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Referral Infomediaries and Retail Competition

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ABSTRACT

An important phenomenon on the Internet has been the emergence of "infomediaries" or Internet referral services such as Autobytel.com and Carpoint.com in the automobile industry, Avviva.com in real estate and Healthcareadvocates.com in medicine. These services offer consumers the opportunity to get price quotes from enrolled brick-and-mortar retailers as also information on invoice prices, reviews and specifications before they commence the shopping process. Internet referral services also direct consumer traffic to particular retailers who join them.

The view of industry analysts and practitioners is that these services are a boon to consumers who can use them to get better prices from retailers. What is less clear though is the manner in which these infomediaries affect the market competition between retailers. In this paper, we analyze the impact of referral infomediaries on the functioning of retail markets and the contractual arrangements that they should use in selling their services. We identify the market conditions under which the business model represented by these services would be viable and also provide an understanding of how this institution would evolve with the growth of the Internet.

The model that we develop captures the key economic characteristics that define an Internet referral infomediary. On the consumer side, a referral infomediary performs the function of "price discovery": a consumer can use the service to costlessly get an additional retail price quote before purchase. On the firm side, a referral service endows an enrolled retailer with the ability to price discriminate between consumers who come through the service and those who come directly to the store. Specifically the model consists of a referral infomediary and a market with two downstream retailers who compete in price. The retail market is comprised of three consumer segments: a segment loyal to each retailer and a comparison shopping segment that shops on the basis of the lowest price. The referral infomediary reaches some proportion of the total consumer population and this characterizes the reach of the Internet in this market.

The impact of the infomediary on the market is best illustrated by the case in which one of the retailers is enrolled in the institution. We show that the referral price will always be lower than the retail store price offered by an enrolled dealer. The incentives of the retailer while setting the on-line referral price are driven not only by the comparison shoppers who search at both stores, but also the consumers who would have searched only at the competing store. Thus the use of a referral service as a price discrimination mechanism leads to lower online prices.

Next, the profits of the enrolled dealer first increase and then decrease with the reach of the institution. One might find this surprising because the referral service provides the enrolled retailer the benefit of price discrimination as well as the benefit of additional demand (because the retailer gets the opportunity to quote a price to all online customers, some of whom were not previously accessible). However, the referral service also creates a competitive effect because it helps an enrolled retailer to poach on its competitor's customers

who were previously unavailable. The strategic response by the competitor is to price aggressively in order to protect its loyal base and this intensifies price competition leading to lower equilibrium profits. This competitive effect increases with the reach of the infomediary. As a result, the profits of the enrolled retailer first increases and then decreases with the reach of the referral infomediary.

We also show that the referral infomediary should prefer an exclusive strategy of allowing only one of the two retailers to enroll. A non-exclusive strategy implies that consumers who use the service will get referral prices from both retailers leading to Bertrand type competition for these consumers.

Interestingly, we find that the referral service can unravel (in the sense that neither retailer can get any net profit from joining) when its reach becomes too large. In this case, any retailer that joins can poach upon a large proportion of its competitor's customers leading to intense price competition. Consequently, the joining firm will make less profits than if it had not joined. This provides a rationale for the current attempts by firms such as Autobytel to diversify aggressively into additional service areas.

We extend the model to the case where the referral infomediary can identify the different consumer segments and show that consumer identification can prevent the infomediary from unraveling when the reach of the institution increases. Finally, we extend the model to the cases in which retailer loyalty is asymmetric and in which the reach of the Internet can vary across the different segments.

Keywords: Referral Services, Infomediaries, Internet, Price Discrimination, Retail Competition.

1. Introduction

The exponential growth of the Internet is an important business development of the last decade. Electronic commerce is expected to go up to as much as 1 Trillion dollars by 2002 (as noted by John T. Chambers, the CEO of Cisco systems in October 1998).[1] The growth of e-commerce has been accompanied by radical changes to the traditional ways of doing business. The emergence and growth of the so-called "infomediaries" such as Autobytel.com and Carpoint.com in the automobile industry, Avviva.com in real estate, Austinlrs.com in legal services, and Healthcareadvocates.com in medicine evidence the impact of these institutions on the functioning of conventional markets.

The performance of these infomediaries and their impact on the traditional retail marketplace has perhaps been most closely watched in the automobile industry. These infomediaries (or Internet referral services) such as Autobytel.com, Autovantage and Carpoint p with information on invoice prices, specifications, reviews, and the opportunity to get a price quote from a local retailer who is enrolled with the service. These third-party referral infomediaries are rapidly changing the way consumers shop and buy their cars. A J.D. Powers study in July 1999 reported that retailers collected an average of 37 leads a month from Internet referral services and closed an average 15% of them. Forrester Research reports that more than two million households used these Internet companies to research car purchases and estimates that 50% of new car buyers will research purchases on-line in the next five years. A recent Consumer Reports survey (Wall Street Journal, March 17, 2000) also indicates that consumer experience with these infomediaries has been positive and that 60% of those who used this service to generate a price quote will go back to them in the future. In fact, the National Automobile retailers Association (NADA), after fighting with these independent Internet services for several years, has finally decided to launch its own car-shopping web-site (Wall Street Journal, March 16, 2000).

