Internet Shopping Agents: Virtual Co-Location and Competition*

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September, 2001

* We thank Severin Borenstein, Yuxin Chen, Eitan Gerstner, Michael Katz, Dmitri Kuksov, David Levine, V. Padmanabhan, Duncan Simester, David Soberman, Jereon Swinkels, J. Miguel Villas-Boas, Florian Zettelmeyer and seminar participants at the Berkeley I.O. seminar, University of Chicago, University of Florida, Insead, Berkeley/Davis/Santa Clara/Stanford colloquium, and UCLA for their comments. We also thank the Editor, AE and the reviewers of this journal. Addresses for correspondence: Haas School of Business, University of California at Berkeley, Berkeley, CA 94720-1900 and the John M. Olin School of Business, Washington University, St. Louis, MO 63130-4899. email:giyer@haas.berkeley.edu; pazgal@olin.wustl.edu.

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Abstract

Recently, we have experienced an emergence of comparative "Internet Shopping Agents" (ISAs) that allow consumers to costlessly search across many online retailers and buy at the lowest price. An ISA can be thought of as an institution that creates all or nothing type of competition in the following sense: Because consumers see all the retail prices with a single search, a retailer of a homogenous good should get all the demand if it charged the lowest price in the ISA, but should get absolutely nothing if it charged a price that was even slightly higher. One would expect these ISAs to reduce frictions and lead sellers of homogenous goods (CDs, books and videos) who join the institution to be subjected to intense price competition. Yet many Internet retailers have rushed to join these ISAs. There is also ample evidence that instead of charging uniform prices, the prices charged by retailers inside the ISA vary substantially for any given consumer search. Furthermore, while some retailers do join ISAs, there are also others who simultaneously elect to stay out and not join shopping agents.

This paper offers a rationale for the above phenomenon. It traces out the set of economic forces that govern the emergence and functioning of these ISAs and their effect on market competition. Our investigation of this institution is predicated on a framework that highlights the role of consumer differences in retailer loyalty as well as the propensity to search the institution. An ISA creates differentiation in the pricing strategies of ex-ante identical retailers. In equilibrium, some retailers choose to join the ISA motivated by the mass of consumers that they can win, while others simultaneously elect to stay out and focus on extracting surplus from the store-loyal consumers who are willing to pay their reservation price. The nature of pricing practiced by the retailers that join the institution is such that the average price charged increases with the number of retailers joining. The average prices paid (minimum posted prices) by consumers that shop the ISA can increase or decrease when more retailers join, depending on whether or not the reach of the ISA is independent of the number of joining retailers.

We show that when the reach of the institution is endogenous and when the traffic at the ISA confers complementary side-benefits such as advertising revenues, there exists a unique number of retailers who will join the institution. We identify the conditions under which the ISA will have the incentive to share the side-benefits with the inside retailers: i.e. the ISA strategically ploughs back a portion of the side-benefits into the retail market, creating a situation in which not only the ISA and the inside retailers gain, but also the outside retailers are better off (than in a world without an ISA). We also provide empirical validation for several results using pricing data gathered through 7 leading ISAs (two portal owned and 5 stand-alone) on 35 items in the books, CDs and movie video categories. We find support for the prediction that retailers inside an ISA use probabilistic pricing, for the result that the average price charged is increasing in the number of retailers in an ISA.

Keywords: Consumer Search, Comparison Shopping, Shopping Agents, Internet Retailing.

1. Introduction

The exponential growth of the Internet is perceived to be the single most important development in Information Technology in the last decade. Electronic commerce, which has been characterized as the process of carrying out business transactions over the Internet has returned approximately 80 billion dollars for the 1998 fiscal year and is expected to go up to as much 1 Trillion dollars by 2002 (as noted by John T. Chambers the CEO of Cisco systems in October 1998).[1]

Much of the Internet-based electronic commerce is currently restricted to on-line shops and services that are accessible via a Web browser. A consumer can search for a specific product using a browser and then purchase it by simply entering a valid credit-card number. However, the rapid evolution of Internet technology is changing the nature of Internet retailing. Online retailing is quickly evolving beyond the straightforward adaptation of brick and mortar stores. In fact, an emerging generation of electronic shopping services are not retailers at all. Rather, they are Web sites that offer the use of a sophisticated "Internet Shopping Agent" (ISA) to prospective customers. These agents, also called shopping "bots" (an abbreviation for robots), are designed to take the legwork out of online shopping by escorting consumers through the purchasing process.

Andersen Consulting developed the first example of a sophisticated shopping agent, *BargainFinder,* in 1995. This agent accepts a request for a music CD from the consumer and searches a number of on-line CD stores for availability and prices. Over the last 5 years a number of ISA's have been successfully established. Shopping agents such as *mySimon.com*, Excite's *Jango* or *EvenBetter.com* allow consumers to search the Web for a fully specified product and then to tabulate the sites where the product can be bought and for what price. Generally, these agents are only sources of information–the consumer must link to the retailers listed by the agent to close the deal.

Figures 1a and 1b show the results of representative searches conducted by the authors using two shopping agents. Figure 1a presents a tabulated result of a search for a CD titled "Dreaming Of You" by Selena (which was one of the top 10 albums in Billboard's best selling list at the time of our search) using Andersen Consulting's *BargainFinder* while Figure 1b depicts the outcome of a search for the book "The Theory of Learning in Games," by Fudenberg and Levine using *mySimon.* Some interesting aspects of these representative searches demonstrate the issues examined in this paper:

- The goods in question are homogenous search goods such as CD's, books, or video/audio cassettes (Nelson 1970). A consumer searching for a particular music CD or a specific best-selling novel knows even prior to the actual consumption that she will get the same benefit from the good irrespective of the supplying retailer. The role of the ISA for goods such as CD's

[1]Forrester Research has estimated the sales of consumer goods on the Internet to be $7.8 billion in 1998 and estimates it to go up to $108 billion by 2003.

and books is the reduction of search costs for price information. Traditional wisdom suggests that shopping agents that reduce consumers' search costs for price (perhaps eliminating them altogether) should intensify price competition. In fact, the very nature of the ISA creates all or nothing competition in the following sense: Because consumers get to see all the retail prices with a single search, a retailer should get *all* the demand if it charged the lowest price in the ISA, but get *nothing* if it charged a price that was even slightly higher. Such intense price competition should drive down profits, and so, the incentives of retailers should be clear. Yet, many Internet retailers of goods such as CD's and books have rushed to join comparison shopping institutions.

- Given the environment with intense price competition, homogenous goods and that the consumers' who use the agent face no search costs of obtaining price information, one does not expect to find large differences between the prices charged by retailers in the ISA. However (as the empirical data that we have shows), the prices charged by different retailers in the institution can differ substantially.

- While retailers do join comparative shopping agents, there are also instances of retailers that are reluctant to let shopping agents into their sites. For example, *CDNow* one of the largest music retailers on the web routinely blocks shopping agents.[2] Most retailers who indulge in blocking claim that they do not wish to reduce the competition to a single dimension (i.e., price) while ignoring other features such as the retailer's brand/store reputation, reliability and quality of service. Can there be a different motive for this behavior? Alba et. al (1997) mention that an important research issue is to understand the factors that lead to Internet retailers to inhibit search. Here we examine the market factors that lead retailers to prevent ISA based searches.

Software agents by reducing the costs of price search have the potential to improve consumer surplus. By scouring the Web, searching the relevant databases for product details, and synthesizing the results–from a simple price comparison on a CD to the complex details of a car insurance purchase–shopping agents provide information that search engines can miss and that shoppers could otherwise access only by visiting individual sites.

This paper focuses on the role of shopping agents in providing price comparisons for homogenous goods such as CD's, videos or books. It is precisely in these situations where we expect the Internet institution to bring about a nearly perfect market. Yet, sellers of homogenous goods do join ISA's. Furthermore, as the empirical evidence that we have gathered indicates, there can be substantial differences in the prices charged by retailers in an ISA.

[2]See "Web's Robot Shoppers Don't Roam Free," The Wall Street Journal, 09/03/1998.

To analyze these questions we assume the following consumer characteristics and behavior. Consumers differ in their loyalty to the retailers and their propensity to use the ISA. The model captures consumer behavior through three segments. Each retailer enjoys a certain fraction of consumers who are "store loyals" and will only buy from that retailer (up to a reservation price). These consumers possessing a high degree of retailer loyalty do not use the ISA at all. This is consistent with the idea that the brand name and reputation of the retailer can play an important role in determining consumer preferences (Brynjolfsson and Smith 1999). In contrast to the store loyals, a second segment of consumers has no store loyalty at all and have negligible costs of searching the ISA. We label these consumers as "ISA loyals" and they use the comparative shopping institution to purchase the good for the lowest price inside the ISA. Finally, we assume a third segment of consumers who have some store loyalty but who also search the ISA in order to capture the idea that the ISA is an institution that allows consumers to check if firms indulge in price gouging. This segment of consumers that we label as "partial loyals" consists of consumers who visit the ISA but who might forego the opportunity to buy inside at the lowest price as long as their favorite store is reasonably priced. In other words, they use the ISA to monitor whether their favorite store is price gouging. In our model, these consumers buy at their favorite retailer as long as the price they are required to pay is not higher than the average price they can get from comparison-shopping. This operationalization is motivated by the fact that several leading ISA's allow for the calculation of the average/median price information of searches made by consumers.

The competitive environment consists of n retailers. After the emergence of the institution, each retailer simultaneously decides whether or not to join the institution and a price strategy contingent on this decision. We first examine the case where the reach of the ISA (i.e., the number of consumers using the institution) is exogenous and independent of the number of retailers joining the institution as a benchmark. In reality this represents the fact that many leading ISA's depend on their association with a leading portal site for traffic generation. Next, we analyze the case where the reach is endogenously determined by the number of retailers joining the institution in equilibrium (i.e., the reach of the ISA depends upon the franchise of the retailers joining the institution). We also assume that the traffic at the ISA confers side-benefits such as advertising revenues to the owner of the institution.

In equilibrium, an inside retailer (one that allows shopping agents access to its price data) will not charge a fixed price but will instead use mixed price/promotional strategies. Next we find that the average retail price charged by an inside retailer *increases* with the number of retailers that join the ISA and this is reminiscent of Rosenthal (1980). Here, this result is linked to the formation of the Internet institution and to the all-or-nothing type of competition that it engenders. To understand this result, note that in order to win all the consumers who patronize the Internet shopping institution an inside retailer has to have the lowest price. This involves a clear trade-off. A decrease in price will increase the retailer's chance of winning all the consumers who shop using the ISA, but it also forces the retailer to subsidize its store loyals. As more retailers join the institution, the chance of winning all the consumers decreases and this motivates the inside retailer to strategically focus more on extracting surplus out of its loyal consumers by charging higher prices. Thus, the intense competition within the institution leads to a higher average price as more retailers join. The average prices paid by the consumers who use the ISA (which is the average minimum price in the institution) is lower than that paid by the store loyals who buy from their favorite retailer. However, the average prices that consumers pay in the ISA can increase or decrease with the number of inside retailers: It increases when the reach is exogenous, but decreases when the reach of the ISA is endogenous.

The main results of the paper pertain to the entry equilibrium of retailers. In equilibrium, only some of the retailers choose to join the institution while others opt to not join. This is the case even though the retailers are ex-ante identical. An outside retailer that does not join has two possible pricing strategies. It can focus exclusively on the store loyal consumers by charging their reservation price. Or it can lower the price to below the average price within the institution and also attract its partial loyal segment. As more retailers join the average price within the institution increases. This makes cutting price to attract the partial loyals easier and less costly. Thus, the maximum number of inside retailers is determined by the following indifference condition: retailers on the outside should be indifferent between charging the reservation price and lowering the price to also attract the partial loyals.

