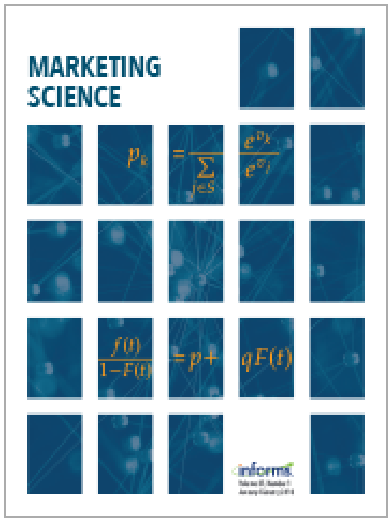

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Research Note

Managing e-Marketplace: A Strategic Analysis of Nonprice Advertising

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The e-marketplace has emerged as an important electronic shopping environment that, according to a recent *Forrester Research* report, may evolve into a dominant force in Internet marketing. We investigate an e-marketplace with online stores offering competing products. We find that featuring is associated with a price premium and serves as a mechanism to mitigate competition among online stores. In essence, featuring facilitates a convenience-price trade-off. Those consumers who find that the cost of searching outweighs the benefit of a lower expected price shop at the featured store where the price is higher on average. We endogenize consumers' decisions on shopping at the featured store or use the search engine to shop at the low-price store and examine the robustness of our results in an n-store setting.

Key words: nonprice advertising; competitive strategy; e-commerce; game theory
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1. Introduction

Imagine a consumer who needs to buy a product from a category with which he/she is not familiar. Ideally, the consumer would go through all alternatives and buy the one that has the best value. However, searching through all of them (a typical category consists of thousands of SKUs) would be long and tiresome. With the advent of e-commerce, the consumer has even more choices. Sitting in front of his/her computer, the consumer can browse through thousands of stores. Nevertheless, the abundance of alternatives is not always an advantage. For example, a search for a PDA (personal digital assistant) using Google.com returns 4,810,000 results. Granted, searching online is by no means the same as searching offline. After all, the consumer is sitting in a comfortable chair and, with the help of the search engine, can refine the search terms and soon narrow down to a much smaller set of alternatives. However, the process still can be quite time consuming.[1] Fortunately, many online shopping malls, or e-marketplaces, have featured stores for each category. Links to the featured stores are typically placed in prominent spots on the website of the e-marketplace. With a single click, the consumer can go to a featured store for the particular product in which she is interested. Should she expect a price discount or a price premium from the featured store?

The e-marketplaces are an emerging phenomenon. However, it is conceivable that featuring in e-marketplaces will be an enduring trend. To keep up with the pace of rapid technological advances, marketing researchers are encouraged to focus on future issues rather than on past issues (Shugan 2004). This research takes the first step toward understanding the strategic implication of featuring in the context of e-commerce. Our particular focus is on the interaction between electronic marketplaces and their member stores. An e-marketplace provides links to numerous firms that sell their products and services online and attracts consumers through a large bundle of information. Some of the leading examples of e-marketplace are shopping sites at major Internet portals such as Yahoo! Shopping, eShop@msn, Shop@AOL, professional service referral sites such as WebMD, Homefair.com, and Edmunds.com. According to a *Forrester Research* report (March 2001), e-marketplaces will drive almost half of online retail sales by 2005.

To examine the impact of featuring in e-marketplaces, we consider a stylized model of an e-market-

[1] A search for PDA using MySimon.com, a popular shopping bot, returns 303 results after a guided refinement of search terms. Both the Google.com and MySimon.com search results were obtained on July 29, 2005.

place interacting with competing online stores. The e-marketplace offers a two-part tariff to the stores. Given the contract offered by the e-marketplace, each online store simultaneously decides whether to join the e-marketplace or not. Consumers are heterogeneous in their price sensitivity and search costs. Their shopping decisions are based on their trade-offs among store preferences, expected prices to pay, and search costs. To those who patronize the e-marketplace, two options are available: shopping at a featured store or searching within the e-marketplace using the embedded search function. As a result of trading off between the expected price to pay and the cost of search, consumers with low search cost use the search function embedded in the e-marketplace to search for a store with the lower price. In contrast, consumers with high search cost attach a high value to convenience, and they go to a featured store in the e-marketplace and shop there. We find that featuring leads to price premium in the e-marketplace. As such, featuring serves as a competition-mitigating mechanism. Our result is consistent with the findings in Iyer (1998) and Dubé and Manchanda (2005), who show that nonprice factors such as service and advertising reduce price competition.

Three streams of research are relevant to our study: collocation, franchising, and the emerging literature on Internet institutions. The insights of the extant collocation literature (Dudey 1990, Wernerfelt 1994, Fischer and Harrington 1996) are largely predicated on spatial competition, the trade-off between increased competition among firms and reduced search costs among consumers, and product differentiation. This literature is able to explain why firms may choose to collocate but sheds little light on the role of an intermediary on facilitating collocation. Collocation at an e-marketplace has unique features. Specifically, online stores are not confined by geographical distance and physical location, all competitors are just a few clicks from each other regardless of whether they are in an e-marketplace or not. Through the choice of featured stores and the level of advertising, an e-marketplace is much more capable of influencing consumer's awareness and store choice than brick-and-mortar marketplaces such as the conventional malls. Our model differs from the extant collocation literature in both the underlying mechanism and focus. In the offline setting, firms collocate to provide convenience to consumers at the cost of increased competition and hence product differentiation is a necessary condition. By contrast, we focus on the role of the e-marketplace as an intermediary; an e-marketplace provides convenience to mitigate competition and this applies to both homogeneous and heterogeneous products.

Similar to a franchisor, an e-marketplace implements two-part tariffs to its member stores. However, the e-marketplace and franchise are very different institutions. In a franchising channel, the franchisor chooses the locations of the franchisees to minimize competition within the franchise.[2] By contrast, the e-marketplace mitigates competition by providing an environment for consumers to trade off price with convenience.

Our study adds to the growing literature on Internet marketing and e-commerce. In a conceptual paper, Alba et al. (1997) examine the impact of e-commerce on the entire marketing channel. They point out that online shopping reduces the importance of location and may complement or even replace the traditional business models. We show that, while the physical location is less relevant online, the virtual location of the stores, i.e., the e-marketplace, becomes important and has significant strategic impact on firms' competitive strategies. Lal and Sarvary (1999) investigate the conditions under which the Internet may soften price competition. They demonstrate that given consumers' favorable prior evaluation of nondigital attributes, the low cost of evaluating digital attributes on the Internet enhances loyalty and, hence, increases sellers' profits. Our study suggests that the emergence of e-marketplaces offers an additional mechanism to mitigate online competition. Considerable enthusiasm has been aroused among marketing academics to study the new institutions and business models spawned by the Internet. Baye and Morgan (2001) study the role of an information gatekeeper on the competitiveness of a homogeneous product market. They find that the gatekeeper does not advertise prices of all firms and that advertised prices are lower than unadvertised prices. Similar to Baye and Morgan, we show that the e-marketplace does not feature all stores; but contrary to Baye and Morgan, we find that featured stores charge higher prices. In a recent paper, Iyer and Pazgal (2003) explore the strategic implications of the Internet shopping agents such as Mysimon.com. Zettelmeyer et al. (2001) and Chen et al. (2002) examine the impact of an Internet intermediary such as Autobytel.com and Carpoint.com on consumer behavior as well as firm behavior. Our paper complements this stream of research by investigating the business model and competitive implications of another important Internet institution: the e-marketplace.