The conventional wisdom on these Internet referral infomediaries is that they are a godsend to consumers because consumers can now use these services to research car prices and get binding price quotes from retailers. What is less clear is the impact of these intermediaries for the retailer and for retail competition. Consider the impact of referral infomediaries on retailers. Opinions range from the one extreme as articulated by a retailer (Framingham Ford) ".....You will always need (a salesperson and a brick and mortar facility) to show you (the consumer) the product and features when you are buying a piece of equipment between $15,000 and $40,000" to the other extreme "...the beginning of a never ending nightmare" (Wall Street Journal, July 12, 1999). A recent survey by J.D. Power found that 48% of the retailers surveyed perceived Internet referral services to be a threat to the existing system. This diversity of perspectives on the impact of these infomediaries is perhaps a reflection of the relative infancy of this phenomenon. However, it also points to the need for theoretical analysis of the phenomenon. Our hope is to contribute to a better understanding of this Internet institution and its implications.

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[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.

1.1. Infomediaries: Key Research Issues

In established markets (such as the one for automobiles), referral infomediaries primarily re-allocate existing customers between retailers in a geographical market. Consumers are not likely to purchase more cars just because of the emergence of a referral service. This reallocation of customers obviously impacts retail competition and thereby retailer profits. This raises a series of research problems. For instance, how will these intermediaries change the functioning of the retail market and the nature of retail competition? What type of contractual arrangements should these intermediaries use in selling their services to retailers? Under what market conditions will the business model represented by referral infomediary be viable? What are the implications of growing reach of e-commerce for these institutions?

The model that we develop to study these issues captures two economic characteristics that define a referral institution. On the consumer side, a referral infomediary performs the function of "price discovery." A consumer who uses the service can costlessly get an additional retail price quote before purchase. On the firm side, a referral service endows enrolled retailers with a price discrimination mechanism. A retailer that joins a referral service has the ability to price discriminate between consumers who come through the service and those who come directly to the retail store.

We examine how the infomediary affects the competition between retailers in a market as also incentives of an individual retailer to enroll. We also investigate the optimal contractual policy that a referral infomediary should use to sell its service. *Conceptually, this is the problem of how a seller should contract for the sale of a price discrimination mechanism.* The literature on price discrimination has dealt with how firms can price discriminate between different groups of consumers and on the efficiency of different types of discrimination mechanisms. This paper goes beyond the question of "how" a firm can price discriminate to investigate the manner in which a vendor can market the ability to price discriminate in an imperfectly competitive market. We investigate whether the referral infomediary should grant geographical exclusivity to a retailer as opposed to adopting a non-exclusive policy. This question is relevant because there is significant variation in the policies adopted by different automobile referral services. Autobytel, the largest and perhaps the most successful Internet referral service offers geographical exclusivity to its retailers. In contrast, firms such as AutoWeb and AutoVantage have adopted a non-exclusive policy in most areas.

1.2. Brief Overview of Model, Intuition and Key Results

Our model consists of a referral infomediary and a market with two downstream retailers who compete in price. In the absence of the infomediary the market is comprised of three segments: a segment loyal to each retailer and a comparison shopping segment that shops on the basis of the lowest price. The referral infomediary is modeled an independent entity that reaches some proportion of the total consumer population (a function of the reach of the web among consumers in this market) and it performs the following functions: a) It allows consumers to costlessly get a binding price quote from the enrolled retailer(s). b) It

allows an enrolled retailer the ability to price discriminate between consumers who come via the referral service and consumers who come directly to the retail store.

The impact of the infomediary on market competition is best illustrated by the case in which only one retailer is enrolled in the institution. The enrolled retailer has the ability to offer a referral price as well as a brick-and-mortar retail price to consumers who come directly to the store. In contrast, the other retailer can only offer a store price. This endogenously changes the behavior of consumers who use the institution. Consumers who would have shopped at the enrolled retailer in the absence of the infomediary can now choose from the lower of the referral and store price at that retailer. Consumers who would have shopped at the non-enrolled retailer in the absence of the infomediary will now be able to choose from the lower of that retailer's store price and the referral price. The comparison shoppers who originally searched both the stores will now be able to choose from the lowest of the two store prices plus the referral price. The behavior of consumers who do not use the Internet referral institution remains unchanged.

The analysis of the impact of the infomediary on consumer behavior and retail competition leads to several interesting implications.

- *Retail Prices:* The referral price (i.e., price quote to the consumer who approaches retailer via the web) will always be lower than the retail store price offered by the enrolled retailer. The incentives of the retailer while setting the on-line referral price is driven not only by the comparison shoppers who search at both stores, but also the consumers who would have searched only at the competing store. Consequently, consumers who get a referral are more price elastic than those who do not. Thus the use of the referral service as a competitive price discrimination mechanism leads to lower online prices.

- *Retailer Profit:* The profits of the enrolled retailer are in the form of an inverted U w.r.t. to the reach of the referral infomediary: i.e., profit first increases and then decreases with the reach of the institution. The intuition is as follows. The enrolled retailer's profit is governed by three effects. The retailer enjoys the benefit of a *demand effect* because it gets the opportunity to quote a price to all the online consumers, among whom some were previously not accessible to the retailer. The benefit from this demand effect increases with the reach of the institution. However, the referral infomediary also creates a *competitive effect* because it enables the enrolled retailer to poach on the competitor's customers. The strategic response of the competing retailer is to price aggressively in order to protect its customer base. This increases the intensity of price competition and has negative impact on retailer profit. Finally, there is a *price discrimination effect*. The enrolled retailer can price discriminate the users and non-users of the referral infomediary through offering a different online referral price from its store price enabling better surplus extraction from the market. This effect has a positive impact on the profit of the enrolled retailer. The benefit derived from price discrimination reaches its maximum when the sizes of the infomediary users and non-users segments are relatively close. Thus the benefit of the price discrimination effect for the enrolled retailer increases and then

decreases as the reach of the referral institution increases. Consequently, when the reach of the referral infomediary is small enough, the benefit from the increased demand and price discrimination ability for the enrolled retailer dominates the cost of the increased competition created by the referral institution. This results in the retailer's profit increasing with the reach of the institution. However, as the reach of the referral institution further increases the price discrimination benefit diminishes and retail competition becomes so intense that profit of the enrolled retailer declines with increasing reach.