We show that there is a unique number of retailers who enter the institution in equilibrium when the reach of the institution is endogenous and when the traffic at the ISA confers complementary side-benefits to the owner of the ISA. Side-benefits such as advertising revenues have real impact on the equilibrium only when the reach of the institution is endogenous. In particular, the ISA has an incentive to share some of the side benefits with the inside retailers. This result finds at least anecdotal support. For example, *mySimon*, which is a leading stand-alone ISA that is not linked to any portal sites, relies on the draw that its member retailers have. Consistent with our analysis *mySimon* routinely offers free banner advertising space to its member retailers while portal owned ISA's such as *Shopping.com* or *Jango* do not. Furthermore, if the incremental advertising side-benefits from additional retailers joining is substantial, the ISA can actually have the incentive to plough back a significant portion of these benefits back into the retail market. This creates a situation benefiting not only the ISA and the inside retailers, but also the retailers who do not join.

We extend the analysis to the case of heterogenous retailers and find that if the difference in the retailers' loyal segments is sufficiently small then the retailers with larger loyalty are likely to be the inside retailers. Finally, we provide empirical evidence for the inside pricing predictions of the model using pricing data for 35 items in the music CD, books and video categories that was gathered in searches made on seven leading ISAs (two portal-owned and five stand-alone ISAs). The data consisted of bi-weekly retail price time series data. We find support for the prediction that retailers inside an ISA use probabilistic pricing, for the result that the average price is increasing in the number of retailers in an ISA, and for the prices that consumers pay. We find support for both these model predictions.

The rest of the paper is organized in the following manner. Section 2 presents the basic model. Section 3 discusses the case of exogenous reach while section 4 develops the case of endogenous ISA reach. In section 5 we discuss the impact of retailer heterogenity. We present empirical evidence in Section 6 and discuss the institutional implications of the research in section 7. Section 8 concludes.

2. The Model

Consider an industry comprising of n identical and risk-neutral online retailers. These retailers sell a homogenous product such as a music CD or a specific book to the end-consumer market. The product is produced and distributed at a constant marginal costs of c which for the rest of the analysis is assumed to be zero without loss of generality. The market is comprised of a unit mass of identical consumers. Each consumer has a demand of at most one unit of the product. Consumers have a common reservation price for the product which is normalized to 1 without loss of generality.

We now discuss the impact of an Internet shopping agent that allows a consumer to costlessly compare the prices of all the retailers that join the ISA. Consumers who use the agent can identify the lowest price store and purchase the product from it. Thus, given a homogenous product, consumers who use the Internet agent will purchase from the lowest priced retailer. The consumer segmentation that we use captures differences in the relative loyalty for the shopping institution versus individual on-line retailers. This is done by defining three consumer segments.[3]

Store Loyals

These consumers have a high degree of retailer loyalty and do not use the ISA. They form a fraction α of the total consumers and are symmetrically split between the retailers. Even in the presence of the Internet agent, this segment will continue to buy the good only from their favorite retailer (as long as it is priced below the reservation price). Several authors provide evidence and explanations for why consumers might have store loyalty in an electronic marketplace. Brynjolfsson and Smith (1999) provide evidence that store reputation can be important to Internet consumers. Similarly, satisfaction from previous experience might also be a determinant of store loyalty. Urban et al. (1998)

[3]The important aspect that a model of an ISA should capture is that firms that are inside the ISA face consumers who are able to do more price search/comparisons than firms that are outside. In our model the inside retailers face consumers who costlessly see k prices while outside firms face consumers who go to their favorite store. However, even if the outside firms face searching consumers who search between stores, the insights still hold as long as the outside firms face consumers who on average have comparative price information about fewer stores than the inside firms. Our consumer segmentation captures this aspect of the ISA.

have argued that trust and assuaging consumer privacy is one of the most important components of loyalty on the Internet. For instance, consumers who are new to Internet shopping are usually reluctant to give their credit card information to an unknown retailer even if they can get a cheaper price. Consumers may also develop loyalty to a particular retailer due to switching costs: i.e. the effort required to learn about and navigate through a retailer site or even due to the time cost of entering information with a new retailer. In sum, any of these factors can lead to store loyalty among consumers. Thus in the model the ISA has no effect on the behavior of this store loyal segment. Each retailer can charge the reservation price and still sell to its store loyal customers, achieving a profit of $\alpha \times \frac{1}{n} \times 1 = \frac{\alpha}{n}$.

ISA Loyals

In contrast to the store loyal consumers we assume that a fraction β of consumers have negligible cost of an additional search at the ISA, and no loyalty to their original store after the emergence of the Internet institution. These customers always search and use the ISA to find the store offering the cheapest price. In particular, they buy from the retailer that has the lowest price out of the k retailers that joined the ISA. In this sense, these consumers can be seen as being loyal to the ISA institution. A recent survey by Nua Internet Surveys estimates that on a world-wide basis, 5 million consumers primarily shop through ISA's.[4]

Partial Loyals

The remaining segment of size $\gamma = 1 - \alpha - \beta$ is comprised of consumers who have some store loyalty but who also search at the institution. This segment allows us to capture the fact that the ISA can be used by consumers to monitor whether their favorite firm is price gouging. We label these consumers as having an intermediate (or partial) level of retailer loyalty in the following sense: These consumers would like to shop from their preferred retailer but, unlike the store loyal consumers, they search the ISA and are not willing to pay the full reservation price at their favorite store. Again we assume a symmetric split of these consumers between all retailers. Thus, these consumers visit the shopping institution to get price information. Then, if their favorite retailer is outside, they buy from that retailer only if it charges a price below the average price they saw in the institution.[5]

[4] Another reason for differences between consumers in using the ISA can be the awareness of the existence of the institution among consumers. A recent survey by Jupiter Communications found 28% of their respondents to be currently unaware of the existence of any ISA. However, note that in the long-run it is possible for a substantial proportion of on-line consumers to be aware of the existence of ISA's. In this case, the other factors such as the reputation of their favorite retailer or the cost of searching over and above their favorite store can still prevent a significant proportion of consumers from being ISA loyal. In any event, if the awareness for an ISA increases over time, then this can be interpreted as an increase in the size of the ISA loyal segment.

[5] Note that the use of the average price as the benchmark for decision making by these consumers in this model is motivated by the fact that several leading ISA's allow for the calculation and report of the average/median price on

Otherwise, they buy through the ISA at the lowest price. Jupiter Research estimates that about 10% of ISA users' aim is to monitor their own favorite store.[6]

Note that $r = (\beta+\gamma)$ represents the potential "reach" or the attractiveness of the institution. We will first analyze a model in which the reach r is assumed to be exogenous and independent of k the number of retailers that join. The independence between r and k represents the institutional reality that the traffic to many of the major ISA's are currently driven by their link to portal sites (see *InformationWeek* 12/07/98). For example, *Jango* is linked to *Excite* and its reach depends directly on the nature and the size of web traffic that the portal generates.[7] An alternative interpretation of this assumption is that the reach is a direct consequence of the reputation and the promotional efforts of the ISA itself and that it does not depend on the reputation of the member retailers that join the institution. It is possible that in the early stage of the evolution of an agent such as *BargainFinder*, consumer awareness and usage is primarily determined by reputation building by the ISA itself.

However, the reach of the ISA can also be enhanced by the retailers that end up joining the ISA. In other words, the reputation and the franchise of the joining retailers can benefit the ISA (i.e., $r = r(k)$). This is clearly the case for stand-alone ISA's such as *mySimon*. In section 4 we address environments in which the reach of the institution is a function of the number of retailers joining it. Clearly, this also means that the size of the store loyal segment will also dependent upon the number of inside retailers (i.e., $\alpha = \alpha(k)$).

Finally, we assume that the owner of the ISA derives side-benefits from increased traffic at the web-site. The most obvious side-benefit of greater traffic is the increased advertising revenues that the owner of the institution can get. We denote the side-benefit function as $B(r)$ and assume that $B'(r) > 0$ (the side-benefits increase with the total reach of the institution). As will be apparent, $B(r)$ has real impact on the equilibrium when the reach of the ISA is a function of the number of retailers joining the institution.

Given this set-up, each retailer independently decides whether or not to join the ISA. Then,

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searches made by consumers.

[6]It is useful to specify the model that represents the market without an ISA and how this is consistent with the model of a market with an ISA. A natural way to model a pre-ISA market is to consider, that in the pre-ISA world, a proportion of α consumers are store-loyal and only search at their favorite store (as in the model of this paper). The remaining $(1-\alpha)$ consumers are searchers (who are analogous to the ISA and the partial loyals in the main model). In the absence of the ISA, the searchers indulge in a one additional search. They are able to search one additional store and get comparative prices from 2 stores. In the market with the ISA, the searchers use their one additional search for searching at the ISA. In other words, with one additional search, these searchers are now able to see k additional prices, rather than just one additional price. This captures the idea that the ISA reduces the cost of search and allows consumers to get price information from more stores than in the pre-ISA world. The analysis of this pre-ISA model is available from the authors. Comparison with this pre-ISA model shows that the average price paid by searchers and the expected inside price with an ISA is lower when compared to the expected price in the pre-ISA market. We thank an anonymous reviewer for comments on this issue.

[7]One might think of the portal's reach as the total potential reach of the ISA. Clearly, some consumers who use Excite might not use Jango. However, as long as the actual traffic in Jango is increasing in the portal's traffic, the model and the results of the paper will continue to be valid.

conditional on the entry decision, retailers simultaneously choose a pricing strategy. A retailer that decides not to join and stays out of the ISA does not have access to the traffic of ISA loyal consumers who use the ISA and buy at the lowest price. Such an outside retailer has two possible strategies: It can choose to sell only to its store loyals by charging the reservation price or it choose to sell to both its store loyals and its partial loyals by charging a price at or below the expected inside price. An inside retailer that joins the ISA, will get its store loyals, but in addition it can also win the ISA loyals and partial loyals if it has the lowest price.

The equilibrium is determined by the condition that retailers will join the institution as long as the profits they can get from joining are greater than the profits they can achieve outside. Obviously, retailers will choose their prices conditional on whether they participate in the ISA or whether they are an "outside" retailer.

3. ISA's and Retail Competition

3.1. ISA's Reach Independent of k

We first analyze the impact of an Internet shopping institution on competition given that the reach of the institution is independent of the number of retailers joining. This analysis is important to understand the role of ISA's such as *Jango* or *Shopping.com* that rely on their link to portal sites for customer traffic. To understand how retailers within the institution behave, it is necessary to analyze the consequence for a retailer that happens to be an outside retailer. Clearly, a retailer will only join the institution if, in equilibrium, it can guarantee itself at least as much (or more) profit as it could make by staying outside. By remaining outside each retailer guarantees itself a profit of $\frac{\alpha}{n}$ by charging the store loyal consumers their reservation price. In the proposition we characterize the equilibrium number of retailers joining. We look for a symmetric price equilibrium of the competition within the institution given that some k retailers have joined.

Any pricing equilibrium of the retailers competing in the institution cannot involve pure strategies. Suppose the retailers were to compete by choosing a pure strategy price. Then in a symmetric equilibrium each retailer's demand will be made up of its store loyal consumers $\frac{\alpha}{n}$ (i.e., the loyal consumers of the retailer that do not use the ISA) and possibly the $\beta + \gamma$ consumers who use the Internet institution. The consumers shopping in the ISA choose the retailer that offers the lowest price. This means that any given retailer in the ISA will always have an incentive to "undercut" the competition and attract the entire customer base $\beta + \gamma$ that uses the Internet institution. Furthermore, similar to Varian (1980) and Narasimhan (1988) the price equilibrium can only involve totally mixed strategies. The following proposition characterizes the equilibrium number of retailers joining the ISA and also the unique symmetric price equilibrium in the ISA. Proofs of all the Propositions are provided in the Appendix.