The rest of the paper is organized as follows: Section 2 lays out the key elements of our model. Section 3 presents the results of the model. We begin our analysis by assuming that the sizes of feature store

[2] For some classic papers on franchising, readers are referred to Mathewson and Winter (1985) and Lal (1990).

shopper and searcher segments are exogenous. This allows us to obtain closed-form solutions without sacrificing insights from the model. We then explicitly model consumer search behavior and endogenize consumers' shopping decisions between featured-store shopping and using the search engine. To establish the robustness of our results, we extend the model to an n-store setting. Section 4 provides a summary of the paper and concludes.

2. The Model

2.1. The Setting

Consider an e-marketplace and two competing stores in a representative category of an infrequently purchased product. Such a category can be PDAs, digital cameras, small appliances, etc. Each consumer has a reservation price 1 to the product category and buys at most one unit of the product. The marginal cost of the online stores, such as payment to wholesalers/manufacturers and selling costs, can be normalized to 0, and the total number of consumers can be normalized to 1 without loss of generality.

2.2. Key Assumptions

Consumers potentially incur three types of shopping costs: cost of price discovery (search cost) prior to choosing a store, travel cost to go to the chosen store, and inspection cost before buying but after a store is chosen. In particular, consumers can incur the cost of price discovery and travel cost either concurrently or separately.

In this paper, we make the following assumptions regarding the shopping costs online: (1) the cost of price discovery is significant. (2) Travel cost is negligible if a consumer visits a featured store or a store she is loyal to, or she goes to a store through the link provided in a search engine. (3) Each consumer can only inspect one store. Assumption 3 implies that the consumer search process is simultaneous but not sequential. It is similar in spirit to the mechanism adopted in Chen et al. (2002) and Iyer and Pazgal (2003).

As already discussed in the introduction, the cost of price discovery can be significant online as the search technology on the Internet is imperfect. Travel cost is negligible on the Internet so long as a consumer knows the link to the store but is infinite if the link is unknown. Our focus on infrequently purchased product categories justifies the assumption of high inspection cost. In addition, there is both behavioral and empirical evidence in support of our assumptions. According to research from BMP interAction (1999), a different breed of Internet user is now online. Newer internet users are likely to have a lot less patience when searching for online information. They are quite different from the idealistic early adopters who were very interested in the workings of the Internet and thought nothing of spending countless hours surfing. "Now you have a more mature consumer who doesn't want to spend time online," says BMP interAction's managing director Jason Goodman. "They want to be there within three clicks." Donthu and Garcia (1999) report that Internet shoppers are more convenience seekers than Internet nonshoppers are. We can infer from these studies that a sizable proportion of online shoppers would find it very costly to search. The time-perception literature also suggests that the expectation of a wait's length affects its perceived length (Doob 1971). If so, it would be expected that feelings of tension are elicited as a function of how long a person expects to wait. As Gorn et al. (2004) put it aptly, "a 20-second wait in an online environment may be similar to a 20-minute wait for a service in person." Given this, search and inspection costs in the e-marketplace can be substantial depending on how much time consumers expect to spend. In addition, once their patience is exhausted (shopping time is beyond their expectation), the additional inspection cost would be perceived to be very large. Using data from over 10,000 Internet households and three commodity-like products: books, CDs, and travel, Johnson (2004) show that people visit few stores online despite the fact that consumers are just a few mouse clicks away from other stores. This is consistent with our assumption that consumers inspect one store only.

2.3. Consumer Segmentation

Based on their store preferences, consumers can be classified into three segments. Each store has a loyal segment of size α;[3] the remaining consumers, with a segment size of $1 - 2\alpha$, do not have preferences between store 1 and store 2.

The loyal consumers know the links (web addresses) to their favorite stores and shop there directly,[4] hence incurring inspection cost only. The rest of the consumers do not know the links of the online stores before they start shopping online for the product. They can use general purpose search engines, such as Google.com, or shopbots, such as Mysimon.com, to search for the links of the stores and the prices they offer. Alternatively, they can go to an e-marketplace, such as Yahoo! Shopping. We assume that a segment of size m_0 consumers search and shop outside the e-marketplace and the remaining

[3] Shankar et al. (2001) and Smith and Brynjolfsson (2001) document empirical evidence of consumer loyalty in the virtual setting. Smith and Brynjolfsson (2001) show that such loyalty exists even for homogeneous products.

[4] The qualitative results of the paper do not change if some or all loyal consumers use the e-marketplace to access their favorite stores.

consumers shop inside the e-marketplace. The size of m_0 depends on the reach of the e-marketplace. Two options are available to the e-marketplace shoppers: they can either use the e-marketplace's search engine or go to a featured store without search. We define the segment sizes of the consumers who search inside the e-marketplace and the featured store shoppers as m_e and m_f, respectively. It follows that consumers who search inside or outside the e-marketplace (the m_0 and m_e segments) incur both search cost and inspection cost, whereas consumers who shop at the featured store (the m_f segment) incur inspection cost only. Note that $2\alpha + m_0 + m_e + m_f = 1$. The consumer segmentation is illustrated in Figure 1.

In order to determine whether to search or shop at the featured store, e-marketplace shoppers make the convenience-price trade-off. Assume that the search costs s are distributed uniformly on the interval $[0, \bar{s}]$. If consumers believe that the difference in price between the featured and nonfeatured stores is relatively small, consumers who have moderate search costs will shop at the featured store and thus become a member of the m_f segment. Conversely, if the price differential is expected to be substantial, even consumers with high search costs may use the search engine and become a member of the m_e segment. The effect of featuring has been studied extensively in the choice modeling literature in the context of consumer brand choice ever since the seminal paper by Guadagni and Little (1983). In this literature, consumer utility is typically modeled as a function of price and feature/display and the effects of price-cut and feature are found to be substitutable, which implies that featuring can offset the effect of high price. For example, Gupta (1988), Lattin and Bucklin (1989), and Tellis (1988) find that the effects of features and displays are approximately equal to a 10% price cut (cf., Allenby and Lenk 1995), while Allenby and Lenk (1995) show that the effects are equivalent to a 15%–30% price cut. A direct implication of those findings is that some consumers may buy a higher priced featured product rather than a lower priced nonfeatured product, all else being equal. Our assumption on the effect of featuring is consistent with the aforementioned empirical evidence.

2.4. Sequence of Moves

The channel consists of three parties: the e-marketplace, the stores, and consumers. We assume that the e-marketplace charges a fixed fee for featuring and when stores are equally qualified for featuring, the e-marketplace can restrict the number of featured