- *Infomediary Contracting Strategy:* We find that the referral institution will prefer an exclusive strategy (of allowing only one of the retailers to enroll). A non-exclusive strategy implies that consumers who use the web will get referral prices from both retailers. This creates Bertrand-type competition for these consumers. Consequently, once either one of the retailers becomes a member, the other retailer will make greater profits staying out even if the institution owner allows access for free. This result is supported by the available anecdotal evidence. Autobytel's has consistently offered geographical exclusivity to its member retailers and industry experts have pointed to this as being one of the reasons why Autobytel has emerged as the largest and most profitable referral service. In contrast, firms such as AutoVantage and AutoWeb, that have used the non-exclusive approach have been less successful.

- *The Impact of Increasing Reach of the Internet:* The analysis also provides insight into how this institution might evolve in the future. We find that the referral institution can unravel (in the sense that no retailers can gain any net profit from joining the institution) when its reach becomes very high. In this case, any retailer that joins the institution will be able to poach on a large proportion of the competitor's customers. The resulting price competition is so intense that the joining firm will make no net profit than if it had not joined. Consequently, a retailer will not join even if the referral infomediary allows access for free and the institution unravels as a result. It is perhaps this issue that is at the heart of the current attempts by referral services such as Autobytel to diversify into additional service areas such as financing and after-market services.

We also extend the model to the case where the referral service can identify consumers of different segments and find that with customer identification the institution can exist for always values of reach. This implies that referral services can make complementary investments in consumer identification as the reach of the institution increases. Finally we extend the basic model to accommodate asymmetry in retailer loyalty and also examine the case where the reach of the Internet varies across the comparison shopping and the retailer loyal segments.

The rest of the paper is organized as follows. Section 2 reviews the related research and Section 3 presents the basic model (i.e., the market without an Internet referral infomediary). Section 4 examines the consequence of the infomediary. Section 5 develops extensions to the infomediary model setting. Section 6 concludes with a brief summary and directions for future research.

2. Related Research

Our theoretical analysis of the referral infomediary as a price discrimination and demand re-allocation mechanism in a competitive market shows that Internet referral prices can be lower than the prices offered to consumers who do not use these services. Recently Scott Morton, Zettelmayer and Silva Risso (2001) have used transaction data obtained from Autobytel to compare online prices to retailer showroom prices and find that on average customers with an Autobytel referral pay 2% less for their cars. They attribute this result to Autobytel selecting low-cost retailers, the bargaining power of the referral service and to lower costs of serving an online customer.

There are also some other papers which have empirically investigated the impact of the Internet on prices and market behavior (Brown and Goolsbee 2000, Brynjolfsson and Smith 1999) and have shown that while the Internet does lead to lower average online prices, it does not lead to fully frictionless market implying zero economic profits for firms. A paper by Lal and Sarvary (2000) also makes similar arguments for non-search goods. This paper shows another important context for this view: the context of an Internet institution acting to provide a competitive price discrimination and demand re-allocation mechanism. While the referral infomediary might imply lower Internet prices, it does not necessarily mean zero profits for the competing retailers.

The paper also adds to the emerging research on Internet institutions. For example, Iyer and Pazgal (2000) analyze the impact of Internet comparison shopping agents on retail competition and show why some online retailers might join a shopping agent despite the fact that this institution allows costless search among all member retailers. While the referral infomediary also helps consumers to reduce search costs, it is significantly different from a shopping agent in two respects: The referral infomediary is an "aggregator" of consumers with the ability to deliver consumers to a particular retailer; and it acts as a price discrimination mechanism because it can provide consumers an online price which can be different from the store price of an enrolled retailer.

3. The Model

We first discuss the specifics of the market in a world without Internet referral infomediaries.

3.1. Retailers and the Consumer Market

We consider two retailers ($i = 1, 2$) who compete in prices in the end-consumer market. Retailers are assumed to be identical in terms of selling costs and these costs are set to zero without loss of generality. This assumption enables us to fully develop the demand-side implications of the Internet institution on market competition which is the primary focus of this paper.

The market consists of a unit mass of consumers. Consumers buy at most one unit of the product and have identical reservation prices which can be normalized to 1 without any loss of generality. However, consumers are heterogeneous in terms of their costs of searching at the retailers. A proportion a of consumers have zero cost of searching at both the retailers for price information before making a purchase decision. These consumers are akin to the informed consumers or switchers in the standard models of sales such as Varian (1980) and Narasimhan (1988). We will call these consumers "comparison shoppers" in the paper.

Of the remaining $1 - a$ consumers, a segment of them with a size of b_1 have zero cost of searching at retailer-1 (R1), but a prohibitively high cost of searching at retailer-2 (R2). Consequently, they only shop at R1 in the absence of an Internet referral infomediary. In the rest of the paper we will label this segment of consumers as R1-shoppers. The remaining segment of size b_2 are R2-shoppers. They have zero cost of searching at R2, but have a prohibitively high cost of searching at R1. These consumers only shop at R2 in the world without the referral infomediaries. In the basic model we assume that $b_1 = b_2 = b = \frac{1}{2}(1 - a)$. Later we allow b_1 to be different from b_2 in Section 5.