Proposition 1: *When α, β and γ are independent of k,*

1. *The equilibrium number of inside retailers can be any $k \leq k^*$, where k^* solves the equality $E_k^*(p) = \frac{\alpha}{\alpha+\gamma}$. Furthermore, the ISA will get the entire advertising side-benefit.*

2. *The equilibrium c.d.f of the prices charged by each of the k inside retailers in a symmetric equilibrium $F^*(p)$ is given by,*

$$F^*(p) = \begin{cases} 0 & \text{if} \quad p < z \\ 1 - \left(\alpha \frac{1-p}{pn(\beta+\gamma)}\right)^{\frac{1}{k-1}} & \text{if} \quad z \leq p \leq 1 \\ 1 & \text{if} \quad 1 < p \end{cases}$$

where z is the minimum price of the mixed strategy distribution and is given by $z = \frac{\alpha}{\alpha+n(\beta+\gamma)} = \frac{\alpha}{\alpha+nr}$.

It is useful to first understand the inside price equilibrium before discussing the entry equilibrium. Retailers inside the ISA used mixed pricing strategies. The mixed strategies in which retailers choose prices below the reservation price and according to the distribution $F^*(p)$ allows a retailer to trade-off between taking advantage of its store loyals (by charging the reservation price 1) and charging lower prices for the chance of being the most attractive retailer for the customer base in the ISA.

Note that the retailers choose prices between 1 and a minimum price $z = \frac{\alpha}{\alpha+n(\beta+\gamma)}$. This minimum price charged increases unambiguously with the degree of retailer loyalty (α) and decreases with the overall reach of the institution ($\beta+\gamma$). Greater retailer loyalty increases the guaranteed profit of each retailer. This means that retailers who join the institution would compete less aggressively for the inside consumers. Consequently the minimum price increases with α. We now discuss the main implications of the pricing equilibrium.

3.2. Average Retail Prices in the ISA

Let us first define $W^*(p,k)$ as the equilibrium probability of charging a price above p (i.e., $W^*(p) = 1 - F^*(p)$). From Proposition 1 this probability can be written as:

$$W^*(p,k) = \left(\frac{\alpha(1-p)}{pn\,(\beta+\gamma)}\right)^{\frac{1}{k-1}} = \left(\frac{\alpha(1-p)}{pn\,(1-\alpha)}\right)^{\frac{1}{k-1}} \qquad (1)$$

The first point to note is that $W^*(p,k)$ is an increasing function of k for every possible price.[8] Thus, $W^*(p,k_1)$ stochastically dominates $W^*(p,k_2)$ whenever $k_1 > k_2$. This is also evident from the plot of the c.d.f shown in Figure 2. This means that the average retail price charged by a retailer in the

[8] Note that $a^{\frac{1}{b}}$ is an increasing function of $b > 1$ as long as a is less than one. The argument in $W^*(p,k)$ is less than one by construction.

institution increases with the number of retailers that join. The traditional notion is that an increase in competition (due to the increase in the number of retailers) should have the effect of lowering prices. In contrast and similar to Rosenthal (1980), it is possible for average prices to go up with competition in the institution that the model represents.

Consider the incentives faced by an inside retailer. In order to win all the consumers who patronize the institution, the retailer will have to be the one charging the minimum price. Thus, to increase its market share among the inside consumers, the retailer will have to indulge in intense price competition. Cutting prices, however, implies a clear trade-off. While a decrease in price increases a retailer's chance of winning all the inside consumers, it also subsidizes the $\frac{\alpha}{n}$ store loyal consumers who are willing to buy from the retailer even at the reservation price. As the number of inside retailers increases, all else being equal, any inside retailer will now have a lower chance of winning all the consumers for a given reduction in its price. The strategic response of a retailer to this is to focus relatively more on extracting surplus from its store loyal customers. This leads to an increase in the average prices charged by an inside retailer. The closed-form expression for the average price with k inside retailers is:

$$E_k^* = \int_0^1 \frac{1}{n\frac{1-\alpha}{\alpha}p^{k-1}+1}dp \tag{2}$$

3.3. Prices Paid By Consumers

Consider the probability that the minimum price is above a certain level p: $(W^*(p,k))^k = \left(\frac{\alpha(1-p)}{pn(1-\alpha)}\right)^{\frac{k}{k-1}}$. This probability is also an increasing function of k for every possible p. Once again as the number of inside retailers increases, not only does each retailer charge a higher price on the average, but the mean price paid by consumers also increases. Thus, (paradoxically) greater competition in the form of more retailers does not benefit the consumer. With more retailers, each individual retailer cares more about extracting surplus from its loyal base than about competing for the consumers who patronize the institution. Thus, it is possible for consumers to be worse off as more retailers join the ISA.

Nevertheless, the reader must note that the ISA has the potential to benefit consumers who are willing to search beyond their favorite retailer. The $\beta + \gamma$ consumers pay the minimum of all the posted prices in the institution that therefore benefit from a substantially lower price than the store loyal consumers: The ISA benefits the "inside" searching consumers. Note, though, that the size of this benefit diminishes as more retailers join an ISA.

3.4. Equilibrium Number of Inside Retailers

Proposition 1 states that some retailers in the industry will choose not to join the ISA even if the ISA does not charge anything for its services. Indeed, as in the case of *CDNow*, these retailers will choose to block the ISA. The ISA endogenously creates differences in the price strategies among ex-ante symmetric retailers. Only a fraction of the retailers will join the institution and upon joining will adopt different price strategies than that of an outside retailer.[9]

To understand this result, consider the strategy of an outside retailer that does not join the ISA. Such a retailer has two possible strategies. It can charge the reservation price of 1. In this case it will only sell to its store loyal consumers and get the (guaranteed) profit of $1 \times \frac{\alpha}{n}$. Alternatively, the retailer can lower its price to E_k^* in order to increase its market share. In this case the retailer will not only get its store loyal consumers, but will also attract a mass $\frac{\gamma}{n}$ of its partial loyal consumers. Thus, whether an outside retailer will lower its price to E_k^* or not will depend on the size of the required price cut. Note also that in our model the outside retailers will not play a mixed strategy (i.e. they will not mix in the two possible prices). This is because in equilibrium ($k \leq k^*$) the reservation price strategy is strictly dominating.[10]

Suppose that only a few retailers have joined the institution. Consequently, E_k^* will be relatively small making the price cut needed to attract the partially loyal consumers costly. As a result the outside retailer will adopt the reservation price strategy. But, when a sufficiently large number of retailers have joined, E_k^* will be high enough to cause the outside retailer to deviate from the reservation price. Charging the reservation price can no longer be an equilibrium strategy for the outside retailer as the profits from charging E_k^* are now higher. But this would imply that the inside retailers would have an incentive to leave the ISA and the equilibrium unravels as a result.

Thus the presence of only a few retailers makes joining the institution attractive for an outside retailer due to less inside competition. As more retailers join, the average inside price charged increases, and this makes adopting the price cutting strategy progressively easier for an outside retailer. Every retailer joining the institution, reduces the marginal benefit of joining for a succeeding

[9]It may be argued that in the initial stages of evolution of the institution there might be lack of a convention among retailers regarding whether or not to join. One might postulate such a lack of consensus rather than equilibrium behavior to be the reason for why some retailers stay out while others join. Nevertheless, ISA's have now been around for more than five years and this seems to be sufficient amount of time in the Internet economy. Many leading ISA's have been in operation for 3-4 years. This should support the fact that, at least in the aggregate, the incentives of managers in profit maximizing Internet retailers should reflect equilibrium behavior.

[10]In order to have the property that there is mixed strategies for outside retailers in equilibrium, it is necessary to construct a model where outside firms also face searching consumers. In our model the inside firms face consumers who see k prices while outside firms face consumers who go to their favorite store in equilibrium. The results of the paper pertaining to average prices as well as the entry of retailers have to do with this essential characteristic that inside the ISA consumers are able to do more price comparisons. Even if the outside firms were to face searching consumers, the insights of our model will hold as long as firms outside face consumers who on average have comparative price information about fewer stores than firms inside the ISA. And any reasonable definition of an ISA should imply this characteristic.

retailer. In equilibrium, when sufficient number of retailers have joined the institution, an outside retailer becomes indifferent between charging the reservation price and lowering the price to also attract the partially loyal consumers. This is the meaning of the equality condition in the proposition.

Proposition 1 focuses on only one of the two forces that characterize the institution (i.e., that more retailers joining the institution results in higher average prices). This force only determines the maximum number of retailers k^* that can join the institution. Notice however, that for any $k < k^*$ the outside retailers will still not have an incentive to cut prices to E_k^*. For any $k < k^*$, the competition between the inside retailers will adjust so as to give each retailer its guaranteed profit of $\frac{\alpha}{n}$ from its store loyal consumers. Thus effectively preventing outside retailers from profitably joining the ISA. To identify a unique equilibrium number of inside retailers we have to accommodate a second aspect of the ISA: the fact that the "reach" of the ISA can be endogenous and can depend on the number of retailers joining the institution. We analyze this important aspect in the following section.

4. Endogenous Reach of the ISA

Endogenizing helps us to capture the institutional reality that the popularity of a shopping agent (as measured by the traffic that it generates) depends on how widely it is adopted by the industry. This leads to some of the main results of the paper. Assume now that the reach of the shopping agent is proportional to the number of retailers joining it. In particular, let $r(k) = t\frac{k}{n}$ where $0 < t < 1$ is the marginal effect of an additional inside retailer on the reach of the ISA. In other words, the size of the store loyal segment is $\alpha(k) = 1 - t\frac{k}{n}$. Given this the equilibrium price distribution of Proposition 1 can be rewritten as,

$$F^*(p) = \begin{cases} 0 & \text{if} \quad p < z \\ 1 - \left(\frac{tk(1-p)}{np(n-tk)}\right)^{\frac{1}{k-1}} & \text{if} \quad z \leq p \leq 1 \\ 1 & \text{if} \quad 1 < p \end{cases} \quad \text{where } z = \frac{tk}{tk(1-n)+n^2}.$$

We have the following result.

Result 1: *When the reach of the shopping agent is given by $r = t\frac{k}{n}$, there exists a critical t_c, such that for every $t \leq t_c$ the average price, $E_k^*(p)$, charged by a retailer is monotonically increasing in, k, the number of retailers joining the institution. Furthermore, $t_c = 0.841843$.*

Unlike the case of exogenous reach the average price charged by an inside retailer can be non-monotonic w.r.t k. This happens when the marginal effect of an additional inside retailer on the reach of the ISA is large ($t > t_c$) and when a sufficiently large number of retailers are already inside the institution. In this situation, each inside retailer enjoys a very small segment of store loyals. This forces the inside retailers to compete more intensely for the consumers who patronize the ISA.

We will first discuss the main points of this section through Proposition 2 for the case of $t \leq t_c$ and then discuss what happens when $t > t_c$.

Proposition 2: *Let $t \leq t_c$, and the side-benefit function be regular ($B(r) > 0$, $\frac{dB}{dr} > 0$). Define k^* which solves the equality $E_k^* = \frac{n-k}{n-k(1-\delta)}$. In this expression $\delta = \frac{\gamma}{\beta+\gamma}$ is the proportion of the partial loyals out of all the consumers who use the ISA. The entry equilibrium of retailers will be as follows:*

1. *Let $m > k^*$, and $L(m) = \frac{\gamma(m)}{n} E_m(p)$. If the shape of $B(r)$ obeys an "increasing sufficiently slowly" (i.s.s) property defined by $B(r(m)) - B(r(k^*)) < L(m)m \; \forall \; m$, then the unique entry equilibrium involves k^* retailers. In this equilibrium, the outside retailers charge the reservation price. Furthermore, the lump-sum side payment made by the ISA to each inside retailer will be arbitrarily small.*

2. *However, if $B(r)$ "increases fast enough" and $B(r(m)) - B(r(k^*)) > L(m)m$ for some non-empty set M of all $m > k^*$, then the unique entry equilibrium is $m^* > k^*$, where $m^* = argmax_{m \in M}[B(r(m)) - L(m)m]$. In this equilibrium the prices charged by the outside retailers are lower than the reservation price and equal to $E_{m^*}(p)$. The ISA will make non-negligible lump-sum payments $L(m^*)$ to each of the m^* inside retailers.*

In the previous case of exogenous reach, the side benefit enjoyed by the ISA had no impact either on the equilibrium entry or on the price strategies of the retailers. This is no longer the case with endogenous reach. The manner in which the side-benefit $B(r(k))$ increases with the number of retailers affects the entry equilibrium.

