and large enough to prevent price competition.

[10] Assuming equal prices in both distribution channels simplifies the analysis. In practice, many brands using dual distribution channels have identical prices in their stores and on the Internet. Among vertically integrated brands, The Gap follows this strategy while Macy's is an example among department stores. In §5.2, we show that prices need not be equal for our results to hold.

[11] This is an important difference from the previous model that will be crucial when we examine possible deviations from the proposed equilibria. In the "stores-only" case the only way to keep a customer who is disappointed with fit is to compensate her for the bad fit with a low price. That is because the customer has to make the shopping trip anyway and once in the store, she can change her mind. With the advent of the Net, firms only have to convince the customer that price is low enough to compensate her for the *expected* loss that she incurs if she orders the unfamiliar brand without trying it.

Figure 2 Consumers' Strategies and Corresponding Payoffs—Stores and Net Case



3.2.2. Search Equilibrium.

Proposition 4. *There is a unique equilibrium in which consumers search if and only if*

$$f > \frac{k_1}{q}, \tag{13}$$

$$q\left(r + f - \frac{k_1}{q} - c_1\right) < r - qc_1 - (1 - q)c_2, \tag{14}$$

$$(1 + q)\left[r - f + \frac{k_1}{q}\right] - qc_1 - c_2 < r - qc_1 - (1 - q)c_2, \tag{15}$$

$$2\left[r - f + \frac{k_1}{1 - q} - c_2\right] < r - qc_1 - (1 - q)c_2. \tag{16}$$

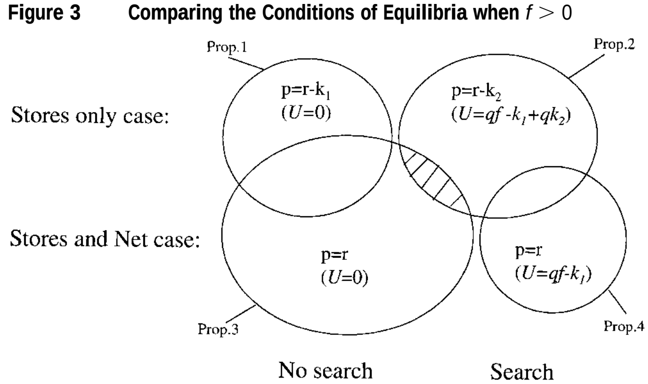
In case of a bad search outcome, consumers go home and order the familiar brand on the Net. In equilibrium, prices are $p_1 = p_2 = r$, profits are $r - qc_1 - (1 - q)c_2$, and consumer surplus is $qf - k_1 > 0$.

Conditions (13)–(16) and the proof (available in the Appendix) follow the exact same logic as those of Proposition 2. Compared to the no-search equilibrium, prices remained unchanged. Just as in the stores-only case however, this equilibrium essentially results in lower prices because now, the expected utility from search has increased. In contrast with the no-search equilibrium, some of the surplus remains with the consumers.

4. Discussion

In this section, we would like to evaluate how the introduction of the Internet affects the equilibria derived in the stores-only case. We have shown that in the stores-only case, there are two potential equilibria in pure strategies: a search equilibrium and a no-search equilibrium. We need to evaluate how these equilibria change once the Internet is introduced. To do so we have to compare the conditions in Propositions 1–4. The result of this analysis is shown in Figure 3, where each circle represents the parameter space corresponding to the "search" and "no-search" equilibria in the

Figure 3 Comparing the Conditions of Equilibria when $f > 0$



"stores only" and "stores and Net" cases.[12] The figure also shows equilibrium prices and consumer surplus (in parenthesis) in each case. Observing this figure it is easy to see that under some conditions the introduction of the Internet leads to higher prices and profits. In particular, in our model, the introduction of the Net may result in three possible outcomes.

First, when consumers do not search in the absence of the Internet then the Net does not induce consumer search and prices may go up.[13] In this way, monopoly pricing can be maintained and consumer surplus remains zero. In essence, under this outcome all the efficiency gains provided by the Net remain with the firms. The intuition behind this outcome is the following. Consumers are reluctant to search in the stores-only case to begin with. The introduction of the Net makes the search option even less attractive, because it allows them not to make a shopping trip at all. This extra consumer surplus, which results from saving the shopping trip, can be included in the prices by firms. Furthermore, the restrictions on f imposed by the conditions in Propositions 1 and 3 result in sufficient differentiation between the two products to prevent price competition between firms.

Second, when consumers search in the absence of the Internet then they may continue searching after the introduction of the Net, but prices and profits may increase as all the savings in distribution and shopping trip are appropriated by the firms. In other words, there is an overlap between the conditions of Propositions 2 and 4.[14] In this respect, notice that compared to the stores-only case prices increase by k_2 while consumer surplus decreases only by qk_2. In this scenario, note that search takes place even in the presence of the Net but consumers save the trip of going from one store to the other in case of a bad outcome. This is the reason why consumer surplus decreases only by qk_2. This situation can only occur when the benefit from search, qf is sufficiently large compared to k_1 and k_2 because in case of a bad outcome consumers end up with a negative surplus (i.e. they wasted the shopping trip). A sufficiently high f also provides enough differentiation between the products to ensure that firms do not have an incentive to undercut each other's prices.