3.2. The Impact of a Referral Infomediary

Suppose that a referral infomediary now emerges. A recent J. D. Powers study (April 2000) reveals that nearly 5% of all new car buyers now use an online referral infomediary. Clearly, this number will change over time as the reach and familiarity of the infomediary evolves. To model this we assume that a fraction, k (where $0 < k < 1$), of all consumers use the referral infomediary. k is the reach of the referral institution. We assume for now that this reach is identical across all consumer segments. This assumption will be relaxed in Section 4.

The referral infomediary can enroll either one retailer or both of them. Besides from offering a price to consumers who directly visit the store, an enrolled retailer has the ability to offer the k online consumers a referral price. The impact of the referral institution on consumer behavior is captured as the follows: Consumers who use the referral infomediary will get an additional and binding price quote from an enrolled retailer at zero cost (consumers can get two binding price quotes if both retailers are enrolled). A consumer with price information obtained through both the referral service and store visit(s) will choose the lowest price and purchase at the retailer who offers that price (either through the online infomediary or at the store). An enrolled retailer can potentially offer different prices to consumers who visit the store directly or inquire prices online. In this manner the infomediary allows a member retailer to price discriminate among its customers.

3.3. The Game

The objective of the paper is to study how retail competition will respond to the emergence of a referral infomediary and also to analyze how the infomediary should organize its contractual relationship with retailers. We therefore analyze a two-stage game. In the first stage the referral infomediary chooses a contract that has two specific dimensions. The first is a decision on whether to sell the service exclusively to only one retailer in a market (denoted by the subscript x) or non-exclusively to both retailers (denoted by the subscript n). Contingent on this, the referral infomediary also has to choose the payment contract which we denote as C_{iz} (where i denotes the retailer and $z = x, n$).

Consider first the exclusive contract under which the referral infomediary makes an exclusive offer to one of the two retailers.[2] If the first retailer rejects the offer the infomediary has the option of offering the service to the second retailer. Note that under the strategy of enrolling only one retailer, say retailer i, the referral infomediary's contracting strategy consists of an offer of C_{ix} to retailer i and an offer C_{jx} to the other retailer, retailer j, in the event that retailer i rejects the infomediary's offer.[3] Given this game structure, the infomediary's problem is to choose C_{ix} and C_{jx} to maximize its profit. On the other hand, if a non-exclusive contract is used by the infomediary, its offer is made simultaneously to both retailers and the retailers simultaneously decide whether or not to accept the contract. A retailer will join the institution only if its net gain from joining is positive. In cases where a retailer is indifferent between enrolling the referral service and staying out, we assume that it will choose not to enroll.

Contingent on the first-stage contract, the second stage of the game involves price competition between retailers in which both retailers simultaneously choose prices. If a retailer is enrolled in the referral institution it can choose an online referral as well as a store price. A retailer that is not enrolled chooses only a store price. We will analyze the basic model in next section to examine the impact of referral infomediary on retail competition and the optimal contracting strategy of the referral infomediary.

4. The Impact of Referral Infomediary on Retail Competition

In this section we first analyze the price competition between retailers and the impact of the Internet referral infomediary on this competition. To begin with we briefly state the results pertaining to the case of retail competition in a market without the referral infomediary. This will provide the baseline against

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[2]Exclusive contracts can be legally binding and have sanctity in a court of law. In the U.S., exclusive contracts are subject to a rule of reason and in Canada the only anti-trust challenge to an exclusive contract is that it constitute an "abuse of dominant position." See Continental TV Inc. v. GTE Sylvania Inc., U.S. 36 (1977) and Preston (1994) and the Director of Investigation and Research v. NutraSweet (1990), 32 C.P.R. (3d) 1 regarding the legality and enforceability of exclusivity contracts.

[3]Under exclusive contract, the referral infomediary sets the price for the second retailer after the first retailer rejects the offer (there is no reason why the referral infomediary should be forced to set a price for the second firm before the first firm makes its decision). Analytically, however, there is no difference between this structure and one in which the referral infomediary chooses both prices prior to the first retailer's decision.

which the impact of the Internet referral institution can be compared. Without the referral infomediary the model collapses to a standard model of price competition as in Varian (1980) or Narasimhan (1988) with a segment of a consumers who search both retailers and buy at the lower price and two segments of b consumers that visit only one retailer. In equilibrium both retailers adopt mixed strategy pricing. Let $H_1(p) = Pr(p_1 \geq p)$ and $H_2(p) = Pr(p_2 \geq p)$, where p_1 and p_2 are the prices offered by R1 and R2 respectively. The equilibrium price distributions are $H_i(p) = \frac{b}{a}(\frac{1}{p} - 1)$, where $(\frac{b}{b+a} < p < 1)$. Firms' equilibrium profits are $\pi_i = b$ and firms' average equilibrium prices are $E(p_i) = \frac{b}{a} \ln(\frac{b+a}{b})$.

Depending upon the first-stage contract, there are two possibilities: one in which only one retailer joins the referral institution and the other in which both retailers join. We will begin our analysis with the case where only one retailer is enrolled into the referral institution.