The first part of the Proposition represents the case where every additional joining retailer adds a sufficiently small incremental value to the side-benefit enjoyed by the ISA. In the previous discussion of exogenous reach any $k \leq k^*$, can be part of an equilibrium. However, when the reach depends on the number of retailers joining, the owner of the Internet institution will be strictly better off if the maximum number of retailers are motivated to join because this maximizes the reach and the corresponding advertising side-benefits. The owner of the ISA therefore has an incentive to make a payment to retailers for joining the ISA. Thus, it can indeed be optimal for the owner to pay some retailers to sign up. Proposition 2.1 indicates that these payments to retailers will be negligibly small if the *i.s.s* property $B(r(m)) - B(r(k^*)) < L(m)m \; \forall m$ holds. Given this, exactly k^* will join in equilibrium and the remaining outside retailers will charge the reservation price.[11] In contrast, if

[11]Note that in this case it is not an equilibrium for a retailer to join the ISA but continue to charge the reservation price (i.e. behave like an outside retailer) even though this will guarantee the same profit as being outside. This is because the ISA has the incentive to make it beneficial for the inside retailers to not adopt the "reservation price only" strategy. If inside retailers charge only the reservation price, then there will fewer number of inside retailers in equilibrium and this implies lower side-benefits for the ISA.

the $i.s.s$ condition is not satisfied then it will be attractive for the owner of the ISA to motivate an even larger number of retailers $m > k^*$ to join.

Recall from our previous discussion in section 3.4 that the equilibrium k^* represents the maximum number of retailers beyond which the outside retailers will have an incentive to charge lower than the reservation price (and attract the partial loyals). The owner of the ISA faces a distinct tradeoff. The ISA will have the incentive to motivate the maximum number of retailers to join as the reach and the side-benefit increases monotonically with the number of joining retailers. However, if the number of inside retailers becomes too large (and in particular if the number of inside retailers is any $m > k^*$), then the outside retailers will have the incentive to cut the price in order to attract the partial loyals and thereby increase their profits to $(\alpha(m) + \gamma(m))E_m$. This would mean no retailer would want to join the ISA unless the ISA can subsidize it through a non-negligible lump-sum side-payment that covers the difference between the inside and outside profits i.e., $L(m) = \frac{\gamma(m)}{n} E_m$. Clearly, making this payment $L(m)$ to each of the inside retailers is only attractive for the ISA if the side-benefit enjoyed is substantially higher for additional retailers joining beyond k^*. This is the intuition for $i.s.s$ property and the first part Proposition 2. When the side-benefit does not increase fast enough, the ISA prefers to restrict entry to only k^* retailers and make negligible side-payments. Note that in this case, the outside retailers follow the reservation price strategy and the equilibrium profits of all retailers will be $\frac{\alpha(k^*)}{n}$.

However, when the advertising side-benefit enjoyed by the ISA increases substantially with additional retailers joining, the ISA has the incentive to make positive side-payments of $L(m^*)$ and motivate $m^* > k^*$ retailers to join. Interestingly, the outside retailers charge less than the reservation price (i.e., they charge E_{m^*}) and get the benefit of selling to the partial loyals. The inside retailers benefit from the positive side-payment. Thus the ISA ploughs back part of the advertising revenues back into the retail market if the increase in the reach dependant benefits are sufficiently large. In doing so, the ISA makes all firms better off: Not only do the owner of the ISA and the inside retailers benefit, but also the retailers who do not join enjoy greater profitability than in a world without an ISA. The reason for this as follows: Because the advertising side-benefit increases substantially with respect to additional reach, the ISA would like more firms to join. The resulting increase in the side-benefits can create a Pareto improvement: the ISA is better off even after making side-payments to the additional joining firms (and making them better off). In other words, if the advertising side-benefits enjoyed by the ISA increases at a sufficiently fast rate with additional retailers joining, then the ISA can afford to share the advertising benefits with the joining retailers and still be better off. Additional profits accrue because it is optimal for the ISA to make more than k^* retailers to join which creates more advertising benefits. And these advertising benefits enable a Pareto improvement for the ISA and all the inside retailers. The ploughing back of advertising side-benefits also has a strategic effect on the behavior of the outside retailers and causes them to lower prices to the expected inside price and thereby raises their profits beyond the guaranteed profit of $\frac{\alpha}{n}$.

This Proposition also highlights the effect of price monitoring intensity on equilibrium behavior. Recall that the size of the partial loyal segment represents the extent of price monitoring that inside retailers will be subjected to. Proposition 2 shows that if the size of this segment is small enough (i.e. price monitoring is not too intense), the ISA will find it beneficial to share the advertising side-benefits and motivate additional retailers to join in equilibrium. When additional retailers join the ISA and the expected inside price increases and outside retailers will cut price to attract their partial loyal consumers. Consequently, to keep the inside retailers from defecting, the ISA will have to make suitable side-payments to each inside retailer. When the size of the partial loyal segment is small, the side-payments needed are also small.

The reader must also note some interesting institutional aspects of side-payments made by the ISA to the inside retailers. In actual practice, the side-payments can be in the form of free advertising offered by the ISA to its member retailers. Our results predict that such payments are most likely to be made by stand-alone ISA's that are not attached to any portal sites. In fact, *mySimon* which is a stand-alone ISA provides advertising space for its participating merchants at no additional cost. While *Yahoo*, *Lycos*, or *Excite* do not provide such free space to retailers that are associated with their respective ISAs. The results also highlight the importance of advertising and other side-benefits that web traffic generates. It provides a perspective on the idea that site-traffic investments that result in future payoffs in advertising revenues and other complementary benefits can be a feasible revenue model for leading B2C Internet companies.

In sum, while the outside retailers prefer a strategy of extracting surplus from their store loyals, the inside retailers move to the ISA motivated by the traffic of consumers that they can attract inside the institution. Furthermore, this discussion of endogenous reach provides a rationale for why some retailers will stay out and "block" the ISA while others prefer to join. In our model, a retailer who elects to block the ISA imposes a positive externality on all other retailers because this reduces the size of the consumer segment that comparison shops through the ISA (or by effectively increasing the set of store loyal consumers). Thus blocking or staying out can be seen as attempts made by retailers to reduce the traffic at the ISA and thereby preventing the ISA from being too successful. In fact, attempts made by retailers such as CDNow were considered by analysts as attempts at reducing the legitimacy of ISA's.

Figure 3a shows the impact of the number of retailers that join on the average price charged by the inside retailers. As before the average price charged by the retailers increases with k. But unlike the previous case of exogenous reach, the minimum price paid by consumers decreases with k. Thus with endogenous reach, consumer surplus will keep increasing as more retailers join. This is due to the fact that the number of consumers drawn to the institution increases with k. Therefore, the gain from charging the lowest price is also increasing in k. Consequently, the greater the number of inside retailers the greater will be the motivation of each retailer to win all the consumers. This results in a lower average minimum price being charged.

Figure 3b shows how the equilibrium number of inside retailers is affected by some of the important parameters of the model. It can be seen that the equilibrium number of inside retailers decreases with δ the proportion of partial loyals (out of all the consumers who use the ISA). As δ increases there are fewer consumers who are completely loyal to the ISA and more who are willing to consider both. This makes the institution less attractive for an outside retailer. Furthermore, an increase in the marginal effect of an inside retailer (t) causes more retailers to join the institution. Larger t implies that each inside retailer brings more shoppers to the institution. The positive externality that this places on all the other inside retailers outweighs the cost of increased competition.

Finally, for completeness we briefly discuss the case when $t > t_c$. The condition $t \leq t_c$ ensures that the expected price is increasing in the number of inside firms. However, for the case of $t > t_c$ (i.e. small segment of store loyals), the expected inside price might behave non-monotonically w.r.t the number of inside firms (i.e. it can increase and then decrease). Now there are two possible cases. Either, the equilibrium k^* occurs in the rising part of the expected inside price curve, in which case all the results are exactly as in Proposition 2. Or, (when t is very large) we have that all the firms will want to join the ISA. This makes intuitive sense, because if the marginal effect on reach of an additional retailer joining is extremely large, we should naturally expect all retailers to want to join the ISA.

5. The Impact of Retailer Heterogeneity

It is possible that retailers might differ in their reputation or the extent of their store loyalty. For example, *CDNow* enjoys a much greater loyal segment than MuZicDepot.com. This can be modeled by assuming differences in the sizes of the store loyal segments across retailers. In this section, we examine the role of loyalty differences in determining retailer strategies with respect to an ISA. An important objective of extending the model to retailer heterogeneity is to understand when a retailer with large loyalty would want to join the ISA. We examine this question in the context of portal owned ISAs with exogenous reach.

Consider the following extension to the basic model. Let there be two types of retailers that differ in the sizes of their store loyal segments. For generality we also allow for the two types of retailers to have different sizes of partial loyals. The first type consists of n_1 retailers each having a store loyal segment of size α_1 and a partial loyal segment of size γ_1. The second type consists of n_2 retailers with each retailer having a *larger* store loyal segment of size α_2 and a partial loyal segment of γ_2. The total size of the store loyal segment is $\alpha = n_1\alpha_1 + n_2\alpha_2$. In the exposition that follows, we will refer to a retailer of first type as a “small” retailer and to its counterpart from the second type as a “large” retailer.

We examine the incentive of the different types of retailers to join the ISA. It turns out that the difference in the store loyalties between the two groups determines the type of inside equilibrium that results. We will first analyze a case where the difference in store loyalty between the groups is sufficiently large.

5.1. Sufficiently Large Difference in Store Loyalties

Proposition 3: *As long as the difference in store loyalty is sufficiently large (sufficiency condition being $\alpha_2 - \alpha_1 > \gamma_1$), then*

1. *If there is only one small retailer in the industry (i.e., $n_1 = 1$), then this small retailer will always join the ISA. The small retailer will make a profit of $\frac{\alpha_2}{\alpha_2+S}(S + \alpha_1) > \alpha_1$.*
2. *If $n_1 \geq 2$, then there will always be at least two small retailers joining the ISA. In this case, the small inside retailers will make only their guaranteed profits α_1.*

In this proposition, $S = (1 - \alpha)$.

From Proposition 3.1 we have that a sole small retailer will always join the ISA as long as the difference in the store loyalties is sufficiently large. The small retailer will always make a profit greater than α_1 by joining the institution, though this means competing with the inside large retailers. This is because the small retailer now benefits from the consumer traffic it can win within the ISA. In addition, because the small retailer competes with retailers who have a larger pool of guaranteed consumers, it faces less aggressive price competition (than if it were to compete with other small retailers) and therefore does not compete away all the profits gained on the consumers in the ISA. The greater the difference in the store loyalties the greater is the equilibrium profit of the small inside retailer.

To understand this result suppose the small retailer stays out. Then the outside small retailer has 2 options. It can either charge the reservation price and get the guaranteed profit of α_1. Or it can cut price to the average inside price and attract the partial loyals. This means that the small retailer will always join under the condition that the inside profits are greater than what it could get by staying outside and cutting price to the expected inside price. When the difference in store loyalty is sufficiently large, the inside profit of the small retailer is large enough for this condition to be satisfied.

For (the more general) case when the industry has two or more small retailers, Proposition 3.2 shows that at least 2 small retailers will always join the ISA. A small retailer has the incentive to join the ISA when other small retailers have not entered. Suppose that only one small retailer joins in equilibrium. Then such a retailer will make a profit of $\frac{\alpha_2}{\alpha_2+S}(S+\alpha_1) > \alpha_1$. Now consider the outside small retailer(s). If they were charging the reservation price, then any one of these retailer(s) could improve their profits to $\frac{\alpha_2}{\alpha_2+S}(S+\alpha_1)$ by joining the ISA. On the other hand, if the outside small retailers were cutting price to the expected inside price in equilibrium, then two possibilities exist. Either the profit made by an outside retailer will be higher (in which case the inside small retailer will deviate and move out), or the profit of the inside small retailer is higher and the outside small retailers will want to join the ISA.[12]

Thus when the difference in store loyalty is large enough, any feasible equilibrium will be characterized by at least two small retailers and some k_2 large retailers. The price equilibrium inside the ISA for any feasible configuration of large and small retailers is detailed in the following Proposition.