Finally, the most surprising result of the above analysis is the existence of a possibility where introducing the Internet not only increases prices and profits but also stops consumer search (the shaded region in Figure 3 shows that there is an overlap between the conditions of Propositions 2 and 3).[15] The intuition is similar to the one provided above: *the introduction of the Internet results in a change of paradigm with respect to the cost of searching.* Since with the Net there is an option for consumers not to go shopping at all, the effective cost of searching increases to the extent that consumers are better off ordering the familiar brand on the Net without search. In other words, without the Internet, while the cost of shopping, (k_1) has to be incurred in buying a product, the cost of search is the cost of making an additional trip to the other store in case of a bad outcome ($(1 - q)k_2$). With the introduction of the Internet, consumers need not make a shopping trip. However, if the consumer were to try the unfamiliar brand, the cost of search would be equal to the cost of making a shopping trip, k_1. Thus the Internet makes search relatively more expensive. This allows for the possibility of consumers searching in the absence of the Internet while *not* searching with the introduction of the Net.

Given the above analysis, it can be seen that the Internet can reduce price competition and consumer search even when prior research suggests that this should not be the case. In particular, even if the Internet reduces the discriminatory power of information regarding merchandise quality, the presence of non-digital attributes might lead to decreased price competition and consumer search. Similarly, in contrast to Bakos (1997), we show that even when the cost of

[12]For the parameter regions outside the circles, i.e. outside the conditions of Propositions 1–4, there is no equilibrium in pure strategies. However, mixed-strategy equilibria may exist.

[13]While there is no overlap between the conditions of Propositions 1 and 4 (see Equations (1) and (13)), there is one between the conditions of Propositions 1 and 3. Assuming that $c_1 = c_2 = 0$, an example of a set of parameters that fulfill the conditions of both propositions is: $r = 1$, $f = 1.6$, $k_1 = 0.5$, $k_2 = 0.45$, and $q = 0.2$.

[14]An example of parameter values that fulfill both sets of conditions when distribution costs are assumed away is: $r = 1$, $f = 1.5$, $k_1 = 0.2$, $k_2 = 0.1$, and $q = 0.3$.

[15]Parameter values corresponding to this overlap include: $c_1 = c_2 = 0$, $r = 1$, $f = 1.4$, $k_1 = 0.5$, $k_2 = 0.3$, and $q = 0.3$.

searching for prices is lower than the cost of searching for product attributes the Internet can reduce price competition and consumer search. Finally, the results also imply that even if the cost of distribution is higher on the Internet, it might be profitable to use it as a complementary distribution channel to existing stores. Comparing profits in the search equilibria with the Internet (Proposition 4) and without the Internet (Proposition 2) shows that selling through the Net may result in higher profits even if the cost of distribution on the Net is slightly higher (i.e. $c_2 > c_1$).

5. Extensions

In this section, we relax two important assumptions of the model: (i) that all consumers have access to the Internet, and (ii) that prices are equal in the store and the Internet. Our results show that neither of these assumptions is critical to obtain the general insights of the model.

5.1. Some Consumers Do Not Have Access to the Internet

Assume that only a proportion α of the consumers have access to the Internet. In this case, depending on the value of α, the number of potential equilibria is higher although the prices that can constitute a potential equilibrium remain the same: r, $r - k_1$, and $r - k_2$. This is because the search behavior of consumers, represented in Figures 1 and 2, does not change. The conditions under which these prices are an equilibrium becomes much more complicated however, because the number of possible deviations increases significantly. In particular, the deviating firm can target both the Net users and those not having access to the Net. Instead of exploring all possible equilibria in this setup, we restrict our attention to one particular equilibrium which allows us to investigate the generalizability of the most important insight from §§3 and 4, namely that the Internet may increase prices and reduce consumer search. We would like to verify if this result still holds if some consumers do not have access to the Internet. The following proposition states the existence of an equilibrium where such an outcome is possible (proof is available from the authors).

Proposition 5. *Assume that $k_1 - qk_2 \le qf \le k_1 < 2q(1 - q)f$. Under the conditions outlined in the Appendix, prices $p_1 = p_2 = r$ constitute an equilibrium in which consumers who have access to the Net order the familiar brand on the Net and consumers without access to the Net do not purchase anything. In this equilibrium, firms' profits are $\alpha(r - c_2)$ and consumer surplus is* 0.

As mentioned earlier, an important aspect of this equilibrium is that the conditions under which it holds overlap with the conditions of Proposition 2 as long as the number of consumers having access to the Net is high enough.[16] In other words, even if some consumers have no access to the Net, firms might use the Net as a distribution channel and increase their prices, thereby stopping consumer search. Clearly, the higher the proportion of Net users, the more likely that such an outcome will occur.

5.2. Different Prices in the Stores and on the Net

What happens if prices are different in the store and on the Internet? In this section, we assume that, when firms sell over the Net, they charge a fee for shipping and handling, denoted δ. As such, if the product's price is p then consumers pay p in the store and $p + \delta$ on the Net. While firms are still faced with a single pricing decision, they can discriminate between their distribution outlets. Again, the analysis becomes more complicated, and depending on the value of δ, there are many more cases. However, as long as δ is smaller than the marginal cost of visiting an additional store (k_2), the results remain exactly the same. The following two propositions describe the conditions for the search and no-search equilibria under this scenario (proofs are available from the authors).