Figure 1 Consumer Segmentation

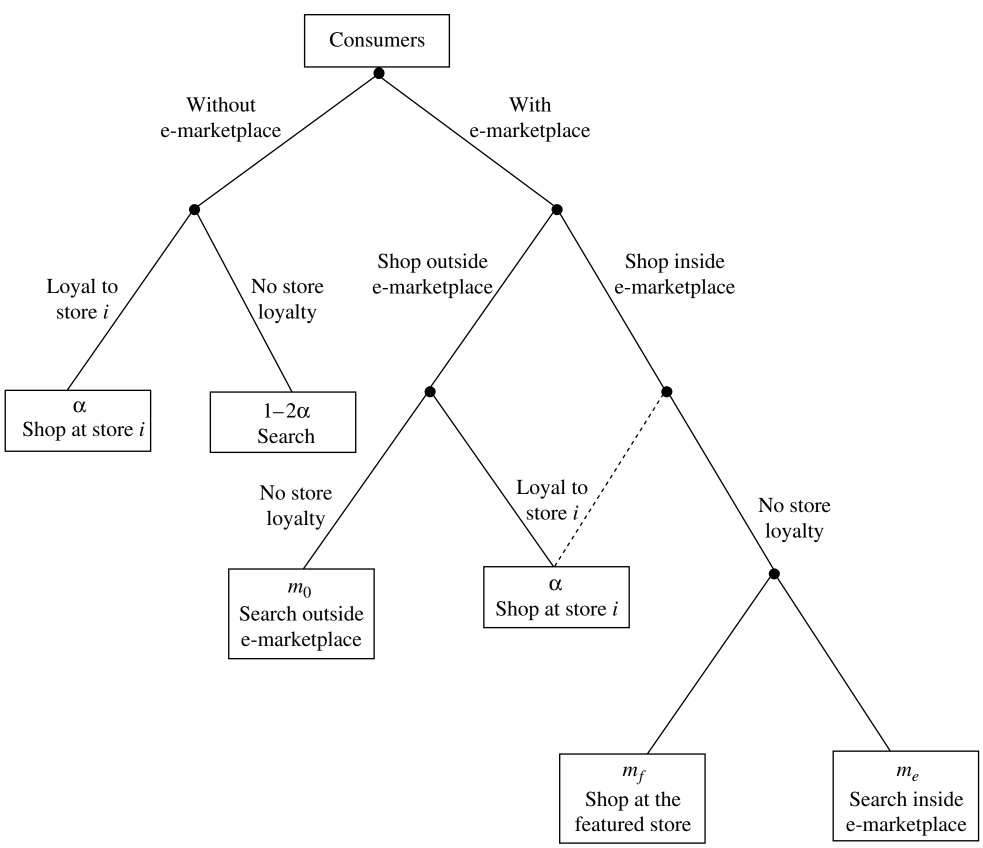

Table 1 Summary of Notations

m_0: the size of non-e-marketplace searchers segment.
m_e: the size of the e-marketplace searchers segment.
m_f: the size of the featured store shoppers segment.
α: the size of the loyal segment to each store.
f: the lump sum payment the e-marketplace demands from the nonfeatured store when it joins.
f_f: the lump sum payment the e-marketplace demands from the featured store.
r: the percentage fee component of the two-part tariff.
s: the search costs of a consumer, $s \in U[0, \bar{s}]$.

stores if there is a space limit or doing so maximizes its profit. The e-marketplace offers a two-part tariff to the stores contingent on the number of stores joining it. If both stores join the e-marketplace, the contract is in the form of (f, f_f, r). f and f_f are the lump sum payments (fixed fees) the e-marketplace charges to the nonfeatured store and the featured store for joining it, respectively. r is the commission rate (percentage fee) charged by the e-marketplace for every dollar of sales made by the member stores through the e-marketplace.[5] If only one store joins the e-marketplace, the contract is in the same form but (f, f_f, r) can be of different values from the contract offered when both stores join. Given the contracts offered by the e-marketplace, each online store simultaneously decides whether to join the e-marketplace or not, and whether to be featured or not. The stores then simultaneously formulate their pricing policies. Finally, the e-marketplace shoppers decide whether to search or shop at the featured store.

We have kept the mathematical details at a minimum. For technical notes and proofs, readers are referred to the appendices. A summary of key notations is given in Table 1.

3. Analysis and Results

We adopt a subgame perfect equilibrium as the solution concept throughout the paper. As a benchmark case, we consider the situation where the e-marketplace is not present. Without the e-marketplace, the two stores' customer base consists of loyal customers and searchers. In a similar setting, Narasimhan (1988) establishes that a pure strategy equilibrium does not exist and characterizes the mixed strategy equilibrium. The descriptive validity of a mixed strategy equilibrium has been assessed in different contexts. For example, researchers have shown a symmetric mixed solution can account for the investment decisions of firms (Rapoport and Amaldoss 2000, 2004) and alliances (Amaldoss et al. 2000). There is also empirical support for the asymmetric mixed strategy solution (Amaldoss and Jain 2002).

If there is no featured store, a consumer who would otherwise go to the featured store may choose to go to a store randomly or go to a store with a lower price. Since we consider infrequently purchased product categories, it is reasonable to assume that those consumers do not know the links to the member stores of e-marketplace so that they have to use a search engine. A search engine in the e-marketplace typically returns the links of stores with price information. Therefore, it is logical to assume that the featured store shoppers would obtain price information as a byproduct of their search for store links and would rationally go to the store with the lowest price under such situations. Thus, we assume that if there is no featured store, a consumer who would otherwise go to the featured store will buy from the store with the lower price. Note that we assume the would-be featured store shoppers buy from the two stores randomly (i.e., behave as a loyal consumer); the absence of a featured store is an equally convenient assumption that does not affect our results qualitatively.[6]

If neither store is featured in the presence of the e-marketplace, each store has α loyal customers and the rest of the customers are searchers. As in the benchmark case, the equilibrium profit of each store cannot be higher than α, the guaranteed profit from loyal customers. Thus, there is no improvement in channel profit and the e-marketplace cannot make any profit. Therefore, the presence of the featured store(s) is essential for the viability of the e-marketplace. We summarize the above intuition in Lemma 1.

Lemma 1. *The e-marketplace features at least one store.*

If at least one store is featured in the e-marketplace, there are three alternative scenarios: (1) in-out-1, where one store joins the e-marketplace and is featured but the other does not join the e-marketplace; (2) in-in-1, where both stores join the e-marketplace and one of them is featured; and (3) in-in-2, where both stores join the e-marketplace and both are featured.

[5] We do not use different commission rates because there are legal issues in charging different commission rates to the featured and nonfeatured stores. In practice, major e-marketplaces such as Yahoo! Shopping charge the same percentage fee to all member stores. We thank an anonymous reviewer for bringing this point to our attention.

[6] Under such an assumption, the only difference is that each store would have a higher guaranteed demand in the absence of a featured store. Specifically, the equilibrium profit in the benchmark case would be $(\alpha + m_f/2)$ instead of α. However, when one store is featured (this is the outcome in equilibrium), the outside option of the other is α. Because in the equilibrium the e-marketplace always features a store (otherwise it earns no profit) and stores have incentive to be featured to obtain extra demand, the higher guaranteed demand in the absence of featured store (occurs off-equilibrium) does not alter the results in the paper.

It is easy to show that the e-marketplace should optimally have both stores join in equilibrium and that the stores have no profitable deviations once they join.

Lemma 2. *Both stores join the e-marketplace in equilibrium.*

Proof. All proofs are in Appendix B.

Lemma 2 indicates that the only alternatives left are in-in-1 and in-in-2. We consider these two scenarios in turn.

3.1. In-in-1

Assume without loss of generality that store 1 is the featured store (the "in-in-1" scenario). In the presence of a featured store, the m_f segment of feature store shoppers will shop at store 1, which effectively increases the size of store 1's loyal segment from α to $\alpha + m_f$ and reduces the size of the searcher segment in the market to $1-2\alpha-m_f$. The size of store 2's loyal segment is unchanged. The profits of the featured and nonfeatured stores are $\pi_1 = [\alpha + m_f(1-r)] - f_f$ and $\pi_2 = \hat{p}[\alpha + m_0 + m_e(1-r)] - f$, respectively, where $\hat{p} = [\alpha + m_f(1-r)]/(\alpha + m_0 + (m_e + m_f)(1-r))$. Let $F_1(p)$ and $F_2(p)$ denote the cumulative distribution functions of the prices of the featured store and the nonfeatured store, respectively. The store pricing strategies are

$$F_1(p) = \begin{cases} 0, \quad p < \dfrac{[\alpha+m_f(1-r)]}{\alpha+m_0+(m_e+m_f)(1-r)}, \\ \dfrac{[\alpha+m_0+m_e(1-r)]\{[\alpha+m_0+(m_e+m_f)(1-r)]p-[\alpha+m_f(1-r)]\}}{[\alpha+m_0+(m_e+m_f)(1-r)][m_0+m_e(1-r)]p}, \\ \qquad \dfrac{[\alpha+m_f(1-r)]}{\alpha+m_0+(m_e+m_f)(1-r)} \le p < 1, \\ 1, \quad p \ge 1, \end{cases} \tag{1}$$

and

$$F_2(p) = \begin{cases} 0, \quad p < \dfrac{[\alpha+m_f(1-r)]}{\alpha+m_0+(m_e+m_f)(1-r)}, \\ \dfrac{[\alpha+m_0+(m_e+m_f)(1-r)]p-[\alpha+m_f(1-r)]}{[m_0+m_e(1-r)]p}, \\ \qquad \dfrac{[\alpha+m_f(1-r)]}{\alpha+m_0+(m_e+m_f)(1-r)} \le p \le 1, \\ 1, \quad p \ge 1. \end{cases} \tag{2}$$