Proposition 4: *If there are $k_1 \geq 2$ small and some k_2 large retailer(s) inside the ISA then in a non-degenerate equilibrium,*

1. *The small retailers will adopt a mixed strategy in price according to the equilibrium c.d.f $F^*(p)$ where,*

$$F^*(p) = \begin{cases} 0 & \text{if} \quad p < z \\ 1 - \left(\alpha_1 \frac{(1-p)}{pS}\right)^{\frac{1}{k_1-1}} & \text{if} \quad z = \frac{\alpha_1}{\alpha_1+S} \leq p \leq 1 \\ 1 & \text{if} \quad 1 < p \end{cases}$$

   Furthermore the small retailers will make their guaranteed profit α_1.

2. *The large inside retailers charge the reservation price and their equilibrium profit will be α_2.*

In a non-degenerate equilibrium the inside small retailers will play a mixed strategy in equilibrium. Following a logic similar to that of Proposition 1 (and given at least 2 small inside retailers), the price competition between the small retailers forces them to compete away all but their guaranteed profits α_1 in equilibrium. The more interesting point is that the large inside retailers play the reservation price. In other words, the large inside retailers continue to behave as if they were outside retailers. This result has an analogue in the observed behavior of Internet retailers. When the difference in the store loyalties is sufficiently large, larger retailers such as *Amazon.com* can be inside the ISA and can continue to charge high prices.

5.2. Store Loyalty Difference Not Large Enough

Let us now consider the case where the difference in the store loyalty of the two types of retailers is not very large.

[12] Only under the knife-edge condition that $E_{1,k_2}(\alpha_1+\gamma_1) = \frac{\alpha_2}{\alpha_2+S_{new}}(S_{new}+\alpha_1)$, is it possible for an equilibrium to exist with only one small inside retailer even though the outside small retailers are cutting price to the average inside price. Under this condition $S_{new} = \beta+\gamma_1+n_2\gamma_2$ is the reach of the ISA when the outside small retailers are cutting price to the expected inside price.

Proposition 5: *If the difference in the store loyalty is not large enough* $(\alpha_1 + \gamma_1)E_{k_2} > \frac{\alpha_2}{\alpha_2+\tilde{S}}(\tilde{S} + \alpha_1 + \gamma_1)$, *then there can exist an equilibrium with only large retailers inside (at least some* k_{2min} *or more large retailers) . The large inside retailers play mixed strategies in prices. The large outside retailers charge the reservation price while the small outside retailers charge the expected inside price. In this equilibrium, the large retailers will make their guaranteed profit of* α_2 *while the small (outside) retailers make a profit* $E_{k_2}(\alpha_1 + \gamma_1) > \alpha_1$. *The relevant reach of the institution for this Proposition is* $\tilde{S} = \beta + n_2\gamma_2$.

The purpose of this Proposition is to identify the strongest possible equilibrium condition for large retailers to join the ISA. This condition is obviously the one that pertains to the extreme case in which only large retailers are inside the ISA in equilibrium. If the difference in loyalty is not too large, only the large retailers patronize the institution. With smaller difference in store loyalty, a small retailer entering the ISA faces price competition from other retailers that are similar to itself. This reduces the potential gain for the small retailer from joining the ISA. The small retailers make greater profits staying out and charging the average inside price to attract their partial loyals. Therefore even though the small retailers do not join, the ISA has a strategic effect on the market that allows the small retailers to make more than their guaranteed profits (i.e., more profit than they would have made in a world without the ISA).

6. Institutional Implications

There is an ongoing debate about the benefits of ISA's for consumers. Many analysts agree that comparison shopping should, in general, allow consumers to find deals for search goods such as CD's, videos, or books. However, others point out that despite the rush of retailers to join shopping agents such as *mySimon* and *Jango*, these shopping agents do not necessarily give consumers the best deal.[13] Furthermore, it has been pointed out that from a consumer's perspective, the prevailing prices within ISA's have not improved (and might have actually gone up) even as retailer participation has increased over time. The preceding analysis clarifies this debate. As shown in section 3.3 an increase in consumer prices might be a natural consequence of the all-or-nothing type of competition in the electronic institution, when the reach of the institution is independent of the number inside retailers. This implies that within ISA's such as *Jango* whose reach is primarily determined by portal sites, average consumer prices can go up with more inside retailers. On the other hand in ISA's where the inside retailers have a role in drawing consumer traffic, average minimum prices can go down with the number of inside retailers (as in Figure 3a).

[13] See "Bots Don't Make Great Shoppers: Intelligent agents that search the net often miss out on the best bargains," Stephen Wildstrom, Business Week, 12/07/1998.

The paper highlights a central trade-off created by the ISA. Only some retailers decide to join the ISA while others simultaneously choose to stay out. The question of which of these strategies is the best for a retailer has been a subject of much controversy among industry experts. Glover Ferguson a director of the e-commerce program at Anderson Consulting, has mentioned that retailers would balk at joining an ISA because "...nobody wants to be reduced to a commodity.." However, a contrary view that retailers have no choice but to join bots is presented by Venky Harinarayan of *Junglee* "....as consumers start moving to the medium, you have to follow them if you are a retailer..".[14] Our paper indicates that the extreme scenarios painted by analysts are unlikely to be the ultimate outcome as the ISA institution takes root. We provide a rationale for why some retailers that join the institution might continue to co-exist in equilibrium with retailers that choose to stay out. After the emergence of the ISA institution, the inside and outside retailers endogenously segment the consumer market.

The paper also shows that retailers of search goods such as CD's and books can immunize themselves against ISA's only by protecting their store loyals. Recent articles in the trade press discuss this issue and mention that retailers will have to improve services and offer added values to their shoppers if they want to keep them (see "The Attack of the Robots, *The Wall Street Journal*, 12/07/98). However, fewer online merchants currently block successful ISA's such as *mySimon* than even a year ago. This has been attributed to fact that these ISA's have invested in increasing the traffic to their sites (see "Agents Go Price Shopping," *InternetWeek*, 12/07/98). Consistent with the predictions of the paper, if the ISA's are successful in attracting shoppers to their sites and chiseling away at the store loyals, we should expect fewer Internet merchants to resist moving over to the institution.

It is useful to link certain aspects of competition in an ISA to competition in the brick-and-mortar world. The ISA brings the k retailers returned in a search in direct competition with each other because it allows the consumers to see in a single search the prices of all the retailers. There are similarities between an ISA and the phenomenon in the brick and mortar world of a central market or bazaar in which all retailers of a given type cluster together in physical location. However, this phenomenon is a somewhat different problem because in the conventional world colocation acts as a commitment mechanism for sellers. As in Wernerfelt (1994) and Dudey (1990), competing sellers might voluntarily colocate in order to commit to not charge high prices to consumers who have already invested in the sunk cost of travel.

7. Empirical Evidence

In order to test some of the predictions of the theory we collected data on the pricing behavior of retailers in two leading portal owned ISA's (*Yahoo!Shopping* and Alta Vista's *Shopping.com*.)

[14] See "Web's Robot Shoppers Don't Roam Free," The Wall Street Journal, 09/03/1998.

between March-July 2001 and also five stand-alone ISA's (*mySimon*, *BottomDollar*, *EvenBetter*, *Bsilly* and *PriceScan*) between April-October 2000. The pricing data was collected on a bi-weekly basis in 3 different categories of homogenous goods, namely music CD's, movie videos and books.

7.1. Data Collection Methodology

For both the portal owned and the stand-alone ISA's a set of 35 items were chosen in the 3 categories as follows. For the CD category we randomly selected 10 titles using *Billboard's* top 50 list. Similarly, 10 movie video titles were chosen from *CDNow's* movie list (titles were chosen from the children, comedy and drama genres). Finally, for books the following criteria were used. We chose only hard-cover titles. A total of 15 titles were randomly chosen, 5 from the New York Times bestseller lists (fiction and non-fiction), 5 general fiction books, and 5 popular college textbooks. Note that because the data were collected in different time periods, the set of items in the stand-alone and the portal owned ISA's are not exactly identical.

For these items searches were conducted on all the chosen ISAs on a bi-weekly basis. For each search we collected the entire distribution of prices charged by the retailers returned in the search. All the ISAs report and tabulate the basic price net of shipping and handling and this is the price that is used for the analysis. We also captured the identity of the retailers in each search. A total of 50 such searches were conducted for each of the items over the seven month period in the stand-alone ISAs while a total of 35 searches were conducted over the five month period in the portal based ISA's. Thus the data consisted of $35(items) \times 5(ISAs) = 175$ time-series each containing 50 observations (snap-shots) of prices in participating stores for the stand-alone ISAs and $35(items) \times 2(ISAs) = 70$ time series each containing 35 observations for the portal owned ISAs.[15]

7.2. Testing the Predictions

We use this data to test the model prediction pertaining to probabilistic pricing by the inside retailers and the behavior of the inside prices.

7.2.1. Identity of the Retailer Charging the Minimum Price

The first objective of the exercise is to validate the prediction that retailers inside the ISA engage in mixed strategy pricing and do not adopt a fixed pricing strategy. An empirical consequence of mixed strategy pricing is that retailers change prices over time and that there is no one single store that is constantly charging the minimum price. In other words, the store charging the minimum price in the ISA changes across the periods.

[15] Note that each snap-shot consists of the prices charged by all the retailers returned by the search.

We construct three specific measures from the dataset to test this prediction. A simple measure is the average number of stores charging the lowest price at least once in the collection period. However, a more comprehensive measure will be one which not only captures the "number" of retailers in a time-series that had the lowest price, but also the share of each retailer. Such a measure will therefore be a form of concentration ratio similar to the *Herfindahl index* which is used to measure industry concentration (See Tirole 1988, p. 221). To obtain such a measure, within each time series and for each store that charged the lowest price, we calculate its proportion of the total times it was indeed the cheapest. Formally, the concentration index is the sum of the squares of these proportions for all the retailers. The inverse of the concentration index could be viewed as the "effective" number of stores with the lowest price.

The concentration index defined above does not capture one more aspect that is important for testing the prediction pertaining to the identity of the lowest price. Consider the following two hypothetical sequences of lowest price stores: $AAAAABBBBBCC$ and $ABABABCABABC$. Both sequences have 3 stores charging the minimum price and have identical concentration indices of $(\frac{5}{12})^2 + (\frac{5}{12})^2 + (\frac{2}{12})^2 = \frac{54}{144} = 0.375$. However, the two sequences differ in the amount of "switching" that exists in the identity of the lowest price retailer from one period to the next. Accordingly, consider a third measure that is switching index which records the number of times the identity of the lowest priced retailer changed (from one period to the next) in a sequence relative to the maximum number of such changes possible. The closer this index is to 1 the greater is variability in the identity of the lowest priced retailer across the periods. The first sequence has a switching index of $\frac{2}{11}$ while the second has an index of $\frac{11}{11} = 1$.

We compute all the three types of measures described above. Table 1a summarizes the three indices averaged over the stand-alone ISAs and for all items within a category, while Table 1b does the same for the portal owned ISA's. For the stand-alone ISA's, the mean number of lowest price stores across all the categories is 5.7 ranging from a high of 6.4 for books to a low of 4.8 for Music CD's. Thus across all categories and all the stand-alone ISAs there were an average of about 6 different retailers charging lowest price for the six month period in our dataset. For the portal owned ISAs we get similar results. The mean number of retailers across the 3 categories in $Yahoo!$*Shopping* is 5.8 and in *Shopping.com* is 3.9 (category-wise details are in the table).