Proposition 6. *Assume that $\delta < k_2$. There is an equilibrium in which consumers do not search and order the familiar brand on the Net if*

$$f + \delta \le \frac{k_1}{q} < 2(1 - q)f + \delta, \tag{17}$$

$$(1 + q)\left[r + f - \frac{k_1}{q}\right] - qc_1 + \delta - c_2 < r - c_2, \tag{18}$$

[16]For the case outlined in footnote 15, α needs to be higher than 84% for the overlap to occur.

$$2\left[r - f + \frac{k_1 - q\delta}{1 - q} - c_2\right] < r - c_2, \tag{19}$$

or, if

$$f + \delta < 2(1 - q)f + \delta \leq \frac{k_1}{q}, \tag{20}$$

$$2[r - (1 - 2q)f - c_2] < r - c_2. \tag{21}$$

In this equilibrium, prices are $r - \delta$, *firms' profits are* $r - c_2$, *and consumer surplus is* 0.

Proposition 7. *Assume that* $\delta < k_2$. *There is an equilibrium in which consumers search if*

$$f + \delta > \frac{k_1}{q}, \tag{22}$$

$$q\left[r + f - \frac{k_1}{q} - c_1\right] < r - q(\delta + c_1) - (1 - q)c_2, \tag{23}$$

$$(1 + q)\left[r - f + \frac{k_1}{q} - \delta\right] - q(\delta + c_1) - c_2 < r - q(\delta + c_1) - (1 - q)c_2, \tag{24}$$

$$2\left[r - f + \frac{k_1 - q\delta}{1 - q} - c_2\right] < r - q(\delta + c_1) - (1 - q)c_2. \tag{25}$$

In case of a bad search outcome, consumers return home and order the familiar brand on the Net. In equilibrium, prices are $r - \delta$, *firms' profits are* $r - q(\delta + c_1) - (1 - q)c_2$, *and consumer surplus is* $q(f + \delta) - k_1 > 0$.

Notice that the conditions for both equilibria are very similar to the case discussed in §3. Furthermore, if $\delta = 0$, then these conditions converge to those in §3. Finally, it is important to note that again there is an overlap between the conditions of Proposition 6 and Proposition 2. Thus, prices might increase and consumer search may stop as a result of the introduction of the Internet.

6. Conclusions

In this paper, we asked the following question: Under what circumstances are we likely to observe increased prices and reduced consumer search after the introduction of the Internet? Based on our model, the following general observations can be made. First, this outcome is likely to occur for products that people purchase regularly, but not too frequently (e.g. staple items). In this case, consumers are not likely to remember all the specifics about the brands they have not chosen (i.e. there is uncertainty about those brands) but do remember that they have preferred other ones, i.e. their prior evaluation is less favorable ($q < 1/2$) than the current brand's (which they ultimately settled for). In such product categories, brands may benefit from consumer loyalty resulting from knowledge/familiarity. However, such loyalty can be efficiently leveraged only if the products have *relevant, but not overwhelming* nondigital attributes (i.e. when f is within some boundaries). We have seen that nondigital attributes are important because these generate loyalty towards the familiar brand. However, if nondigital attributes are the *only* relevant attributes for consumers' utility, then consumers are too tempted to search. As such, we believe that such outcomes are likely to happen for products where both digital and nondigital attributes are relevant.

Increased prices and reduced consumer search can be observed when the cost of undertaking the shopping trip is higher than the cost of searching between stores (i.e. $k_1 > k_2$). Destination shopping is an example (i.e. when competing stores are in a mall) but one could also think of other situations if the "cost of shopping" is thought about more generally, including, for example, the scheduling of the shopping trip for families, the location of appropriate stores, etc. If these fixed costs are relevant, then the cost of undertaking the shopping trip is the relevant cost for physical shopping. Second, from §5.1 it is also clear that the dynamics leading to reduced competition are more important the higher the proportion of people having access to the Internet. Our results are driven by the fact that there is a change of paradigm in consumers' search costs. However, this paradigm shift only affects Net users. If they represent a minority, the effects described above may not be relevant.

Our results also provide insight with respect to the following question: Should the Internet be used even if it is more expensive than the traditional distribution channel? Comparing profits in the search equilibria with and without the Internet provides an answer. One can see that selling through the Net may result in higher profits even if the cost of distribution on the Net is higher (i.e. $c_2 > c_1$). This is because, in the two types of equilibria firms can increase prices by k_1 and k_2 respectively as a result of the efficiency gains in search that the Net provides for consumers. This result is important in view of our assumption that c_2 incorporates the cost of delivery to the customer which means that distribution through the Net is not necessarily cheaper for firms.

The main purpose of this paper has been to analyze a context where it is possible to charge higher prices (rather than beat the competition on prices with the help of savings in cost of distribution and sales). Our main argument is that although the Internet may make product comparisons easier in some respects, nondigital attributes cannot be communicated through the Net. As the Net allows consumers to save shopping time and effort, it effectively makes it very costly for them to try new products for which the attributes have to be evaluated through physical presence. Hence, under some conditions consumers are relatively better off buying the familiar brand on the Internet rather than trying out the unfamiliar brand in the store. In this way, the Internet allows brands to leverage brand loyalty/familiarity.

Our results also suggest that with the general availability of the Internet, the role of stores might be reconsidered. While we do not explicitly model a dynamic market, our findings along with Klemperer's (1987) results suggest that in a dynamic context where new cohorts of consumers join the market the stores might have a key role in consumer acquisition while demand fulfillment may be left to the Internet, thereby leveraging the acquired customer base. In this way, the role of in-store assistance is critical to ensure that consumers leave the store fully satisfied. This leads to the surprising conclusion that stores may be better off allocating more in-store help to staple products (as compared to fashion items) since acquiring a customer may result in significant future revenue stream via the Internet.