The e-marketplace's expected revenues from the featured store and the nonfeatured store are

$$\begin{aligned} R_1 &= \int_{\hat{p}}^{1} [pm_f r + pm_e r H_2(p)] f_1(p)\, dp + m_f r q + f_f, \\ R_2 &= \int_{\hat{p}}^{1} pm_e r H_1(p) f_2(p)\, dp + f, \end{aligned} \tag{3}$$

where

$$\begin{aligned} H_1(p) &= 1 - F_1(p) \\ &= \frac{\hat{p}[\alpha + m_0 + m_e(1-r)]}{p[m_0 + m_e(1-r)]} - \frac{\alpha}{m_0 + m_e(1-r)}, \\ H_2(p) &= 1 - F_2(p) \\ &= \frac{\alpha + m_f(1-r)}{[m_0 + m_e(1-r)]p} - \frac{\alpha + (m_f + m_e)(1-r)}{m_0}, \\ q &= \frac{m_f(1-r)}{\alpha + (m_f + m_e)(1-r) + m_0}. \end{aligned}$$

3.2. In-in-2

In the in-in-2 scenario, both stores are featured. Featured-store shoppers are equally likely to shop at either store because the two stores are symmetric. Therefore, the effective size of loyal segment is $\alpha + m_f/2$ for each store and we have that $\pi_1 = \pi_2 = [\alpha + (m_f/2)(1-r)] - f_f$. Since the two stores are symmetric, their equilibrium pricing strategies are identical. Let $\tilde{F}(p)$ denote the common pricing strategy. It can be shown that the e-marketplace's expected revenues from each store is

$$\tilde{R} = \int_{\hat{p}}^{1} \left[\frac{1}{2} pm_f r + pm_e r \tilde{H}(p)\right] \tilde{f}(p)\, dp + f_f, \tag{4}$$

where

$$\tilde{H}(p) = 1 - \tilde{F}(p) = \frac{[\alpha + (m_f/2)(1-r)](1-p)}{[m_0 + m_e(1-r)]p}.$$

3.3. Results

Let $\sum R$ denote the e-marketplace's total revenue. Specifically, $\sum R = R_1 + R_2$ under the in-in-1 scenario, and $\sum R = 2\tilde{R}$ under the in-in-2 scenario. Let S denote the e-marketplace's strategy set, $S = \{\text{in-in-1}, \text{in-in-2}\}$. The e-marketplace's maximization problem is given by

$$\begin{aligned} &\arg\max_{\{f,\, f_f,\, r|S\}} \sum R, \\ &\text{s.t.} \quad \pi_1, \pi_2 \ge \alpha. \end{aligned} \tag{5}$$

We characterize the e-marketplace's optimal strategies and equilibrium profits as follows.

Result 1.

(i) The e-marketplace features one store only.

(ii) When the proportion of searchers who search inside the e-marketplace is above a threshold level, $\hat{m}_0 = m_f(1-2\alpha-m_f)/(\alpha+m_f)$, the optimal fees are $f^* = 0$, $f_f^* = 0$, and $r^* = 100\%$.

(iii) When the proportion of searchers who search inside the e-marketplace is below $\hat{m}_0$, the optimal fees are $f^* = m_f(m_0+m_e)/(\alpha+m_0+m_e+m_f)$, $f_f^* = m_f$, and $r^* = 0$.

(iv) The equilibrium profit of the featured store or the nonfeatured store is α for all f^*, f_f^*, and r^*.

(v) The equilibrium profit of the e-marketplace is $\pi = m_f + \alpha m_e/(\alpha+m_0)$ when $m_0 > \hat{m}_0$, and $\pi = m_f(\alpha + 2m_0 + 2m_e + m_f)/(\alpha+m_0+m_e+m_f)$ when $m_0 \le \hat{m}_0$.

(vi) The profit of the e-marketplace increases as the featured-store shopper segment (m_f) increases.

The equilibrium outcome is characterized by the in-in-1 scenario. The e-marketplace designs its fee structure such that both stores find it optimal to join the e-marketplace. Featuring both stores does not have any additional advantage but has the disadvantage of triggering competition between the featured stores. Therefore, the e-marketplace optimally features one store only. The fact that the optimal percentage fee is either 0 or 1 is surprising.[7] Being a monopolist, the e-marketplace can extract all the rent the channel generates and that drives the result. When a sufficient proportion of consumers search inside the e-marketplace ($m_0 > \hat{m}_0$), the stores have strong incentive to compete for these customers through price reduction, and that hurts the e-marketplace's profit. By charging a percentage fee of 100%, the e-marketplace maximally reduces the price competition between the stores and enhances its own profit. In contrast, when a large proportion of searchers search outside the e-marketplace ($m_0 \leq \hat{m}_0$), the percentage fee becomes ineffective because the price competition is largely geared toward thoses consumers who would not contribute to the e-marketplace's profit. In that case, it is optimal for the e-marketplace to charge fixed fees only.

Although the optimal fee structure prescribed to the e-marketplace appears to be extreme, it is consistent with the practice of some real world e-marketplaces. Yahoo! Shopping switched to an all-percentage-fee regime in 1999, whereas Shop@AOL adopted a fixed-fee-only regime in 1997. It is well known that Yahoo! Shopping attracts far more shoppers than Shop@AOL. Thus, the proportion of searchers who search outside Shop@AOL is larger than that of Yahoo! Shopping. Our results suggest that Yahoo! Shopping observed $m_0 > \hat{m}_0$, while Shop@AOL observed $m_0 < \hat{m}_0$. Next, we examine the effect of featuring on store pricing strategies.

Proposition 1. *The average prices of both the featured and nonfeatured stores are higher in the presence of the e-marketplace, and the featured store charges a higher price than that of the nonfeatured store on average. The expected price at the featured store is increasing in the number of featured store shoppers* (m_f).

We find that the featured store charges a higher price on average and the price at the nonfeatured store also rises. Furthermore, the price premium of the featured store increases as the featured-store shopper segment increases. The key driver of this result is that the featured store turns some searchers into loyal consumers. Specifically, the nonloyal consumers have two options when shopping at the e-marketplace: search or shop at the featured store. If a consumer searches, she incurs search cost and buys at the store that offers the lowest price; a consumer incurs no search cost when she shops at the featured store through the link provided. In deciding whether to search or shop at the featured store, a consumer forms an expectation. If she expects that the gain from the search (the price differential between the featured and nonfeatured stores) is less than her search costs, she would shop at the featured store. Otherwise, she would search. In essence, featuring facilitates a convenience-price trade-off. Those consumers who find that the cost of searching outweighs the benefit of a lower expected price shop at the featured store where the price is higher on average. The pricing power of the featured store reduces price competition. Thus, featuring serves as a competition mitigating mechanism.