4.1. Only One Retailer is Enrolled

Suppose that the infomediary enrolls only one of the two retailers (say R1). R1 can therefore set two prices - a store price p_1 for the consumers who come directly to the store, and a price, p_{1e}, for the consumers who come through the referral infomediary. In this manner, the referral infomediary allows R1 to price discriminate between the consumers who use the referral service and who do not use it. However, the other retailer, R2, who is not enrolled in the infomediary can set only one price, p_2, for consumers who come to its store.[4]

Let us now understand how the referral infomediary changes consumer behavior. Among the group of k consumers who are reached by the referral institution, we have: A segment of ak comparison shoppers will search both retailers and will also get an online referral price. This segment will make its choice based upon the lowest price of p_1, p_2 and p_{1e}. A segment of kb R1-shoppers make purchase decisions based upon the prices p_1 and p_{1e}. There is also another segment of kb consumers who were R2-shoppers in the world without the infomediary and did not search at R1's store. In the presence of the infomediary, these consumers can now receive R1's referral price and make a purchase decision based upon the prices p_2 and p_{1e}. Finally, the behavior of the group of $(1 - k)$ consumers who do not use the referral infomediary will obviously not change from what we specified in Section 3.1. In other words, the group of $(1 - k)a$ comparison shoppers will still search both the retailers and buy at the lower price of p_1 and p_2, while the group of $(1 - k)b$ R1-shoppers (R2-shoppers) will visit R1 (R2) and buy at $p_1(p_2)$.

To proceed with the analysis note first that there exists no pure strategy equilibrium in this game. The

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[4]Lal and Villas-Boas (1996) examine a situation where one firm competes by choosing two prices against another firm choosing single price in a mixed strategy equilibrium. They examine price promotions in a channel with exclusive dealing by one of the manufacturers. In their paper the non-exclusive retailer offers two prices for two manufacturer brands and these prices are relevant only for customers who shop at that retailer. In our analysis the two prices charged by R1 are for the same product, but for different groups of customers (i.e, online and offline consumers). Therefore the two prices allows R1 to price discriminate and also reach some R2's loyal (online) shoppers who were previously inaccessible to R1.

reasoning for this is as follows: a) Suppose that one retailer, say R2, chooses a price p_2 that is not too low, then R1 would like to just undercut p_2 in order to attract the comparison shoppers; b) Otherwise, R1 will set prices to the reservation price in order to maximize the profit from its customers who do not comparison shop. A similar reasoning applies to R2's reactions to R1's choices of p_1 and p_{1e}.

Denote $H_{11}(p) = Pr(p_1 \geq p)$, $H_{1e}(p) = Pr(p_{1e} \geq p)$, and $H_2(p) = Pr(p_2 \geq p)$. The profit function of R1 when it charges p_1 and p_{1e} can be written as

$$\pi_1 = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbmin(p_1, p_{1e}) + kbH_2(p_{1e})p_{1e} + kaH_2(min(p_1, p_{1e}))min(p_1, p_{1e}). \quad (1)$$

The first term in the right side of (1) is R1's profit from the R1-shoppers without an online referral. The second term is R1's profit from the comparison shoppers who do not use the referral service. The third term is R1's profit from the R1-shoppers who also use the referral service. The fourth term is R1's profit from the R2-shoppers who now also use the referral service. The final term is R1's profit from the comparison shoppers who use the referral service and search at both R1 and R2's stores as well.

In Appendix A we provide the full analysis of the mixed strategy equilibrium of this game. The solution methodology for this game is non-trivial because of the fact that one of the firms is price discriminating and because of the impact that the referral institution has on consumer behavior. The equilibrium price support of this game is described in the following proposition. Proofs of all the propositions are in Appendix A.

Proposition 1: *In equilibrium, the support for the prices charged by R1 is continuous with $p_1 \in (p_m, 1]$ and $p_{1e} \in (p_b, p_m)$, where $p_m = \frac{b(1-b)}{(1-b)^2 - (1-2b)k}$ and $p_b = p_m(1-k)$. The price support for R2 is also continuous with $p_2 \in (p_b, 1)$.*

This proposition establishes the first result of the paper, namely, the relationship between the online referral price and the store price offered by the retailer enrolled in the infomediary service. This issue has both theoretical and institutional relevance. It is related to the manner in which a firm should use a price discrimination mechanism in the face of competition. As shown in Proposition 1, the referral price offered by the retailer will be lower than the store price. Therefore, the emergence of the referral infomediary, and its role as a price discovery mechanism that offers consumers an additional price quote, leads to unambiguously lower online referral prices.

To understand why the online market is more price elastic for R1, consider the relative proportion of R1-shoppers to the comparison shoppers that R1 faces among the referral service users as opposed to non-users. A lower value of this relative proportion implies higher price elasticity in the segment. Denoting the relative proportions as γ_I and γ_s for the infomediary users and non-users segments that R1 faces respectively, we have that

$$\gamma_I = \frac{k\,b}{ka + k\,b} < \frac{(1-k)\,b}{(1-k)a} = \gamma_s \quad (2)$$

The above inequality obtains because R1 has the incentive to use the referral price to also compete for the kb R2-shoppers who were previously inaccessible (in addition to competing for the comparison shoppers). Therefore, R1 offers lower online price than store price. Thus, the price discrimination mechanism enabled by the infomediary and the incentive of R1 to compete for the consumers who were otherwise captive to R2 leads to lower online prices than its store prices.

Overall, this result helps to clarify the available empirical evidence regarding the impact of referral institutions on retail price competition. In a study using transaction data from Autobytel, Scott Morton, Zettelmayer and Silva Risso (2000) compare online transaction prices to regular showroom prices. The authors find evidence that consumers who came to Autobytel retailers with an online referral paid on an average 2% less than those who go directly to the retailer without a referral. Conditional on the retailer and the car chosen, consumers with a referral paid on average \$379 less than an offline consumer. The data that we acquired from a Carpoint affiliated Volkswagen retailer in St. Louis, MO also shows that the online referral prices offered are lower than the retailer showroom prices.[5] Overall, Proposition 1 provides a basis for why referral infomediaries have been perceived as a beneficial for consumers and for the growth in the usage of this type of Internet institution.