As every analytical model, ours also has a number of limitations, that we delegate to future research.[17] First, we assume that firms are only differentiated along nondigital attributes. This assumption is based on the idea that often nondigital attributes (i.e. fit) are more difficult to define and therefore harder to match for competitors. Having said that, it would be interesting to explore a more general model where differentiation along digital attributes is also present. Second, we do not explicitly model the evolution of consumer preferences overtime as a result of past product experience. Said differently, we assume that based on prior experience, consumers are endowed with deterministic preferences for one of the products but are uncertain about the other. However, we do not explicitly model where this uncertainty comes from and do not link it to previous product choice. In particular, we do not have a segment of uninformed consumers who are not endowed with some prior product preferences. Again, the main idea is that for the products in question the size of such a segment is likely to be small. This feature however, definitely limits the generalizability of our model. It would be useful for future research to explore a dynamic model where consumer preferences evolve as a function of prior product exposure.[18]

Appendix

Proof of Uniqueness for Proposition 1

In what follows, we show that the only potential equilibrium without consumer search is $p_1 = p_2 = r - k_1$. We prove this statement by contradiction. Clearly, there cannot be an equilibrium without search where any of the firms has higher price than $r - k_1$. If there were such an equilibrium, there are no sales and the firm in question would have an incentive to decrease price. Therefore, we have two cases to consider: (i) $p_i < p_j \le r - k_1$, and (ii) $p_i = p_j < r - k_1$. Take case (i) and assume that $p_i < p_j \le r - k_1$ is an equilibrium in which consumers do not search. First, notice that after a bad search outcome consumer i will never go home without buying one of the brands. Not buying would yield utility $-k_1$, while buying the familiar brand gives $r - k_1 - k_2 - p_i$. As $p_i < r - k_1 < r - k_2$ consumer i is better off buying the familiar brand.

[17]We would like to thank one of the reviewers for drawing our attention to these issues.

[18]The authors would like to thank V. Padmanabhan, Debu Purohit, Garth Saloner, Luc Wathieu and the participants of the Stanford Summer Marketing Camp for their helpful comments on earlier drafts. The comments of the Editor, Area Editor, and two anonymous reviewers are also acknowledged.

Second, it might be the case that she prefers to buy the unfamiliar brand even in case of a bad search outcome. Take this case first. Then $r - f - k_1 - p_j \geq r - k_1 - k_2 - p_i$, that is, $p_j - p_i \leq k_2 - f$. If these prices constitute a no-search equilibrium,

$$U_i^s = q(r + f - k_1 - p_j) + (1 - q)(r - k_1 - f - p_j)$$
$$\leq r - k_1 - p_i = U_i^{ns}, \tag{26}$$

i.e. $-(1 - 2q)f \leq p_j - p_i$. Hence firm i can always increase its price such that $p_j \geq p_i$ and $U_i^s \leq U_i^{ns}$. Thus, such an equilibrium cannot exist.

Next, take the case when it is beneficial to buy the familiar brand after a bad search outcome, i.e. $p_j - p_i > k_2 - f$. Then in an equilibrium without search, it has to be the case that

$$U_i^s = q(r + f - k_1 - p_j) + (1 - q)(r - k_1 - k_2 - p_i)$$
$$\leq U_i^{ns} = r - k_1 - p_i.$$

Rearranging, we obtain

$$q(f - p_j) - (1 - q)k_2 \leq -qp_i.$$

Assume first that $q(f - p_j) - (1 - q)k_2 < -qp_i$. For any such price p_i, firm i can increase price by $\epsilon > 0$ without changing the inequality above. Then consumer behavior will not change but profits increase, i.e. such price cannot be an equilibrium in which consumers do not search. Now assume that $q(f - p_j) - (1 - q)k_2 = -qp_i$, that is,

$$0 < p_j - p_i = f - \frac{1 - q}{q} k_2 < f - k_2. \tag{27}$$

It is easy to show that under such conditions firm j's customer will always search so such prices cannot form a no-search equilibrium. If firm j's customer searches, she always buys the familiar brand after a bad outcome ($r - k_1 - k_2 - p_j > r - f - k_1 - p_i$) because (18) implies $p_j - p_i < f - k_2$. Then

$$U_j^s = q(r + f - k_1 - p_i) + (1 - q)(r - k_1 - k_2 - p_j)$$
$$> U_j^{ns} = r - k_1 - p_j$$

because (18) implies $p_j - p_i > 0 > (1 - q)k_2/q - f$.

Next, take case (ii). Let $p_i = p_j = p < r - k_1$. If such equilibrium exists without search, then $U^s \leq U^{ns}$. There are two cases to consider: (a) $f > k_2$, and (b) $f \leq k_2$. If $f > k_2$, then after a bad search outcome consumers prefer to buy the familiar brand. For a no-search equilibrium, it has to be the case that

$$f \leq (1 - q)k_2/q.$$

Assume first that the inequality is strict. Then one of the firms could increase price by $\epsilon > 0$ without altering his consumer's behavior. There is an incentive to deviate, so this cannot be an equilibrium. Next, consider the case when $q(f - p) - (1 - q)k_2 = -qp$, i.e. when $f = (1 - q)k_2/q$. Then firm i, for instance, can decrease price by $0 < \epsilon < f - k_2$. His own customer will still not search but firm j's customer will start searching as

$$U_j^s = q(r + f - k_1 - p + \epsilon) + (1 - q)(r - k_1 - k_2 - p)$$
$$> U_j^{ns} = r - k_1 - p$$

since $\epsilon > f - (1 - q)k_2/q = 0$. This deviation yields profit qp_i while the lost profit is ϵ. If ϵ is small, this is a profitable deviation, thus such prices cannot constitute a no-search equilibrium.