The effectiveness of the above mechanism depends on two key factors. First, the cost of price discovery needs to be significant; otherwise, featuring would not trigger a convenience-price trade-off. Second, the cost of inspection needs to be significant so that consumers do not shop at multiple stores before making a purchase. If inspection cost and travel cost are low, consumers would first go to the featured store and find the price there and then go to other stores to make price comparisons. In that case, the featured store would not have any pricing power over the nonfeatured stores, and hence featuring would not mitigate price competition. Bergen et al. (1996) show that manufacturers increase the inspection cost of consumers by offering branded variants. The high inspection cost results in fewer consumers shopping across retail stores, thereby reducing competition. The same intuition also applies to our setting.

In practice, there are online stores that are not affiliated with any e-marketplace. Although we do not examine such a situation in our model, it is interesting to conjecture how those stores would react in the presence of the e-marketplace. As Proposition 1 asserts, featuring leads to a higher price among the stores within the e-marketplace on average. The stores outside the e-marketplace can free-ride this trend and also charge higher prices on average. Thus, the emergence of the e-marketplace reduces price competition on the Internet. In general, the mechanism is more effective online than offline. The ineffectiveness of the mechanism in the brick-and-mortar stores arises from space limitations. While an e-marketplace can feature

[7] To find the e-marketplace's optimal strategy and its optimal fee structure, we solve the profit maximization problem in Equation (5). The e-marketplace's profit under the in-in-1 and in-in-2 scenarios are given by Equations (3) and (4), respectively. Note that the constrained maximization problem has analytical solutions when the percentage fee r is given. Because r is a choice variable, we need to rely on a numerical procedure. We let α vary from 0 to 0.5 by a step of 0.01; we let m_0, m_e, and m_f vary from 0 to 1 by a step of 0.01; we ensure that the constraint $2\alpha + m_e + m_0 + m_f = 1$ is met; we let r vary from 0 to 1 by a step of 0.001. These configurations exhaust the permissible parameter range.

stores in each product category, subcategory, subsubcategory, having hundreds of featured stores overall, brick-and-mortar stores can only feature a small number of products at any given time.

The acute readers may have noticed that the results presented in this section bear a resemblance to the asymmetric loyalty case in Narasimhan (1988). However, the underlying mechanism is very different. While Narasimhan (1988) considers competition between stores, we consider such competition in a channel context, where the e-marketplace serves as an intermediary. More importantly, loyalty is exogenous in Narasimhan (1988). By contrast, the asymmetric loyalty in our model is the result of featuring. The e-marketplace optimally features one store only to generate convenience-price trade-off among the e-marketplace shoppers, who choose to shop at the featured store or use the search engine to find the low-price store based on their expectations and search costs. We explicitly model such a process next.

3.4. Endogenous Consumer Search

Since each consumer can inspect one store only, e-marketplace shoppers decide whether to search or shop at the featured store up front. Put differently, e-marketplace shoppers cannot first go to the featured store and then search and vice versa. Define disutility as any loss in utility. E-marketplace shoppers incur different magnitudes of disutility in searching versus featured store shopping. In both cases, consumers suffer a utility loss for the price they pay. If a consumer shops at the featured store, she expects to pay the average price of the featured store, $\bar{p}$. By contrast, if a consumer searches, she expects to pay the lowest price, i.e., the minimum price, $p_{\min}$. In addition, e-marketplace searchers sustain a further utility loss by incurring higher search costs. Without loss of generality, we assume the search cost for featured store shoppers is 0. The disutility for e-marketplace searchers (m_e segment) and featured store shoppers (m_f segment) are $du_i = p_{\min} + s$ and $du_f = \bar{p}$, respectively. In choosing their segment membership, e-marketplace shoppers will search when they expect $du_i < du_f$; by contrast, they will shop at the featured store when they expect $du_f < du_i$. In equilibrium, s^* solves $du_i = du_f$, where $s^* = m_e/(m_e + m_f)$. That is, consumers whose time cost is $s \in [s^*, \bar{s}]$ shop at the featured store, whereas consumers whose time cost is $s \in [0, s^*]$ search.

The derivation of equilibria is given in details in the appendix. We find that the results in the model with fixed consumer segments are robust. The pricing strategies of the stores and the fee structure of the e-marketplace in the general model are consistent with those described in the base model. In addition, we establish the uniqueness of the results when consumers are sophisticated and make their shopping decision contingent upon store pricing strategies.

Result 2. There is a unique Nash equilibrium when consumer search is endogenous. In that equilibrium, the average price differential between the featured and nonfeatured stores widens and the size of the featured-store shopper segment (m_f) increases as consumer search costs (s) increase.

To further demonstrate the robustness of our results, we also consider the situation where there are n stores and multiple featured stores. We only discuss the intuitions and leave all the technical details to the appendices.

3.5. The n-Store Case

Suppose that there are n stores in the e-marketplace, where $n > 2$. The e-marketplace must determine the optimal contract (f, f_f, r) with the featured and nonfeatured stores as well as the number of stores to be featured, k. In sum, the e-marketplace's decision problem is $\{(f, f_f, r), k\}$. In an n-store setting, we assume that the convenience of shopping at a featured store decreases as the number of featured stores increases. A recent Business Week (April 26, 2004) article articulates the inconvenience consumers may incur when having to choose among options. As a result, the disutility associated with featured-store shopping now becomes $du_f = \bar{p} + c(k)$, where $c(k)$ is strictly increasing in k for $k > 1$.

Through numerical analysis, we are able to replicate all the results derived under the two-store setting. In addition, we find that scenario 1, where the e-marketplace features all but one store does not occur in equilibrium and there exists an optimal number of featured stores. In particular, the optimal number of featured stores is inversely proportional to $\partial c(k)/\partial k$. In other words, the optimal number of featured stores is decreasing in the inconvenience caused by the presence of multiple featured stores. We also find that the optimal number of featured stores is larger when consumers incur higher search costs. Intuitively, when it is harder to find a lower price, more consumers find it beneficial to shop at featured stores, and the tolerance of the inconvenience caused by multiple featured stores also increases. This result implies that the number of featured stores in the e-marketplace should be inversely related to the prevailing search technology.

4. Summary and Conclusions

In this paper, we provide economic rationales for e-marketplaces and characterize the e-marketplaces' optimal strategies. We demonstrate that nonprice advertising, in the form of featured stores, reduces price competition in the e-marketplace. Furthermore, we show that our results are robust in an n-store setting. The driving force behind this research is that consumers trade off convenience with price. The search technology uniquely available on the Internet and the capability of e-marketplaces to feature numerous stores across product categories facilitate such trade-off.

Anecdotal evidence supports our results. During a seven-month period between December 2000 and June 2001, we tracked the prices at a number of Yahoo! Shopping featured and nonfeatured stores for the following product categories: PDAs, printers, digital cameras, phones, camcorders, DVD players, small appliances, and DVDs. We find that the featured stores charge higher prices than the nonfeatured stores more than 80% of the time. For example, Ritzcamera.com was a featured store for the digital camera category. The price of Olympus Camedia C-700 was $599.99 at Ritzcamera.com, while the price of the same camera was as low as $477 at the nonfeatured stores with an average price of $551.65. Dynadirect.com was a featured store for the PDA category. The price of Casio PC-Unite BZX-20 was $114 at Dynadirect.com, while the prices of the same PDA ranged from $79.95–$99.99 at the nonfeatured stores, with all 15 nonfeatured stores charging a lower price. The average price at the nonfeatured stores was $90.73. Although the above observations are consistent with our results, a more formal empirical study of the e-marketplace would be highly desirable. A recent paper by Montgomery et al. (2004) demonstrates the potential of using clickstream data to conduct structured empirical tests.