Given the relationship between p_1 and p_{1e} shown in Proposition 1, we can now rewrite the profit function in (1) into $\pi_1 = \pi_{11} + \pi_{1e}$ where,

$$\pi_{11} = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 \tag{3}$$

$$\pi_{1e} = kbp_{1e} + (kb+ka)H_2(p_{1e})p_{1e} \tag{4}$$

The first component π_{11} is R1's expected profit from the segment of consumers who do not get a referral price and who therefore buy at the store price p_1. The second component π_{1e} is R1's profit from the segment of consumers who use the infomediary and get a referral price quote p_{1e} from R1.

The relationship between p_1 and p_{1e} established in Proposition 1 also allows us to specify R2's profit as follows:

$$\pi_2 = (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + kbH_{1e}(p_2)p_2 + kaH_{1e}(p_2)p_2. \tag{5}$$

The first term in the right side of (5) is R2's profit from the consumers who do not use the referral service and who are R2-shoppers . The second term is R2's profit from the comparison shoppers who do not use the referral service. The third term is R2's profit from its own shoppers who now use the referral service. The final term is R2's profit from the comparison shoppers who also use the referral infomediary.

Recall that this analysis pertains to the sub-game where only one retailer is enrolled by the referral

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[5]We have 18 months data from a Volkswagen retailer in St. Louis. The data comprises of the transaction prices and gross profits on every car sold by the retailer for a contiguous period of 18 months in 1999-2000. It also includes the information on whether or not each consumer came to the retailer with a referral. Across all models of Volkswagen cars we found that the average price offered to consumers with referrals was lower by \$570.

institution. The strategic consequence of this exclusivity is that R1 can poach R2's consumers via a suitable choice of p_{1e} while simultaneously limiting its subsidy to shoppers at its store through choosing an appropriate store price p_1 (which, as shown in Proposition 1, is always greater than p_{1e}). In contrast, R2 has to rely on a single price p_2. The equilibrium pricing strategies for both retailers can be derived from the three invariance conditions: $\frac{d\pi_{11}}{dp_1} = 0, \frac{d\pi_{1e}}{dp_{1e}} = 0$, and $\frac{d\pi_2}{dp_2} = 0$, along with the boundary conditions for the distribution functions $H_{1e}(p)$, $H_1(p)$ and $H_2(p)$. These conditions result in a set of ordinary differential equations that can be solved for the unique equilibrium of the game. The equilibrium results are summarized in the following Proposition 2.

Proposition 2: *In the case where retailer 1 enrolls in the referral infomediary but retailer 2 does not, both retailers adopt mixed strategies in equilibrium. In equilibrium, we have that,*

1. if $k < 1 - b$, then $\pi_1 = \pi_{11} + \pi_{1e} = \pi_1 = b(1-k)\frac{(1-b)^2+bk}{(1-b)^2-(1-2b)k}$, where $\pi_{11} = b(1-k)$, $\pi_{1e} = b[\frac{(1-b)k(1-k)}{(1-b)^2-(1-2b)k}]$; $\pi_2 = b[\frac{(1-b)^2(1-k)}{(1-b)^2-(1-2b)k}]$; $H_{11}(p) = \frac{\pi_2}{(1-k)(1-2b)p} - \frac{b}{(1-2b)}$; $H_{1e}(p) = \frac{\pi_2}{k(1-b)p} - \frac{1-k}{k}$; $H_2(p) = \frac{b}{a}(\frac{1}{p} - 1)$ for $(p_m < p < 1)$, $H_2(p) = \frac{\pi_{1e}}{(1-b)kp} - \frac{b}{1-b}$ for $(p_b < p < p_m)$; $E(p_1) = \frac{\pi_2}{(1-k)(1-2b)}\ln(\frac{1}{p_m}) + b[\frac{k}{(1-b)^2-(1-2b)k}]$; $E(p_{1e}) = \frac{\pi_2}{k(1-b)}\ln(\frac{1}{1-k})$; $E(p_2) = \frac{b}{a}\ln(\frac{1}{p_m}) + \frac{\pi_{1e}}{k(1-b)}\ln(\frac{1}{1-k})$;

2. if $k \geq 1 - b$, then $\pi_{11} = (1-k)b$, $\pi_{1e} = kb$, $\pi_1 = \pi_{11} + \pi_{1e} = b$; $\pi_2 = b(1-b)$[6]

Proposition 2 indicates that the impact of the infomediary on retail competition depends upon its reach. We begin the discussion with the case when the reach is small.

4.1.1. Reach of the Infomediary is Small (k < 1 − b)

The first point to note is that the profit of the enrolled retailer first increases and then decreases with the reach of the referral institution. The increasing reach of the referral service has three effects that govern R1's profit. First, an increase in the reach of the infomediary creates a positive demand effect for R1: Among the consumers who use the referral infomediary, R1 can now potentially get additional demand from the segment of consumers who would have previously shopped only at R2. Furthermore, the infomediary allows R1 to offer an additional lower price to attract the comparison shoppers online. However, an increase in k also creates a competitive effect. Because R1 can now use a low referral price p_{1e} to poach on the previously guaranteed consumers of R2, the strategic response of R2 is to price aggressively and charge a lower p_2 in equilibrium in order to protect its customer base (i.e., R2-shoppers).[7] This leads to more intense price competition imposing negative effect on both retailers' equilibrium profits. Finally, there is a price discrimination effect. The enrolled retailer can price discriminate the users and non-users

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[6] *Since this scenario does not happen in the equilibrium of the whole game (as we will show later), we just provide the equilibrium profits here in order to save space. The discussion below will pertain to the results for the case where* $k < 1 - b$.