Finally, let $f \leq k_2$. In a no-search equilibrium:

$$U_i^s = q(r + f - k_1 - p) + (1 - q)(r - f - k_1 - p)$$
$$\leq U_i^{ns} = r - k_1 - p,$$

i.e. $-(1 - 2q)f \leq 0$. Since the left-hand side is strictly less than 0, there is an incentive to increase price without violating the above inequality. □

Proof of Proposition 2

Existence. At the proposed prices consumers search if the benefits from search are larger than 0 because buying the familiar brand provides negative utility. We have seen that the only possible equilibrium in which there is search, is one where consumers (weakly) prefer to buy the familiar brand in case of a bad outcome. At the above prices this is the case and consumers' utility is $-k_1$. Thus, $U^s > 0$ if $q(r + f - k_1 - r + k_2) - (1 - q)k_1 > 0$, which leads to condition (4). In the proposed equilibrium profits are $r - k_2 - c_1$.

Next, we will find conditions under which all possible deviations from the proposed equilibrium are unprofitable. There are three possible deviations: (i) increase price without preventing search of the other customer, (ii) decrease price to prevent the search of own customer, and (iii) decrease price to keep the other customer even if there is a negative search outcome. Take the first deviation. Increasing price means that the firm's own customer will not come back under a bad search outcome (she only weakly prefers to come back in equilibrium). The other customer, however, will still search as long as

$$U_{\text{other}}^s = q(r + f - k_1 - p) - (1 - q)k_1 > 0,$$

i.e. $r - k_2 < p < r + f - k_1/q$. In case of a bad outcome this customer will leave (she is indifferent between buying the original brand or going home). Then the demand consists of proportion q of the other firm's customers with successful search. Profits are less than $q[r + f - k_1/q - c_1]$ which have to be smaller than $r - k_2 - c_1$ leading to (5). Next, take deviation (ii). To prevent the search of own customer price has to be such that:

$$EU_{\text{own}}^s = q(r + f - k_1 - r + k_2) + (1 - q)(r - k_1 - k_2 - p)$$
$$< U_{\text{own}}^{ns} = r - k_1 - p,$$

i.e. we need $p < r - f + (1 - 2q)k_2/q$ and $p < r - k_1$. (We used the fact that the customer buys the original brand in case of a bad search outcome.) It is easy to see that under (4) only the first condition is binding. Suppose the firm chooses such a price. To determine the total profits from this deviation we need to understand the behavior of the other firm's customer. The other firm's customer will search of course but what happens when the outcome is bad? If she stays she gets

$$r - f - k_1 - r + f - (1 - 2q)k_2/q = -k_1 - (1 - 2q)k_2/q.$$

If she buys the original brand or if she goes home she gets $-k_1$. So the other customer will not stay, i.e. the demand is $1 + q$. The maximum profit under this strategy is

$$(1 + q)(r - f + (1 - 2q)k_2/q - c_1)$$

which needs to be smaller than $r - k_2 - c_1$, leading to (6). Finally, consider the third deviation. To keep the other customer in case of a bad outcome it has to be the case that $r - f - k_1 - p \geq -k_1$, i.e. $p \leq r - f$. Suppose price $r - f$ is chosen. Then, as this price is lower than the price of deviation (ii), the firm's own customer does not search, i.e. the demand is 2. Thus, we need condition (7) to make the deviation unprofitable. This completes the existence proof.

Finally, at the proposed prices firms' profits are $r - k_2 - c_1$ and expected consumer surplus is

$$EU = q(r + f - k_1 - r + k_2) + (1 - q)$$
$$(r - k_1 - k_2 - r + k_2) = qf - k_1 + qk_2.$$

Uniqueness. First, we prove that there is no equilibrium in which consumers search and buy the unfamiliar brand even in case of a bad search outcome. If such an equilibrium exists, then the expected utility from search has to be higher than the utility from no search for both customers:

$$U_j^s = q(r + f - k_1 - p_i) + (1 - q)(r - f - k_1 - p_i)$$
$$> U_j^{ns} = r - k_1 - p_j,$$
$$U_i^s = q(r + f - k_1 - p_j) + (1 - q)(r - f - k_1 - p_j)$$
$$> U_j^{ns} = r - k_1 - p_i,$$

i.e.

$$p_j - p_i > (1 - 2q)f \text{ and } p_i - p_j > (1 - 2q)f.$$

These inequalities cannot be simultaneously fulfilled.

Next, we prove that there is no equilibrium in which consumers search and buy nothing in case of a bad search outcome. Assume such an equilibrium exists. Then it has to be the case that $r - k_2 < p_i \leq p_j$. Furthermore for firm j's consumer it is the case that

$$U_j^s = q(r + f - k_1 - p_i) - (1 - q)k_1 > U_j^{ns} = r - k_1 - p_j,$$

that is $p_i < f - (1 - q)r/q + p_j/q$. If such prices exist then firm i can increase its price by $\epsilon > 0$. This does not affect the behavior of his own consumer (who already does not come back after a bad choice outcome) and as long as ϵ is small enough (the above inequality holds) firm j's consumer keeps searching. So ϵ is a profitable deviation.