Our model is symmetric. A promising direction to extend the model is to consider the ramifications in the presence of a dominant player such as Amazon.com. Raju and Zhang (2005) shed light on such issues. In addition to using search engines and featured stores, the e-marketplace may coordinate the channel by providing other information (see Moorman et al. (2005) for an example). We caution that our model is static. Although it is a good approximation of reality, a dynamic model where firms adjust their prices over time as they observe their competitors' actual choices may yield richer results. The importance of the pricing dynamics is illustrated in a recent empirical study by Filson (2004), where he shows that many online retailers and e-marketplaces are unprofitable in their early stages, and that observed behavior may not be profitable or sustainable in the long run. An analysis of an alternative search process where consumers update their information set sequentially would be an interesting extension of our model.[8] We leave these issues to further research.

[8] We thank the reviewers for pointing out various directions of extending our model.

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Appendix A. Technical Notes

In this section we provide the detailed derivation of our model extensions.

A.1. The n-Store Case

There are two scenarios to consider: (1) the e-marketplace features all stores but one ($k = n-1$), (2) there are at least two nonfeatured stores. We analyze each of the scenarios in turn.

Scenario 1. We solve for symmetric equilibrium and find that the nonfeatured store and the featured store have mixed strategy equilibriums on the price support $[\hat{p}, 1]$, where $\hat{p}$ is bounded below by $[\alpha + (m_f/k)(1-r)]/(\alpha + m_0 + (m_e + m_f/k)(1-r))$. Let $F_u(p)$ and $F_v(p)$ denote the equilibrium pricing strategies of the featured store and the nonfeatured store, respectively. The equilibrium conditions are as follows:

$$p\{\alpha + [1-F_u(p)]^k[m_0 + m_e(1-r)]\} = \hat{p}[\alpha + m_0 + m_e(1-r)], \quad \text{(A-1)}$$

and

$$p\left\{\alpha + \frac{m_f}{k}(1-r) + [1-F_v(p)][1-F_u(p)]^{k-1} \cdot [m_0 + m_e(1-r)]\right\} = \left[\alpha + \frac{m_f}{k}(1-r)\right], \quad \text{(A-2)}$$

from which we obtain $H_u(p) = 1 - F_u(p) = ((B/p - \alpha)/G)^{1/k}$ and $H_v(p) = 1 - F_v(p) = ((D/p - D)/G)[H_u(p)]^{1-k}$, where $B = \hat{p}[\alpha + m_0 + m_e(1-r)]$, $D = \alpha + (m_f/k)(1-r)$, $G = m_0 + m_e(1-r)$. Note that the featured stores have a mass point at 1, which we denote by $\tilde{q}$. By definition, $\tilde{q} = 1 - F_u(1)$.

The e-marketplace's expected revenues can be decomposed into several parts: (1) revenue from featured store shoppers (R_{m_f}), (2) revenue from searchers who search inside the e-marketplace (R_{m_e}), (3) revenue from fixed fees collected from the featured and nonfeatured stores (R_F). We can express R_{m_f}, R_{m_e}, and R_F as follows:

$$\begin{aligned} R_{m_f} &= \int_{\hat{p}}^{1} p m_f r f_u(p)\, dp + \tilde{q} m_f r, \\ R_{m_e} &= \int_{\hat{p}}^{1} p m_e r f_{\min}(p)\, dp, \\ R_F &= k f_f + f, \end{aligned} \quad \text{(A-3)}$$

where $H_{\min}(p) = H_v(p)(H_u(p))^k$, $f_{\min}(p) = -\partial H_{\min}(p)/\partial p$.

Scenario 2. When there are at least two nonfeatured stores, the featured stores have a symmetric mixed strategy equilibrium, and the price support for the equilibrium is $[\hat{p}, 1]$; the nonfeatured stores have two symmetric mixed strategy equilibriums, and the price supports for the equilibriums are $[\tilde{p}, \hat{p}]$ and $[\hat{p}, 1]$, respectively, where $\tilde{p} = \alpha/(\alpha + m_0 + m_e(1-r))$. The equilibrium condition for the featured stores when $\hat{p} \le p \le 1$ is given by

$$p\left\{\alpha + \frac{m_f}{k}(1-r) + [1-F_v(p)]^{n-k} \cdot [1-F_u(p)]^{k-1}[m_0 + m_e(1-r)]\right\} = \pi(k). \quad \text{(A-4)}$$

The equilibrium conditions for the nonfeatured stores are given by

$$\begin{cases} p\{\alpha + [1-F_v(p)]^{n-k-1}[m_0 + m_e(1-r)]\} = \alpha, & \tilde{p} \le p \le \hat{p}, \\ p\{\alpha + [1-F_u(p)]^{k}[1-F_v(p)]^{n-k-1}[m_0 + m_e(1-r)]\} = \alpha, \\ \quad \hat{p} \le p \le 1, \end{cases} \quad \text{(A-5)}$$

from which we obtain

$$\begin{cases} \tilde{H}_v(p) = \left(\dfrac{\alpha/p - \alpha}{G}\right)^{1/(n-k-1)}, & \tilde{p} \le p \le \hat{p}, \\ H_v(p) = \left(\dfrac{\alpha/p - \alpha}{Z^k G}\right)^{1/(n-1)}, & \hat{p} \le p \le 1, \end{cases} \quad \text{(A-6)}$$

and $H_u(p) = ZH_v(p)$ $(\hat{p} \le p \le 1)$, where $Z = (\alpha/p - \alpha)/(\pi(k)/p - D)$. By setting $\tilde{H}_v(\hat{p}) = H_v(\hat{p})$, we obtain $\hat{p} = \alpha/(GZ^{1+k-n} + \alpha)$.

Using the same decomposition as outlined earlier, the e-marketplace's expected revenues can be written as

$$\begin{aligned} R_{m_f} &= \int_{\hat{p}}^{1} pm_f r f_u(p)\,dp, \\ R_{m_e} &= \int_{\tilde{p}}^{\hat{p}} pm_e r \tilde{f}_{\min}(p)\,dp + \int_{\hat{p}}^{1} pm_e r f_{\min}(p)\,dp, \\ R_F &= kf_f + (n-k)f, \end{aligned} \quad \text{(A-7)}$$

where $\tilde{H}_{\min}(p) = (\tilde{H}_v(p))^{n-k}$, $\tilde{f}_{\min}(p) = -\partial\tilde{H}_{\min}(p)/\partial p$, $H_{\min}(p) = (H_v(p))^{n-k}(H_u(p))^k$, $f_{\min}(p) = -\partial H_{\min}(p)/\partial p$. The optimal percentage fee (r) and fixed fees (f and f_f) and the optimal number of featured stores (k) are derived by maximizing the sum of R_{m_f}, R_{m_e}, and R_F subject to the constraints $\pi_u \ge \alpha$ and $\pi_v \ge \alpha$.