[7] In fact, it can be easily checked from Proposition 2 that the average price charged by R2 decreases with k.

of the referral infomediary by offering an online referral price different from its store price. This price discrimination effect has a positive impact on the profit of the enrolled retailer. The magnitude of this effect reaches its maximum when the sizes of the infomediary users and non-users segments are relatively close, and declines thereafter with further increases in the reach.[8] As a result, when the reach of the referral infomediary is small enough, the benefit from the increased demand and the price discrimination effect for the enrolled retailer dominates the cost of the increased competition created by the referral institution. This results in the enrolled retailer's profit increasing with the reach of the institution. However, as the reach of the institution further increases the benefit from the price discrimination effect diminishes and retail competition becomes so intense that profit of the enrolled retailer declines with increasing reach. An alternate way to understand this result is to notice that R1's profit from consumers who do not use the infomediary, π_{11} (i.e., the profit associated with the store price p_1), decreases with the reach of the institution, whereas its profit from consumers who use the infomediary, π_{1e} (which is associated with the referral price p_{1e}), increases with the reach. Consequently, R1's total equilibrium profit has an inverse U relationship with k.

Note also that the profit of the enrolled retailer, R1, is always greater than the profit of its competitor. The fact that R1 has exclusive access to consumers using the referral service ensures that it always has higher or equal profit than in a world without the online infomediary. In contrast, R2 will be hurt by the referral institution and its profit will be strictly lower than in a world without the referral institution. Not only does R2 get lower demand, but it is also forced to charge a lower price on the average to prevent the its consumers who get a referral price from being poached. As we will demonstrate in section 4.3, this re-allocation of profits between the retailers provides a basis for the endogenous existence of the referral infomediary.

4.1.2. Reach is Large (k > 1 − b)

What happens when the reach of the referral institution becomes sufficiently large with $k > 1 - b$. Now R2 will price even more aggressively to defend its consumers. Consequently, market competition becomes so intense that there is no net profit advantage for R1 to enroll in the infomediary (note that π_1 in this case is the same as that of the case neither retailer joins the institution). This leads to an interesting finding that a retailer will have no incentive to join the referral institution even if the infomediary allows enrollment at no cost.

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[8]When $k \to 0$ or $k \to 1$, R1 will only face one segment (i.e. nobody uses the referral service or everybody uses it). Therefore, there will be no price discrimination effect if $k \to 0$ or $k \to 1$. This means that the benefit of the price discrimination effect is a maximum at an intermediate value of k.

4.1.3. The Impact of the Referral Service on Retail Prices

The availability of the referral service also has some interesting implications for the prices offered by the competing retailers. As we discussed early, the retailer enrolled in the referral service offers higher store price than its Internet referral price. Furthermore, from Proposition 2, we can also verify that the mean store price charged by R1's, $E(p_1)$, is higher than R2's mean store price, $E(p_2)$. However, R1's mean Internet price, $E(p_{1e})$, is lower than $E(p_2)$. This is because the referral service provides the enrolled retailer a price discrimination device, through which R1 can compete aggressively via Internet while limiting its subsidy to its captive consumers who do not utilize the infomediary. In contrast, the non-enrolled retailer has to use a single store price to compete with both the store price and the Internet referral price from its rival. Thus, the average price charged by R2 lies in between R1's average Internet referral price and average store price.

Next consider the impact of the reach of the infomediary, k, on prices. We find that the difference between the average store price and the average Internet price of the enrolled retailer, $E(p_1) - E(p_{1e})$, increases with k. This clearly highlights the price discrimination function of the referral service. Note that $E(p_1)$ increases with k, because p_1 is used by the retailer to exploit the R1-shoppers who are not using the referral service. As the reach increases, the retailer will increasingly focus on those consumers with increased store prices. As expected, $E(p_1)$ also increases with b, the size of R1's captive consumers. In contrast, $E(p_2)$, decreases with k. As the reach of the infomediary increases, the non-enrolled retailer has to compete more aggressively to protect its own customer base.

The relationship between the expected Internet referral price, $E(p_{1e})$, and k is also interesting. It increases with k when both k and b are sufficiently small but decreases otherwise. Recall that the non-enrolled firm, R2, competes for $(1-k)a$ consumers with R1's store price, p_1; but it competes for $(ka + kb)$ online consumers with R1's referral price, p_{1e}. As k increases, the difference between p_1 and p_{1e} increases due to the price discrimination effect. When b and k are sufficiently small, the $(1-k)a$ segment is large. Consequently, R2's pricing strategy will be focused on attempts to undercut R1's store price p_1 in order to win the $(1-k)a$ consumers. This implies that the competition in the online sector will be less, which leads to higher levels of p_{1e}. On the other hand, if k and/or b are large, the segment of $(1-k)a$ consumers will be less attractive while the segment of $(ka + kb)$ consumers who use the referral service become more important to R2. Therefore R2 will set p_2 aggressively to compete mainly with p_{1e}. As a result, p_{1e} decreases with k when k and/or b are large.