Finally, we prove that there is no equilibrium where consumers search and buy the familiar brand after a bad search outcome such that $p_1 \neq r - k_2$ or $p_2 \neq r - k_2$. We prove this by contradiction. First, notice that if consumers come back after a bad search outcome then for both firms' prices it has to be the case that $r - k_1 - k_2 - p \geq -k_1$, that is $r - k_2 \geq p$. We have two cases to consider: (i) $p_i < p_j \leq r - k_2$, and (ii) $p_i = p_j < r - k_2$. Take the first case. In the proposed equilibrium, for customer j, it has to be the case that

$$U_j^s = q(r + f - k_1 - p_i) + (1 - q)(r - k_1 - k_2 - p_j)$$
$$> U_j^{ns} = r - k_1 - p_j,$$

i.e. $f - (1 - q)k_2/q + p_j > p_i$. If such prices exist then firm i has an incentive to increase prices with $\epsilon > 0$, since, as long as $0 < \epsilon < r - k_2 - p_i$, his own customer still comes back after a bad search outcome while firm j's customer will still search because for a small enough ϵ the above inequality continues to hold. Thus ϵ is a profitable deviation.

Next, take the case when $p_i = p_j = p < r - k_2$. The proof follows the same logic as in the previous case. For firm j's customer it has to be the case that

$$U_j^s = q(r + f - k_1 - p) + (1 - q)(r - k_1 - k_2 - p)$$
$$> U_j^{ns} = r - k_1 - p,$$

i.e. $f - (1 - q)k_2/q > 0$. Assume that firm i increases price with $0 < \epsilon < r - k_2 - p$. Then for firm j

$$U_j^s = q(r + f - k_1 - p - \epsilon) + (1 - q)(r - k_1 - k_2 - p)$$
$$> U_j^{ns} = r - k_1 - p.$$

As long as $f - (1 - q)k_2/q > \epsilon > 0$ firm j's customer will keep searching. Thus, there is a profitable deviation by firm i. Therefore such an equilibrium cannot exist. This completes the uniqueness proof. □

Proof of Proposition 3

Existence. At the prices above consumers will not search if $k_1 \geq qf$. We need to find conditions under which all deviations from this proposed equilibrium are unprofitable. There are two deviations to consider: (i) decrease price to induce the other firm's customer to search, and (ii) decrease price to induce the other firm's customer to buy the unfamiliar brand on the Net without search. In both of these deviations the firm's own customer will not engage in search. This is because it is already unprofitable to search for this customer in equilibrium. If her own firm decreases price she has even less incentive to search.

Consider deviation (i). How can a firm induce search of the other firm's customer? To induce search the expected utility from search should be greater than the expected utility from buying any of the brands without search, on the Net. The benefit from buying the familiar brand to the other firm's customer is 0, as r is her reservation price. The benefit from buying the unfamiliar brand without search to this customer is $r - (1 - 2q)f - p$. In summary, the maximum benefit from not searching is $\max(0, r - (1 - 2q)f - p)$.

The expected utility from search depends on the consumer behavior in case of a bad search outcome. In particular, the consumer can either buy the familiar brand on the Net or buy the unfamiliar brand (in the store or on the Net). However, for this last option to be profitable the price has to be lower than the price that would induce this customer to buy the unfamiliar brand on the Net without search (deviation (ii)). This is because the consumer would save the cost of the shopping trip. Thus, the expected utility from search is:

$$EU^s_{\text{other}} = q(r - k_1 + f - p) + (1 - q)(-k_1).$$

Hence, the price needed to induce the other firm's customer to search is such that

$$EU^s_{\text{other}} = q(r - k_1 + f - p) + (1 - q)(-k_1)$$
$$> \max(0, r - (1 - 2q)f - p).$$

If $\max(0, r - (1 - 2q)f - p) = 0$, then the consumer searches if $r + f - k_1/q > p \geq r - (1 - 2q)f$. This is feasible if and only if $2(1 - q)f > k_1/q \geq f$. On the other hand, if

$$\max(0, r - (1 - 2q)f - p) = r - (1 - 2q)f - p,$$

then the consumer searches if

$$r - (1 - 2q)f > p > r - f + k_1/(1 - q).$$

This is also feasible if and only if $2(1 - q)f > k_1/q \geq f$. In summary, the other firm's customer searches only if

$$2(1 - q)f > k_1/q \geq f$$

and

$$r + f - k_1/q > p > r - f + k_1/(1 - q).$$

The maximum revenue from such a deviation is $(1 + q)p$, 1 from own customer (on the Net) and q from the other customer (in the store). The unprofitability of such a deviation is stated in (8) and (9).

Next consider deviation (ii): decrease price to induce the other customer to order our product on the Net without search. This deviation requires that the utility from buying the unfamiliar brand on the Net without search (yielding a utility of $r - (1 - 2q)f - p$) be greater than 0 and the utility from searching. As seen above, the other firm's customer searches only if

$$2(1 - q)f > k_1/q \geq f$$

and

$$r + f - k_1/q > p > r - f + k_1/(1 - q).$$

So, if $k_1/q > 2(1 - q)f > f$ then to implement this deviation, we need $r - (1 - 2q)f - p > 0$. At these prices the demand is 2 and therefore, this deviation is not profitable if (12) holds. If, on the other hand, $2(1 - q)f > k_1/q \geq f$, then to implement this deviation prices need to be smaller than $r - f + k_1/(1 - q)$. At these prices, the demand is 2 and we need (10) to make this deviation unprofitable. Combining conditions (8)–(12) completes the existence proof.