Appendix B. Proofs

Proof of Lemma 2

Proof. For the in-out-1 scenario, assume without loss of generality that store 1 is an e-marketplace store but store 2 is not. In this situation, store 1 is the featured store by default. This scenario corresponds to the case of firms with asymmetric loyal segments as in Narasimhan (1988) and the similar equilibrium results apply. We have $\pi_1 = [\alpha + m_f(1-r)] - f_f$, $\pi_2 = \hat{p}(\alpha + m_0 + m_e)$, where $\hat{p} = [\alpha + m_f(1-r)]/(\alpha + m_0 + (m_e + m_f)(1-r))$. Let $\hat{F}_1(p)$ and $\hat{F}_2(p)$ denote the pricing strategies of the "in" store and the "out" store, respectively. In equilibrium, the pricing strategies must satisfy the following conditions:

$$p\{\alpha + m_f(1-r) + (1-\hat{F}_2(p))[m_0 + m_e(1-r)]\} = [\alpha + m_f(1-r)], \quad \text{(B-1)}$$

and

$$p[\alpha + (1-\hat{F}_1(p))(m_0 + m_e)] = \hat{p}(\alpha + m_0 + m_e). \quad \text{(B-2)}$$

The e-marketplace's expected revenues from the "in" store and the "out" store are

$$\begin{aligned} \hat{R}_1 &= \int_{\hat{p}}^{1} [pm_f r + pm_e r\hat{H}_2(p)]\hat{f}_1(p)\,dp + m_f r\hat{q} + f_f, \\ \hat{R}_2 &= 0, \end{aligned} \quad \text{(B-3)}$$

where

$$\begin{aligned} \hat{H}_1(p) &= 1 - \hat{F}_1(p) = \frac{\hat{p}(\alpha + m_0 + m_e)}{(m_0 + m_e)p} - \frac{\alpha}{m_0 + m_e}, \\ \hat{H}_2(p) &= 1 - \hat{F}_2(p) = \frac{[\alpha + m_f(1-r)]}{[m_0 + m_e(1-r)]p} - \frac{\alpha + m_f(1-r)}{m_0 + m_e(1-r)}, \\ \hat{q} &= 1 - \hat{F}_1(1). \end{aligned}$$

The optimal percentage fee (r) and fixed fee (f_f) are derived by maximizing R_1 subject to the constraint $\pi_1 \ge \alpha$.

Comparing the e-marketplace's profit under the in-out-1 scenario in Equation (B-3) to that of under in-in-1 as shown in Equation (3), it is easy to show that $\hat{R}_1 < R_1 + R_2$ $\forall\, r \in [0, 1)$ and that $\hat{R}_1 = R_1 + R_2$ when $r = 1$. Clearly, the e-marketplace is better off to have both stores join. Suppose that one store wants to stay outside the e-marketplace while the other store joins. The e-marketplace can implement a punishing strategy in the form of $f^* = 0$, $f_f^* = 0$, and $r^* = 100\%$ so that the stores have no incentive to stay outside the e-marketplace. □

Proof of Proposition 1

Proof. In this setting, it can be established that only mixed strategy equilibrium exists.[9] The price support of the two stores is $[\hat{p}, 1]$. In a mixed strategy equilibrium, store i is indifferent to charging any price in its price support. If the featured-store charges the reservation price 1, it will be patronized by its loyal customers and featured-store shoppers, the resulting profit is $[\alpha + m_f(1-r)] - f_f$. If the featured store charges a lower price than that of its competitor, it will get the business from comparison shoppers in addition to its loyal customers and featured-store shoppers. The resulting profit is $[\alpha + m_0 + (m_e + m_f)(1-r)]p - f_f$. Because the featured store can make at least $[\alpha + m_f(1-r)] - f_f$ by charging the reservation price 1, the lower bound of the price support is given by

$$\hat{p} = \frac{[\alpha + m_f(1-r)]}{\alpha + m_0 + (m_e + m_f)(1-r)}. \quad \text{(B-4)}$$

It is easy to verify that for every $p \in (\hat{p}, 1)$, $F_1(p) < F_2(p)$, which implies that $F_1(p)$ first order stochastically dominates $F_2(p)$. When more searchers shop at the e-marketplace,

[9] Rigorous proofs are developed in Varian (1980) and Narasimhan (1988). More details are given in He (2002).

that is, non-e-marketplace shoppers (m_0 segment) become e-marketplace shoppers (m_e and m_f segments), the number of comparison shoppers (m_e segment) and featured store shoppers (m_f segment) increases proportionally. Defining $E(p)$ as the expected price, we have

$$\begin{aligned} E(p) &= \int_{\hat{p}}^{1} p\, dF(p) \\ &= [pF(p)]_{\hat{p}}^{1} - \int_{\hat{p}}^{1} F(p)\, dp \\ &= 1 - \int_{\hat{p}}^{1} F(p)\, dp. \end{aligned} \tag{B-5}$$

Thus, $E(p)$ increases (decreases) when $F(p)$ decreases (increases). Recall that

$$\begin{aligned} F_1(p) &= ([\alpha + m_0 + m_e(1-r)]\{[\alpha + m_0 + (m_e + m_f)(1-r)]p \\ &\qquad - [\alpha + m_f(1-r)]\}) \\ &\quad \cdot ([\alpha + m_0 + (m_e + m_f)(1-r)][m_0 + m_e(1-r)]p)^{-1}, \\ F_2(p) &= \frac{[\alpha + m_0 + (m_e + m_f)(1-r)]p - [\alpha + m_f(1-r)]}{[m_0 + m_e(1-r)]p}, \\ \hat{p} &= \frac{[\alpha + m_f(1-r)]}{\alpha + m_0 + (m_e + m_f)(1-r)}. \end{aligned}$$

Clearly, $\hat{p}$ is increasing in m_f, but $F_1(p)$ and $F_2(p)$ are decreasing in m_f. Note that the profits for store 1 and store 2 are $(\alpha + m_f)$ and $\hat{p}(\alpha + m_0 + m_e)$, respectively. Therefore, as the average price of the featured store ($E(p_1)$), and the nonfeatured store ($E(p_2)$) increase, and as the e-marketplace's profits (proportional to the sum of the two stores' profits) increase, the more shoppers purchase through the e-marketplace. □

Proof of Result 1

Proof. The e-marketplace may choose to feature one store only or both stores. First, we check whether a store wants to be featured or not. Suppose it does not. Then joining the e-marketplace does not add any value to the stores, and the competitive environment is the same as the out-out scenario. Clearly, the stores are better off to have at least one of them featured. To prove that both stores join the e-marketplace in equilibrium, we need to show that out-out and in-out cannot occur in equilibrium. It is easy to verify that out-out is not an equilibrium. When the proportion of searchers who search outside the e-marketplace is at the threshold level, $\hat{m}_0$, the equilibrium profit of the e-marketplace is the same whether the e-marketplace charges $f^* = 0$, $f_f^* = 0$, and $r^* = 100\%$ or $f^* = m_f(m_0 + m_e)/(\alpha + m_0 + m_e + m_f)$, $f_f^* = m_f$, and $r^* = 0$. Solving for $\pi = m_f + \alpha m_e/(\alpha + m_0) = m_f(\alpha + 2m_0 + 2m_e + m_f)/(\alpha + m_0 + m_e + m_f)$ and noting that $m_e = 1 - 2\alpha - m_0 - m_f$, we obtain $\hat{m}_0 = m_f(1 - 2\alpha - m_f)/(\alpha + m_f)$.

To find the e-marketplace's optimal strategy and its optimal fee structure, we solve the profit maximization problem in Equation (5). The e-marketplace's profit under the in-in-1 and in-in-2 scenarios are given by Equations (3) and (4), respectively. Note that the constrained maximization problem has analytical solutions when the percentage fee r is given. Since r is a choice variable, we need to rely on numerical procedures. We let α vary from 0 to 0.5 by a step of 0.01; we let m_0, m_e, and m_f vary from 0 to 1 by a step of 0.01; we ensure that the constraint $2\alpha + m_e + m_0 + m_f = 1$ is met; and we let r vary from 0 to 1 by a step of 0.001. These configurations exhaust the permissible parameter range. The results are stated in Proposition 1.