The concentration indices also provide support for fact that no single store is the minimum priced store. The concentration index ranges from 0.43 for movie videos to 0.52 for Music CD's for the stand-alone ISAs. Recall that the inverse of the concentration index is the effective number of stores with the lowest price which is around 2 stores for the 3 categories investigated here. In $Yahoo!$*Shopping* the index ranges form 0.51 to 0.61 while in *Shopping.com* it is slightly higher. Finally, the switching indices for the three categories in both Table 1a and 1b indicate that there is considerable switching in the identity of the minimum priced retailer from one period to another.

7.2.2. Investigating the Inside Pricing

The pricing result of the paper that we test is the behavior of the average inside price charged by the firms with respect to the number of firms in an ISA. We used the following procedure to investigate average pricing behavior: First, out of the total 175 time-series pertaining to the stand-alone ISA's, 11 did not have enough variation in the number of inside retailers. The difference between the minimum and the maximum number of retailers in these time series was less than or equal to 3. We ignored them and used the remaining 164 time-series for the test. For each time series we calculated, $\bar{n}$, the average number of participating stores.[16] Next we calculated the average price (p^L) for all the time periods where the number of stores was $\bar{n}-1$ or lower and compared it to the average price (p^H) for the time periods when there were $\bar{n}+1$ stores or higher. According to the model we would expect ($p^H - p^L$) to be significantly greater than zero. We therefore conducted t-tests for the differences in the means for each of the 164 time series. Table 2a reports the results. The results as shown in Table 2a provide support for the average price result of the model. Across the three categories, 77% of the t-tests for $(p^H - p^L) > 0$ were significant at the 5% confidence level. Furthermore, there is support in each of the three individual categories. The percentage of significant t-tests vary from a low of 72% for music CD's to a high of 79% for books. Among portal-owned ISA's 61 time-series were usable (i.e. had enough variation in the number of retailers). As shown in Table 2b there is support for the hypothesis that the average price increases with the number of inside firms. Across the three categories 69% of the t-tests (for $p^H - p^L > 0$) were significant at the 5% level.

Finally, we also investigated the effect of the number of participating retailers on the average minimum prices for each category. In Table 3a we present the results for the stand-alone ISA's. The prediction in section 4 (see Figure 3a) is that the minimum inside price should decrease with the number of inside retailers for ISA's with endogenous reach. As before for each time series we calculated the average minimum price (p^L_{min}) for all the time periods where the number of stores was $\bar{n}-1$ or lower and compared it to the average minimum price (p^H_{min}) for the time periods when there were $\bar{n}+1$ stores or higher. The theory predicts that p^L_{min} will be significantly greater than p^H_{min}. We conducted t-tests to test this and report the results in Table 3a. Across the three categories, four-fifths of the t-tests were significant at the 5% level. There is also support in each of the three individual categories. In Table 3b, we report the results for portal owned ISA's. The prediction in section 3, is that the average minimum price for ISA's with exogenous reach should be increasing in the number of inside retailers. However with respect to this prediction, we find that only 48% of the t-tests are significant at the 5% level (we also checked at the 10% significance level and found 61% of the t-tests to be significant).

[16] $\bar{n}$ was rounded to the nearest integer.

8. Conclusion, Limitations and Future Research

Comparative shopping agents allow consumers to costlessly search across many retailers and buy at the lowest price. This would lead one to speculate that these agents should reduce frictions in Internet marketplaces and lead to all sellers charging uniformly low prices. Yet there is ample evidence that there can be large variations in the prices offered by sellers who participate in an ISA. Also, we find retailers rushing to join leading ISAs. But even the most popular ISA's have not been successful in attracting all the retailers in the industry. Large retailers such as $CDNow$ continue to block some shopping agents, even as other retailers join the institution and subject themselves to price competition.

Several research studies have examined the overall effect of the Internet on retail competition. Lal and Sarvary (1999) show that the impact of the Internet on price competition would depend upon the salience of attributes that are easily communicated through the Internet. Zettelmeyer (2000) shows how price competition between Internet retailers can be affected by the expanding reach of the Internet. This paper focuses on the emergence of a specific Internet institution and traces its impact on retail competition. We explain why retailers might join a comparative shopping institution and how price competition between retailers would be affected by an ISA. This institution is particularly interesting because of the all or nothing type of competition that it creates. The paper traces out the set of economic forces that govern the emergence and the functioning of an ISA.

We show that an ISA creates differentiation in pricing strategies between ex-ante identical retailers. Some retailers join the ISA motivated by the lucrative mass of consumers that they can win, while others simultaneously elect to stay out and focus on extracting surplus from their store loyals. This explains why retailers block ISA's even as others have joined the institution. One aspect of the competition that leads to this outcome is the nature of pricing practiced by the retailers that join the institution. The average price charged by retailers inside the ISA goes up with the number of retailers joining the institution.

The analysis indicates that consumers who use the ISA get substantially lower prices than consumers who don't. However, the average prices paid (minimum posted prices) by consumers inside the institution can increase or decrease when more retailers join the ISA, depending upon whether or not the reach of the ISA is independent of the number of joining retailers. We also show that when the reach of the institution is endogenous and when the traffic in the ISA confers complementary side-benefits, there can exist a unique number of retailers who will join the institution. If the incremental side-benefits from additional retailers joining is substantial, the ISA will strategically plough back a portion of the side-benefits into the retail market, creating a situation in which not only the ISA and the inside retailers gain, but also the outside retailers are better off than in a world without the ISA. Our analysis of retailer heterogeneity helps to specify what type of retailers might join the ISA. We identify conditions under which retailers with smaller store loyalty are more likely to join as opposed to conditions where only large retailers join the institution.

Several interesting issues can be further explored. One such issue is the impact of an ISA on the incentives of retailers to endogenously invest in loyalty. Internet retailers invest on customer service, efficient delivery, site reviews etc., in an attempt to generate customer loyalty. One can think of an extension to our model wherein retailers decide on costly investments in loyalty as well as on whether or not to join the ISA (where joining implies a payment to the ISA). An interesting task would be to analyze the conditions under which the ISA creates asymmetric behavior among retailers: Some retailers invest less in loyalty but pay to join the ISA and take advantage of the traffic within, while others invest more and stay out. Another interesting issue is the analysis of dynamic competition in an ISA. As in switching cost models each retailer might compete for old consumers who have previously purchased from the retailer as well as new consumers who have not (as in Klemperer 1987). Old consumers have costs of switching away from their current firm. Retailers can use the institution to attract customers in a current period who then are willing to pay more in a future period. Retailers might charge low current period prices in the ISA to lock-up consumers. Additionally, as the number of inside retailers increases, competition for consumers who will be valuable in the future can become more intense leading to lower prices in the ISA. Another interesting issue not addressed in the current paper is accounting for the non-price aspects of competition among Internet retailers. These include dimensions such as shipping quality and costs, return policies and payment options. On the empirical side, data on these variables will be useful to investigate their impact on retail pricing in the ISA. The role of non-price competition among retailers and the fact that some retailers might have cost advantages for providing non-price attributes would also be useful to investigate. Finally, other questions for future research include investigating competition between several ISA's. As well as the effect of the recent practice by some retailers such as *Amazon.com* to allow for limited price comparisons within their web-site.

APPENDIX

Proof of Proposition 1:

Price Equilibrium Given k Inside Retailers

First we look for a symmetric equilibrium of the competition between the "inside" retailers given that k of them have joined. The guaranteed profit of each of the k retailers if they charge the reservation price will be $\frac{\alpha(k)}{n}$.

A possible totally mixed equilibrium strategy is the following: Retailer j can charge a price according to some continuous c.d.f $F_j(p)$ with support between 1 and a lower bound z_j. Let $W_j(p)$ be the probability that retailer j charges a price above p ($W_j(p) = 1 - F_j(p)$). Assume that the partial loyal segment of size γ buys from within the institution.[17] Given this, retailer j when charging a price p makes an expected profit of:

$$p\frac{\alpha(k)}{n} + pr(k)\prod_{h \neq j} W_h(p) \tag{i}$$

The first term in the expression is the profit a retailer makes from its store loyal customers whereas the second term is the profit which the retailer makes provided it had the lowest price among the k retailers in the ISA (in which case it will capture the entire customer base $r(k)$).

In order for any mixed strategy profile to be a Nash equilibrium it is required that each retailer, given the distribution of strategies chosen by the other retailers, is indifferent between all possible pure strategy prices (i.e., the retailer must make the exact same profit for each price it charges in the support of the distribution $F_j(p)$.) In a symmetric equilibrium we have $W_j(p) = W(p)$ and $z_j = z$ for all j. Therefore we have,

$$p\frac{\alpha(k)}{n} + pr(k)(W(p))^{k-1} = c \tag{ii}$$

where c is a constant.

If retailer j charges the reservation price 1, it will not sell to the $r(k)$ ISA shoppers and will make a profit of $\frac{\alpha(k)}{n}$. Therefore, $c = \frac{\alpha(k)}{n}$. By charging the lower bound z the retailer will get:

$$z\frac{\alpha(k)}{n} + zr(k)(1)^{k-1} = c = \frac{\alpha(k)}{n} \tag{iii}$$

Solving for z and $W(p)$ we get the expressions given in the proposition.

Equilibrium Entry of Retailers

Assume that there are k have joined the institution in equilibrium. Now consider a retailer that decides to stay out. To show this note first that the retailer has two possible pure strategies. It can charge the reservation price and sell only to its store loyals for a profit of $\frac{\alpha}{n}$. Alternatively, it can reduce its price to just below the average inside equilibrium price, $E_k^*(p)$. In which case it will attract its partial loyal consumers (whose size is

[17] Later on we prove that this indeed is the case in the equilibrium.

$\frac{\gamma}{n}$) for a profit of $E_k^*(p) \times (\frac{\alpha+\gamma}{n})$. In equilibrium, the outside retailer will choose the reservation price as long as

$$\frac{\alpha}{\alpha+\gamma} \geq E_k^*(p) \qquad \text{(iv)}$$

Let k^* solve (iv) with equality. Then, the condition holds for every $k < k^*$ because $E_k^*(p)$ is increasing in k. Suppose, (iv) does not hold. Then the outside retailer will choose to cut its price to just below $E_k^*(p)$, preventing the reservation price for the outside retailer from being a part of the equilibrium strategy. However, charging just below $E_k^*(p)$ cannot be part of an equilibrium strategy for an outside retailer because it will induce the inside retailers that make only $\frac{\alpha}{n}$ to leave. Thus, (iv) and the inside price distribution given in Proposition 1 determine the equilibria. Note that (iv) guarantees that all the partial loyals will indeed find the prices inside cheap enough to shop within the ISA. This establishes the remark in footnote 16.

Finally, in this model the outside retailers cannot mix between the two possible pure strategies in equilibrium. In equilibrium $k \leq k^*$ and this ensures that the reservation price strategy is always strictly dominating.

Proof of Result 1: It follows from direct differentiation of the expression for $E_k^*(p)$.

Proof of Proposition 2: In this case the condition in (iv) reduces to $E_k^*(p) \leq \frac{n-k}{n-k(1-\delta)}$. As before we can determine a k^* which is the maximum possible number of inside retailers. However, given that $B(r(k)) > 0$ and increasing in k, the ISA has the incentive to ensure that the maximum number of retailers join the institution. This can be achieved by the ISA announcing the following side-payment schedule: For every $k \leq k^*$, each retailer joining will receive a side-payment of arbitrarily small size $\epsilon > 0$. This is a necessary condition to ensure that k^* will strictly prefer to join.