Uniqueness. We show that the only potential equilibrium without consumer search is $p_1 = p_2 = r$. Again we prove this by contradiction. First, notice that there can be no equilibrium without search where any of the firms chooses a higher price than r. So we have two cases to consider: $p_i < p_j \leq r$ and $p_i = p_j < r$. Take the case $p_i < p_j \leq r$. If this is an equilibrium without search then for the consumer of firm i:

$$EU^s_i = q(r + f - k_1 - p_j) + (1 - q)(r - k_1 - p_i) \leq r - p_i.$$

(We used the fact that consumer i always buys the familiar brand after a bad outcome.) Assume first that the inequality above is strict, i.e. $f - k_1/q < p_j - p_i$. Then firm i can increase price by $\epsilon > 0$ without triggering his consumer's search; thus there is a profitable deviation. Next take the case when $0 < f - k_1/q = p_j - p_i$ and consider firm j's consumer. If she searches she will always buy the familiar brand in case of a bad search outcome because $p_j - p_i > f$. Then at the proposed equilibrium it has to be that

$$EU^s_j = q(r + f - k_1 - p_i) + (1 - q)(r - k_1 - p_j) \leq r - p_j,$$

that is $p_j - p_i \leq k_1/q - f < 0$ which is impossible. So there is no equilibrium without consumer search such that $p_i < p_j \leq r$.

Next, take the case $p_i = p_j = p < r$. For a no-search equilibrium it is the case that

$$EU^s = q(r + f - k_1 - p) + (1 - q)(r - k_1 - p) \leq r - p,$$

i.e. $f \leq k_1/q$. Assume first that the inequality is strict. Then firms have an incentive to increase price with $\epsilon > 0$. If on the other hand $f = k_1/q$ then by decreasing price with ϵ one of the firms can induce the search of the other firm's customer by only changing profits from its own customer with an infinitely small amount. Thus prices $p_i = p_j = p < r$ cannot constitute a no-search equilibrium. □.

Proof of Proposition 4

Existence. At the proposed prices there is search if (13) holds. Profits in the proposed equilibrium are $r - qc_1 - (1 - q)c_2$ and consumers weakly prefer the familiar brand (to not buying anything) after a bad search outcome. Expected consumer surplus is

$$EU = q(r + f - k_1 - r) + (1 - q)(r - k_1 - r)$$
$$= qf - k_1 > 0.$$

There are three possible deviations from the proposed equilibrium: (i) increase price, (ii) decrease price to stop search of own customer, and (iii) decrease price to induce the other customer to order the unfamiliar brand on the Net without search. Consider deviation (i). The other customer will search as long as

$$EU^s_{\text{other}} = q(r + f - k_1 - p) - (1 - q)k_1 > 0,$$

$r < p < r + f - k_1/q$. If the firm's own customer engages in search and if $p > r$, she will always go home without buying in case of a bad outcome. Then, demand is q from the other firm's customer in the store. This deviation is unprofitable if (14) holds.

Next, consider deviation (ii): decrease price to prevent search of own customer. Her utility from search is

$$EU^s_{\text{own}} = q(r + f - k_1 - r) + (1 - q)(r - k_1 - p).$$

Utility from not searching is $r - p$. $U^{ns}_{\text{own}} \geq U^s_{\text{own}}$ if $p \leq r - f + k_1/q$. What does the other customer do if $p = r - f + k_1/q$? In case of a bad search outcome she will not stay as this would give her $r - f - k_1 - r + f - k_1/q = -(1 + q)k_1$ utility which is smaller than $-k_1$. So

$$EU^s_{\text{other}} = q(r + f - k_1 - r + f - k_1/q) + (1 - q)(-k_1) = 2(qf - k_1).$$

Ordering the unfamiliar brand without search gives $r - (1 - 2q)f - r + f - k_1/q$ which is less than the search utility, so other customer searches. The demand is $1 + q$, q from the store and 1 from the Net. To make this deviation unprofitable we need (15).

Finally, consider the third possible deviation. If the other customer orders the unfamiliar brand on the Net her expected utility is: $r - (1 - 2q)f - p$. This has to be larger than the utility from search:

$$EU^s_{\text{other}} = q(r + f - k_1 - p) + (1 - q)(-k_1) = q(r + f - p) - k_1,$$

i.e. $p \leq r - f + k_1/(1 - q)$. This price is smaller than the price of deviation (ii) when the firm's own customer stops searching. So own customer does not search. The demand is 2 from the Net and we need (16) to make the deviation unprofitable.

Uniqueness. First we show that there is no equilibrium in which consumers search and buy nothing in case of a bad search outcome. By contradiction, assume such equilibrium exists. Then it has to be the case that $r < p_i \leq p_j$. For firm j's customer, it has to be the case that

$$EU^s_j = q(r + f - k_1 - p_i) - (1 - q)k_1 > r - p_j,$$

i.e. $p_i < f - k_1/q - (1 - q)r/q + p_j/q$. One can see that firm i can profitably deviate by increasing his price with $\epsilon > 0$.