The equilibrium profit of the e-marketplace is $\pi = m_f + \alpha m_e/(\alpha + m_0)$ when $m_0 > \hat{m}_0$, $\pi = m_f(\alpha + 2m_0 + 2m_e + m_f)/(\alpha + m_0 + m_e + m_f)$ when $m_0 \le \hat{m}_0$. Taking the derivative of π w.r.t. m_f, we obtain $\partial\pi/\partial m_f = 1$ when $m_0 > \hat{m}_0$, and

$$\begin{aligned} \frac{\partial \pi}{\partial m_f} &= (\alpha^2 + 3\alpha m_0 + 3\alpha m_e + 2\alpha m_f + 2m_0^2 + 4m_0 m_e + 2m_0 m_f \\ &\quad + 2m_e^2 + 2m_e m_f + m_f^2) \cdot [(\alpha + m_0 + m_e + m_f)^2]^{-1} \end{aligned}$$

when $m_0 \le \hat{m}_0$. Both derivatives are strictly positive. Therefore, the equilibrium profit of the e-marketplace is increasing in the size of the featured store shoppers segment (m_f). □

Proof of Result 2

Proof. As in the model with fixed consumer segments, we assume that store 1 is the featured store. Comparison shoppers (m_e segment) expect to pay the average minimum price. By contrast, featured-store shoppers (m_f segment) expect to pay the average price of store 1. The equilibrium profits of the featured store and the nonfeatured store are $\pi_1 = \alpha + m_f(1-r) - f_f$ and $\pi_2 = (\alpha + m_0)\hat{p} + m_e(1-r)\hat{p} - f$, respectively. Let $F_i(p)$ denote the equilibrium pricing strategy of store i, where $i = 1, 2$, and define $H_i(p) = 1 - F_i(p)$. We have

$$\begin{aligned} &\alpha + m_f(1-r) \\ &\quad = [\alpha + m_0 H_2(p)]p + [m_f + m_e H_2(p)](1-r)p, \end{aligned} \tag{B-6}$$

and

$$\begin{aligned} &(\alpha + m_0)\hat{p} + m_e(1-r)\hat{p} \\ &\quad = [\alpha + m_0 H_1(p)]p + m_e H_1(p)(1-r)p, \end{aligned} \tag{B-7}$$

from which we obtain

$$\begin{aligned} H_2(p) &= \frac{\tilde{\pi}_1 - \alpha p - m_f(1-r)p}{m_0 p + m_e(1-r)p} \\ &= \frac{\tilde{\pi}_1}{(m_0 + m_e - m_e r)p} - \frac{\alpha + m_f - m_f r}{m_0 + m_e - m_e r} \\ &= \frac{x_1}{p} + y_1, \end{aligned}$$

where $\tilde{\pi}_1 = \pi_1 + f_f$, $x_1 = \tilde{\pi}_1/(m_0 + m_e - m_e r)$, $y_1 = -(\alpha + m_f - m_f r)/(m_0 + m_e - m_e r)$, and $\hat{p} = x_1/(1 - y_1)$.

$$\begin{aligned} H_1(p) &= \frac{\tilde{\pi}_2 - \alpha p}{m_0 p + m_e(1-r)p} \\ &= \frac{\tilde{\pi}_2}{(m_0 + m_e - m_e r)p} - \frac{\alpha}{m_0 + m_e - m_e r} \\ &= \frac{x_2}{p} + y_2, \end{aligned}$$

where $\tilde{\pi}_2 = \pi_2 + f$, $x_2 = \tilde{\pi}_2/(m_0 + m_e - m_e r)$, $y_2 = -\alpha/(m_0 + m_e - m_e r)$.

The profit of the e-marketplace (Π) has several components: the percentage fee from the featured-store shoppers segment, the percentage fee from the e-marketplace searchers segment, and the fixed fees from the featured and the nonfeatured store. Let $v = x_2 + y_2$; Π can be written as

$$\Pi = m_f r E(p_1) + m_e r E \min(p_1, p_2) + f + f_f, \tag{B-8}$$

where

$$E(p_1) = \int_{\hat{p}}^{1} p \frac{-\partial H_1}{\partial p}\, dp = v - x_2 \ln \hat{p},$$

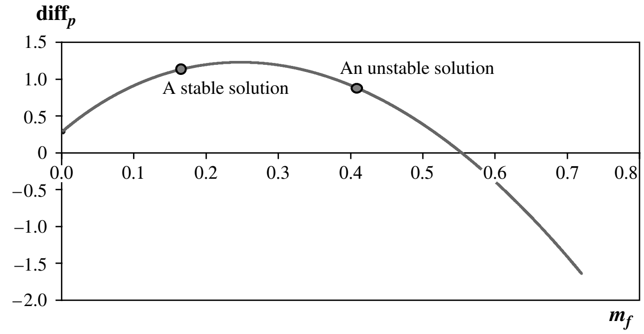
$$H\{\min(p_1, p_2)\} = H_1(p) H_2(p) = \left(\frac{x_1}{p} + y_1\right)\left(\frac{x_2}{p} + y_2\right) = \frac{x_1 x_2}{p^2} + \frac{x_1 y_2 + x_2 y_1}{p} + y_1 y_2,$$

$$E\{\min(p_1, p_2)\} = \int_{\hat{p}}^{1} p \frac{-\partial H}{\partial p}\, dp = \left[\ln p(x_1 y_2 + x_2 y_1) - \frac{2x_1 x_2}{p}\right]_{\hat{p}}^{1} = 2x_1 x_2 \frac{1-\hat{p}}{\hat{p}} - \ln \hat{p}(x_1 y_2 + x_2 y_1).$$

Because the optimal fixed fees (f^*, f_f^*), percentage fee (r^*), and the size of the featured-store shoppers segment (m_f) do not have close-form solutions, we use numerical procedures to find f^*, f_f^*, r^*, and m_f. For each given level of search cost s, we find the corresponding m_f. For each r, we find the corresponding f and f_f by subtracting the outside option of the store from the store's profit given r, provided that the difference is nonnegative. We compare the profit of the e-marketplace for each combination of f, f_f, and r. The combination that yields the highest profit is the combination of f^*, f_f^*, and r^*. We also check that the profit of the e-marketplace is higher when one store is featured than when both are featured. We let search cost s vary from 0 to 1 by steps of 0.01; we let α vary from 0 to 0.5 by steps of 0.01; we let m_0, m_e vary from 0 to 1 by steps of 0.01; we ensure that the constraint $2\alpha + m_e + m_0 + m_f = 1$ is met; and we let r vary from 0 to 1 by steps of 0.001. These configurations exhaust the permissible parameter range. The results of our numerical procedure are stated in Result 1. The optimal size of the featured-store shoppers segment m_f has multiple solutions. In the next paragraph, we establish the uniqueness of the equilibrium.

In Figure 2, the difference between $\bar{p}$ and $p_{\min}$ (diff_p) is drawn against m_f. There are two candidates for equilibrium on the graph; both of them satisfy the first-order condition $p_{\min} + s = \bar{p}$. In addition, an equilibrium must also satisfy a stability condition (the second-order condition) detailed as follows. The stable solution is located in the increasing segment of the graph, whereas the unstable solution is located in the decreasing segment of the graph. Suppose that the two stores' strategy sets are fixed; as s increases, more shoppers will shop at the featured store (m_f increases). Since the stable solution is in the increasing segment of the graph, as m_f increases, the gap between $\bar{p}$ and $p_{\min}$ (diff_p) widens—the gain from using the search engine becomes larger, which

Figure 2 **The Stability of the Solutions**



counterbalances the increase in m_f. Thus, the stable solution is a fixed point. By contrast, because the unstable solution is in the decreasing segment of the graph, as m_f increases, the gap between $\bar{p}$ and $p_{\min}$ (diff_p) becomes narrower, which leads to a further increase in m_f. Thus, an irrelevant disturbance causes the collapse of the unstable solution; in other words, the unstable solution does not constitute a fixed point. □

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