Next we establish the sufficient condition for k^* to be an equilibrium. This requires establishing the condition that ensures that the ISA does not find it optimal to induce any $m > k^*$ retailers to join. Suppose some $m > k^*$ retailers were to join. Then by the definition of k^*, the expected inside price will be so large that the outside retailers will find it optimal to deviate from the reservation price strategy and charge $E_m(p)$. In this case, any outside retailer will make profits of $\frac{\alpha(m)+\gamma(m)}{n}E_m(p)$, which is greater than the inside profit. Therefore, no retailer will want to join unless the ISA makes a non-negligible lump-sum side-payment which equalizes the inside and the outside profits. Therefore the equilibrium side payment will have be $L(m) = \frac{\gamma(m)}{n}E_m(p)$. For k^* to be an equilibrium, the ISA must not find it profitable to offer $L(m)$. This will be the case if $B(r(m)) - L(m)m < B(r(k^*)) - \epsilon \ \forall \ m$. Given that ϵ is arbitrarily small, we get the sufficient condition reported in part 'a' of the Proposition. Part '2' of the proposition is obvious for the case when $B(r(m)) - L(m)m > B(r(k^*)) - \epsilon$ for a non-empty set M of all possible $m > k^*$.

Proof of Proposition 3: Assume to the contrary that there are only some k_2 retailers that are all of the "large" type inside. Then using arguments that are analogous to that in Proposition 1 each will make a (guaranteed) profit of α_2. Furthermore, at least a sub-set of the retailers will mix according to the distribution function specified in the proposition with lower support $z = \frac{\alpha_2}{\alpha_2+S}$, where S is the number of consumers who shop in the institution in equilibrium ($S \geq \beta$). Consider now the incentive of a small (outside) retailer. It can either charge the reservation price and make a profit of α_1. In this case joining the ISA and pricing at z will guarantee that this retailer will win all of $S = (1-\alpha)$ yielding a profit of $z(S+\alpha_1) = \frac{\alpha_2}{\alpha_2+S}(S+\alpha_1) > \alpha_1$. Alternatively, it can charge $E_{k_2}^*$ and make a profit of $(\alpha_1+\gamma_1)E_{k_2}^*$. In this case joining the ISA and pricing at

z will guarantee that this retailer will win all of S yielding a profit of $z(S + \alpha_1 + \gamma_1)$. Therefore this retailer will join if $z(S + \alpha_1 + \gamma_1) > (\alpha_1 + \gamma_1)E^*_{k_2}$ which holds given the sufficient condition in the proposition. This proves the first part of the proposition.

Consider now the case where there are two or more small retailers. Using exactly identical arguments as above, at least one of them will go in. Suppose it was the case that only one small retailer is in. Then this small retailer will behave exactly as described in Proposition 1, and charge the minimum price of $z = \frac{\alpha_2}{\alpha_2 + S}$. However, if only one small retailer is in, any one of the other small retailers has an incentive to join as well and price at $z - \epsilon$, because this will to get a profit which is higher than α_1. Hence in equilibrium, at least two small retailers will join. Using standard arguments it can be easily shown that the inside retailers will compete away all but their guaranteed profits α_1, which completes the proof.

Proof of Proposition 4 : We provide a sketch of the proof. The proof is best illustrated using the example of 2 small and one large inside retailer. The proof for the general case of $k_1 \geq 2$ small retailers and k_2 large retailers is completely analogous. It can be shown that not all the retailers can charge a mass point. Otherwise as in Varian (1980), one of the retailers will have the incentive to undercut when the others are charging the mass point and win all the consumers. Similarly, it can't be the case that a small retailer charges the mass point while the other small retailer(s) do not because, then the focal small retailer can improve its expected profit by cutting price. So no small inside retailer can have a mass point in equilibrium. Similar to Varian (1980), each small retailer charges a price according to $W(p) : p \in (1, z_1)$, where $z_1 = \frac{\alpha_1}{\alpha_1 + s}$ and s is the relevant reach of the institution (note: $W(p)$ is the probability of charging a price above p).

Suppose that the large inside retailer charges according to some distribution $V(p) : p \in (1, z)$ where $z_1 < z_2 < z$, $z_2 = \frac{\alpha_2}{\alpha_2 + s}$ ($V(p)$ is the probability of charging a price above p.) Note that the guaranteed profits are exactly α_1 for the small retailers (because any excess profits will be competed away) and at least α_2 for the large retailer. Now consider that a large inside retailer charges ϵ above z. Then we have $z(\alpha_2 + sW^2(z)) \geq \alpha_2$, which implies

$$\alpha_2 \leq \frac{sW^2(z)}{(1 - z)} \tag{v}$$

Now consider a small retailer charging ϵ above z. From the property of the mixed strategy equilibrium $z(\alpha_1 + sW(z)V(z)) = \alpha_1$, which implies

$$\alpha_1 = \frac{sW(z)V(z)}{(1 - z)} \tag{vi}$$

For arbitrarily small ϵ, $V(z) \to 1$, this combined with (v) and (vi) implies $\alpha_1 > \alpha_2$ which is a contradiction. This contradiction holds for every $z \in (1, z_2)$. Thus the large retailer must charge the reservation price with probability 1. The same method of proof can be used for the general case of $k_1 \geq 2$ small retailers and k_2 large retailers reported in the proposition. A detailed proof of this available from the authors on request.

Proof of Proposition 5: Suppose the equilibrium has only some k_2 inside large retailers playing a mixed strategy with the lower support at $z = \frac{\alpha_2}{\alpha_2 + \tilde{S}}$ guaranteeing a profit of α_2 to each where $\tilde{S}$ is the reach of the institution in equilibrium. The large outside retailers have no incentive to deviate from their strategy of charging the reservation price. The small outside retailers by charging E_{k_2} make a profit of $E_{k_2}(\alpha_1 + \gamma_1)$. If they decide to enter the best they can do is charge a price of z in which case they will get all the inside customers and a profit of $\frac{\alpha_2}{\alpha_2+\tilde{S}}(\tilde{S}+\alpha_1+\gamma_1)$. Given the condition in the proposition this deviation is not profitable. We now must guarantee that the small outside retailers do not want to stay out and price at the reservation value. In this case their profit will be just α_1. Hence as long as $E_{k_2}(\alpha_1+\gamma_1) \geq \alpha_1$ they have no incentive to deviate. As E_{k_2} is increasing in k_2, there is a minimum number of inside retailers $k_{2\,\min}$ such that for every $k_2 > k_{2\,\min}$ the equilibrium holds. Finally, if the equilibrium holds the reach of the institution can be easily computed to be $\tilde{S} = \beta + n_2\gamma_2$, from the assumption of consumer behavior in the model.

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Store	Price	Remarks
CDBargains	8.99	Store Special
CDBargains	12.99	Regular Price
CDLand	****	The search function is temporarily out of service (since at least 2/18/99).
CDMusic	$12.40	
CDnow	****	Blocking out our agents. You may want to try browsing there yourself.
CDworld	$13.47	
Emusic	$13.97	Good Availability
MassMusic	****	Blocking out our agents. You may want to try browsing there yourself.
NetMarket	$11.99	Ships in 24 hours
SecondSpin	****	I could not find it. You may want to try browsing there yourself.

Figure 1a: Search results for "Dreaming of You" by Selena using Arthur Anderson's *Bargain Finder*

mySimon : Books Search Results

Departments GO

home > books, music & movies > books > search results

Did you know that results can be SORTED alphabetically or numerically? Click on the column names to sort!
Tips

9 results returned in total
9 results on this page
30 merchants today in books

Total Pages: 1
For more than 1 page, scroll to the bottom and click "More Results!"

Merchant	*Author*	*Title & Description*	*Price*
amazon.com	Drew Fudenberg, David K. Levine (Contributor)	The Theory of Learning in Games (Economics Learning and Social Evolution, 2) **Condition:** New **Format:** *Hardcover* **Availability:** Usually ships within 24 hours.	$32.95 BUY!
All Direct	Drew Fudenberg , David K. Levine	The Theory of Learning in Games **Condition:** New **Format:** hardcover	$32.29 BUY!
Kingbooks	Fudenberg, Drew	The Theory of Learning in Games **Condition:** New **Format:** Hardcover	$31.96 BUY!
varsitybooks.com	Fudenberg, Drew / Levine, David K.	The Theory of Learning in Games (Economics Learning and Social Evolution, 2) **Condition:** New **Format:** Hardcover **Availability:** In Stock	$28.01 BUY!
a1Books	Fudenberg, Drew / Levine, David K.	The Theory of Learning in Games **Condition:** New **Format:** Hardcover	$32.95 BUY!
barnesandnoble.com	Drew Fudenberg David K. Levine	The Theory of Learning in Games **Condition:** New **Format:** Hardcover **Availability:** In-Stock: Ships 2-3 days	$32.95 BUY!
intertain.com	Fudenberg, Drew/ Levine, David K	The Theory of Learning in Games (Economics Learning and **Condition:** New **Format:** Hardcover	$26.95 BUY!
AlphaCraze.com	Fudenberg, Drew / Levine, David K.	The Theory of Learning in Games (Economics Learning and Social Evolution, 2) Publication Date: May 1998 **Condition:** New **Format:** Trade hard cover **Availability:** *Ships in 1 business day*	$29.66 BUY!
Books.com	Fudenberg, Drew (With:Levine, David K.)	The Theory Of Learning In Games **Condition:** New **Format:** Hardcover **Availability:** In Stock	$32.90 BUY!

home > books, music & movies > books > search results

Figure 1b: Search results for "The Theory of Learning in Games" by Fudenberg and Levine using *MySimon*

Figure 2

(40 firms; 30% hard-core loyal customers different values of *k*)