Next, we show that there is no equilibrium in which consumers search and buy the familiar brand in case of a bad search outcome such that $p_1 \neq r$ or $p_2 \neq r$. By contradiction, again, there are two cases to consider: (i) $p_i < p_j \leq r$, and (ii) $p_i = p_j < r$, since if prices are higher than r then consumers buy nothing in case of a bad search outcome. Take case (i) first. For the customer of firm j, for search to occur it has to be the case that

$$EU^s_j = q(r + f - k_1 - p_i) + (1 - q)(r - k_1 - p_j) > r - p_j,$$

i.e. $p_i < f - k_1/q + p_j$. If such prices exist, firm i can increase price with $\epsilon > 0$ without altering consumer behavior. Thus this cannot constitute an equilibrium where consumers search and buy the familiar brand after a bad search outcome. The argument follows exactly the same logic as in case (ii) and completes the uniqueness proof. □

Conditions for Proposition 5

PROPOSITION 5. *Assume that $k_1 - qk_2 \leq qf \leq k_1 < 2q(1 - q)f$. Then, prices $p_1 = p_2 = r$ constitute an equilibrium in which consumers who have access to the Net order the familiar brand on the Net and consumers without access to the Net do not purchase anything if the following conditions are simultaneously fulfilled.*

Condition 1

$$\alpha\left[(1 + q)\left(r + f - \frac{k_1}{q}\right) - qc_1 - c_2\right] + (1 - \alpha)q\left(r + f - \frac{k_1}{q} - c_1\right) < \alpha(r - c_2). \tag{28}$$

Condition 2

If $qk_1 < (1 - q)^2k_2$ and $f - 2k_1 - (1 - q)k_2 > 0$ then

$$2\alpha\left[r - f + \frac{k_1}{1 - q} - c_2\right] + (1 - \alpha)\left[r - f + \frac{k_1}{1 - q} - c_1\right] < \alpha(r - c_2). \tag{29}$$

If $qk_1 > (1 - q)^2k_2$ and $f - 2k_1 - (1 - q)k_2 \leq 0$ then

$$2\alpha\left[r - f + \frac{k_1}{1 - q} - c_2\right] + (1 - \alpha)q\left[r - f + \frac{k_1}{1 - q} - c_1\right] < \alpha(r - c_2). \tag{30}$$

If $qk_1 \leq (1 - q)^2k_2$ and $(1 - q)f - (2 - q)k_1 > 0$ then

$$2\alpha\left[r - f + \frac{k_1}{1 - q} - c_2\right] + (1 - \alpha)(1 + q)\left[r - f + \frac{k_1}{1 - q} - c_1\right] < \alpha(r - c_2). \tag{31}$$

If $qk_1 \leq (1 - q)^2k_2$ and $(1 - q)f - (2 - q)k_1 \leq 0$ then

$$2\alpha\left[r - f + \frac{k_1}{1 - q} - c_2\right] + (1 - \alpha)q\left[r - f + \frac{k_1}{1 - q} - c_1\right] < \alpha(r - c_2). \tag{32}$$

Condition 3

If $qk_1 + (1 - q)k_2 < qf$ then

$$\alpha(1 + q)\left[\frac{qf - k_1}{1 - q} + r - k_2 - c_2\right] + (1 - \alpha)\left[\frac{qf - k_1}{1 - q} + r - k_2 - c_1\right] < \alpha(r - c_2). \tag{33}$$

and

$$\alpha\left[r - f + \frac{1 - q}{q}k_2 - c_2\right] + (1 - \alpha + q)\left[r - f + \frac{1 - q}{q}k_2 - c_1\right] < \alpha(r - c_2). \tag{34}$$

If $qk_1 + (1 - q)k_2 \geq qf$ then

$$\alpha[r - k_1 - c_2] + (1 - \alpha + q)[r - k_1 - c_1] < \alpha(r - c_2). \tag{35}$$

In this equilibrium, firms' profits are $\alpha(r - c_2)$ and consumer surplus is 0.

References

Alba, Joseph, John Lynch, Barton Weitz, Chris Janiszevski, Richard Lutz, Alan Sawyer, Stacy Wood. 1997. Interactive home shopping: consumer, retailer, and manufacturer incentives to participate in electronic marketplaces, *J. Marketing* **61** (July) 38–53.

Bakos, Yannis J. 1997. Reducing buyer search costs: implications for electronic marketplaces. *Management Sci.* **43** (12) 1676–1692.

The Economist. 1996. Facts and fiction. March 2.
——. 1997. Survey of electronic commerce. May 10.
Financial Times. 1998. Interview Gary Hamel business strategist. October 22.
Fortune. 1996. The birth of digital commerce. Dec. 9.
Information Systems Management. 1996. Competitive implications of the Internet. Summer.
The Internet Retailing Report. 1997. Morgan Stanley, May 28.
Klemperer, Paul. 1987. The competitiveness of markets with switching costs. *Rand J. Econom.* **18** (1, Spring) 741-6261.
Lynch, John, G., Dan Ariely. 1999. Electronic shopping for wine: how search costs for information on price, quality and store comparison affect consumer price sensitivity, satisfaction with merchandise and retention. Working Paper, Fuqua School of Business, Duke University, Durham, NC.
Nelson, Philip. 1970. Information and consumer behavior. *J. Political Economy* **78** (2) 311–329.
——. 1974. Advertising as information. *J. Political Economy* **81** (July/August) 729–754.
The Wall Street Journal. 1997. The virtual emporium is one of a kind—for now. April 23.
Zettelmeyer, Florian. 1998a. Expanding to the Internet: pricing and communications strategies when firms compete on multiple channels. Working Paper, University of California, Berkeley, CA.
——. 1998b. The strategic use of consumer search costs. Working Paper, University of California, Berkeley, CA.

This paper was received April 7, 1998, and has been with the authors 6 months for 3 revisions; processed by William Boulding.