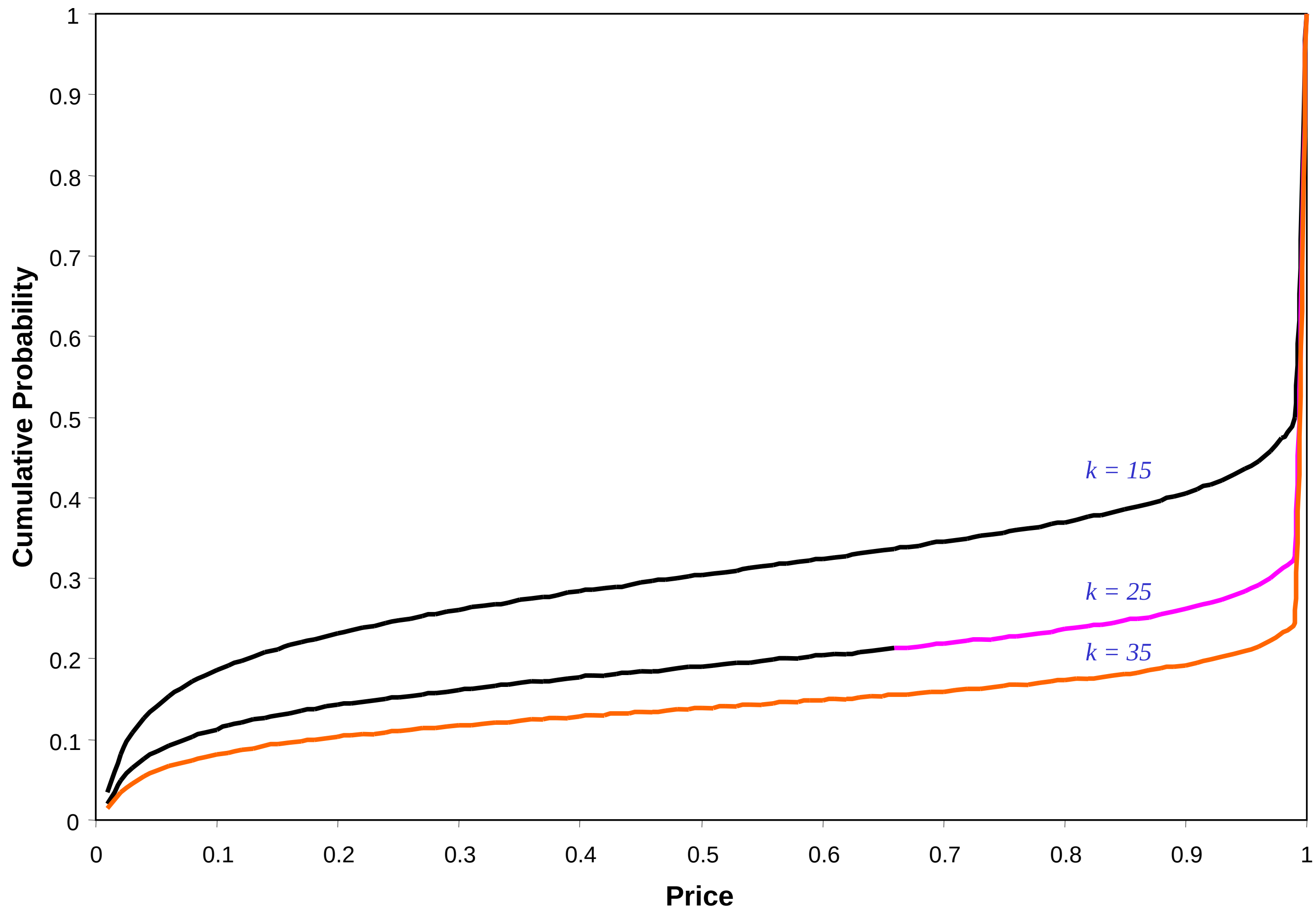

Figure 3a: Average and Minimum Prices

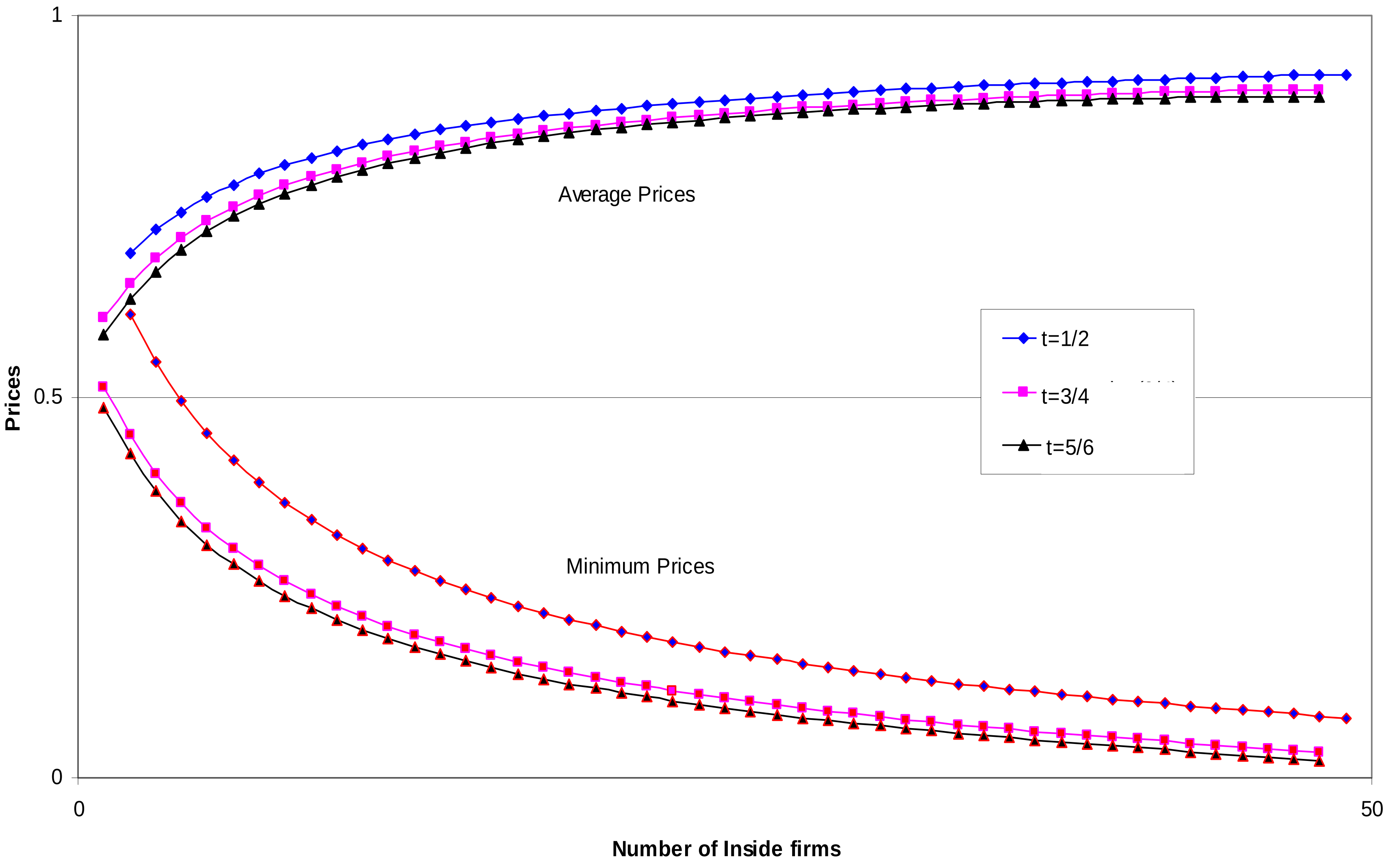

Figure 3b: Equilibrium Number of Inside Firms

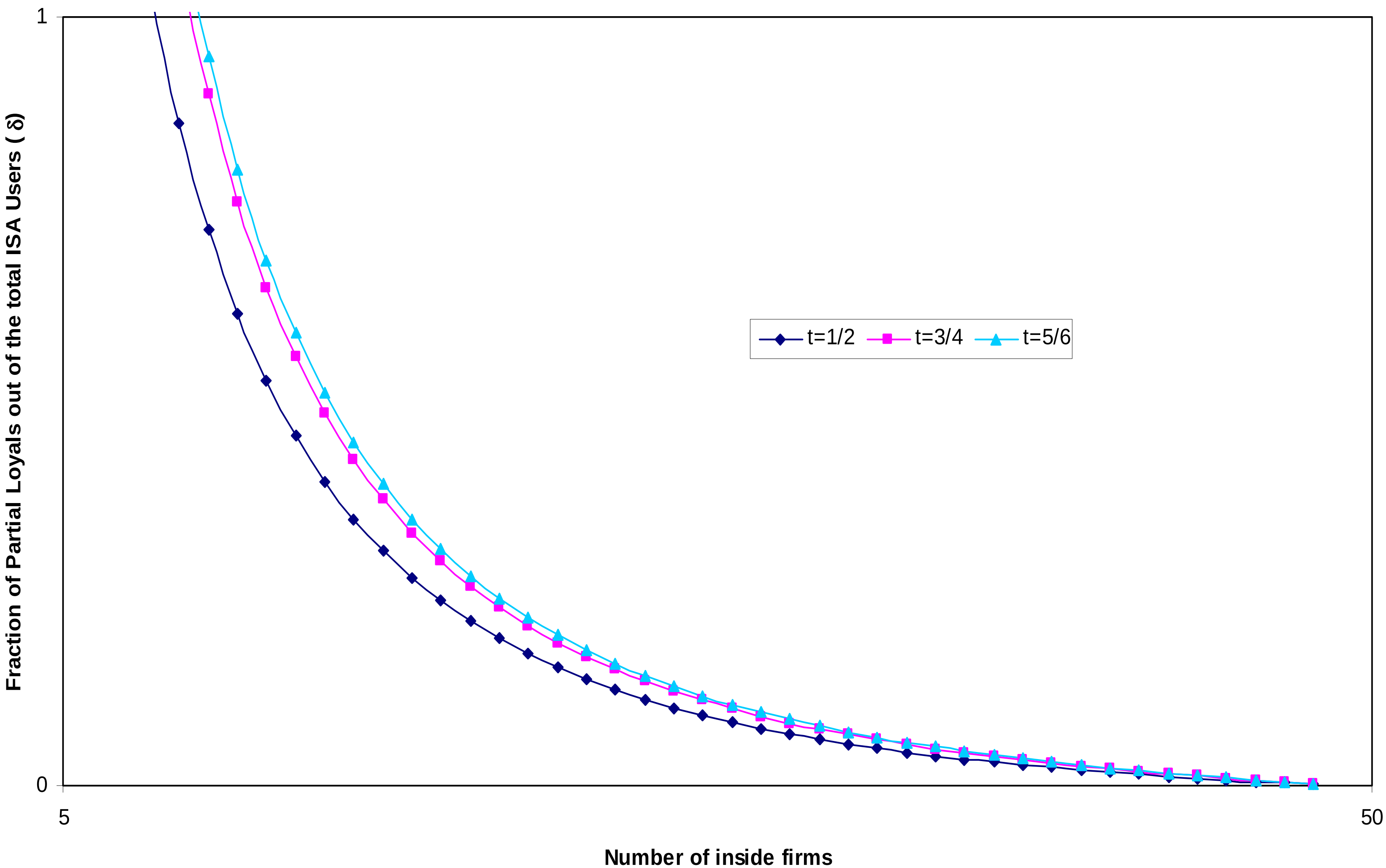

Table 1a: Measures to Test Probabilistic Pricing in Stand-Alone ISAs

	Books	**Music CD**	**Movie Videos**
Mean Number of Lowest Priced Stores (per Time-series)	6.4 (2.6)	4.8 (1.8)	5.5 (2.1)
Concentration Index	0.45 (0.19)	0.52 (0.17)	0.43 (0.22)
Switching Index	0.74 (0.30)	0.65 (0.19)	0.70 (0.22)

Table 1b: Measures to Test Probabilistic Pricing in Portal-Based ISAs

Yahoo! Shopping

	Books	**Music CD**	**Movie Videos**
Mean Number of Lowest Priced Stores (per Time-series)	6.2 (2.8)	5.2 (2.1)	6.0 (2.5)
Concentration Index	0.51 (0.30)	0.61 (0.20)	0.53 (0.25)
Switching Index	0.67 (0.27)	0.62 (0.20)	0.65 (0.21)

Shopping.com

	Books	**Music CD**	**Movie Videos**
Mean Number of Lowest Priced Stores (per Time-series)	2.9 (1.1)	4.3 (1.5)	4.1 (1.6)
Concentration Index	0.70 (0.32)	0.65 (0.23)	0.66 (0.24)
Switching Index	0.55 (0.31)	0.58 (0.24)	0.62 (0.19)

Table 2a: Average Retail Price Behavior in Stand-Alone ISAs:

	Books	**Music CD**	**Movie Videos**	**Overall (Across all Categories)**
# series with significant $p^H > p^L$ at $(\alpha < 0.05)$	56	34	36	126
Total number of time- series in the category	71	47	47	164
% of time-series with significant $p^H > p^L$	79%	72%	77%	77%

Table 2b: Average Retail Price Behavior in Portal-Based ISAs:

	Books	**Music CD**	**Movie Videos**	**Overall (Across all Categories)**
# series with significant $p^H > p^L$ at $(\alpha < 0.05)$	14	9	7	30
# series with significant $p^H > p^L$ at $(\alpha < 0.10)$	19	12	11	42
Total number of time- series in the category	27	17	17	61
% of time-series with significant $p^H > p^L$	70%	71%	65%	69%

Table 3a: Average Minimum Price Behavior for Stand-Alone ISAs

	Books	**Music CD**	**Movie Videos**	**Overall (Across all Categories)**
# series with significant $p^H_{\min} < p^L_{\min}$ at $(\alpha < 0.05)$	58	37	39	134
Total number of time- series in the category	71	47	47	164
% of time-series with significant $p^H_{\min} < p^L_{\min}$	82%	79%	83%	82%

Table 3b: Average Minimum Price Behavior in Portal-Based ISA's

	Books	**Music CD**	**Movie Videos**	**Overall (Across all Categories)**
# series with significant $p^H_{\min} > p^L_{\min}$ at $(\alpha < 0.05)$	13	8	8	29
# series with significant $p^H_{\min} > p^L_{\min}$ at $(\alpha < 0.10)$	16	10	11	37
Total number of time- series in the category	27	17	17	61
% of time-series with significant $p^H_{\min} > p^L_{\min}$ at $(\alpha < 0.05)$	48%	47%	47%	48%