The empirically observed prices from car retailers are usually the prices for realized transactions. The distributions of the empirically observed prices can be different from the "offered' prices of retailers that we just discussed above. For example, if a consumer in the $(1-k)a$ segment who faced prices $p_1$and p_2 but purchased from R1 because $p_1 < p_2$, then most likely in an empirical data-set only the "realized" price p_1 would be recorded but not p_2. To accommodate this fact, we have also derived the distributions of the realized (observed) prices from the distributions of offered prices (see Appendix A) to compare our results

with empirical evidence. We find that the results reported above do not change qualitatively if the offered prices are replaced by the realized prices.

Besides looking at the retailers' expected prices, we have also examined the dispersion of retailers' equilibrium prices. Some interesting findings are (see Appendix A for details):

- The range of p_1 decreases with k but the ranges of p_{1e} and p_2 increase with k.

- The variance of the realized (observed) price p_1 is higher than that of the realized price p_{1e} when k is small.

- When k is sufficiently small, the observed variances of both the enrolled store's prices (p_1 and p_{1e} combined) and the non-enrolled store's prices are lower than the corresponding observed price variances in a world without the infomediary.

When k increases, R1 increases p_1 in order to achieve better price discrimination. Because the upper bound of the distribution for p_1 remains the same (which is the reservation price), this implies that the range of p_1 will decrease with the reach of the institution. Moreover, because the size of the $ka + kb$ segment increases with the reach, the lower bound of p_{1e} and p_2 will be lower with higher k due to the increased competition for this segment of consumers.

The results above suggest that we should expect to observe lower price dispersion for Internet prices than for store prices and lower price dispersions in the market after the referral institution is introduced as long as the reach of the institution is small enough (note that the current reach is about 5% based on a recent J. D. Powers study (April 2000)). These implications seem to be consistent with some recent empirical findings (see Scott Morton, Zettelmayer and Risso 2000). The intuition behind these results are similar to those for the relationship between $E(p_{1e})$ and k. When k is small, R2 focuses on competing with p_1 for the $(1-k)a$ segment so that its distribution will be concentrated in the range of p_1's distribution. Because the range of p_1 decreases with k, p_2 will be less dispersed as k increases in this case. This in turn leads to a decrease in R1's overall price dispersion.[9] Also because p_2 competes more with p_1 than p_{1e} under this situation, p_{1e}'s distribution will be concentrated near its upper bound. The variance of p_{1e} is therefore lower than that of p_1 under this situation (when k is small).

4.2. Both Retailers are Enrolled

Consider now the sub-game in which both retailers are enrolled in the referral infomediary. This implies that both the retailers will have the ability to offer two prices: a store price p_i and a referral price p_{ie}, $(i = 1, 2)$. Within the comparison shopping segment, ak consumers will use the infomediary and receive

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[9]Because in equilibrium R1 responds to R2's price distribution optimally, a more concentrated distribution of R2's prices also leads to a more concentrated distribution of R1's prices.

referral prices from both retailers. Their purchase decisions will be based on $\min(p_1, p_2, p_{1e}, p_{2e})$. In the remaining market, a total of $2bk$ consumers will receive referral prices, p_{1e} and p_{2e}, and also the store prices from respective stores that they search. A set of bk consumers will choose $\min(p_1, p_{1e}, p_{2e})$, while the remaining bk of them will choose $\min(p_2, p_{1e}, p_{2e})$. Finally, the behavior of the set of $(1-k)$ consumers who do not use the referral infomediary will remain unchanged from that specified in Section 3.1. We have the following proposition regarding the equilibrium in this scenario.

Proposition 3: *If both retailers are enrolled in the infomediary, the equilibrium profit of each retailer is* $\pi_i = (1-k)b$. *The equilibrium price strategies are* $p_{ie} = 0$ *and* $H_i(p) = \frac{b}{a}(\frac{1}{p} - 1)$, *where* $\frac{b}{b+a} < p < 1$.

This proposition further clarifies the manner in which the referral infomediary affects the market. Consumers who use the referral institution can get price quotes (p_{1e} and p_{2e}) from both the retailers and can choose to buy at the lower of the two prices. This leads to a homogenous Bertrand price competition in the market comprising of k consumers who use the referral infomediary. Thus, the equilibrium referral prices of both retailers are zero (the marginal cost of the product) and they make zero profit from the set of k consumers. Therefore, the competition between the two retailers will be as if they perceive a smaller market comprising of only $(1-k)$ consumers who go directly to the stores. Consequently, the equilibrium profit of each retailer goes down to $b(1-k)$, which is lower than in a world without the referral infomediary.

The economic characteristic of the referral infomediary captured in our model is that of a mechanism which allows consumers to be reached with an additional price quote. The referral institution in our model does not create additional demand but rather reallocates existing demand among the retailers. This seems to be an accurate way of representing the impact of the institution on retailers. In other words, we believe that consumers do not buy more cars (or increase their valuations for cars) just because Autobytel has come into existence. Rather they use services such as Autobytel and Carpoint to get price quotes in addition to search in the brick-and-mortar world. Thus a referral institution that enrolls both retailers will lead to Bertrand competition in the Internet sector and thereby reduce their profits without conferring any compensating benefit. In other words, the equilibrium profit of each retailer will be lower than that in a world without the infomediary.

4.3. Optimal Contracts for the Referral Infomediary

We have analyzed all the possible second-stage sub-games and are now in a position to go back to the first stage to examine the optimal contract and the resulting profits for the referral institution. In doing so, we will be able to establish the set of market conditions that supports the endogenous existence of the infomediary. The following proposition establishes the optimal contractual policy for the referral infomediary.

Proposition 4: *Let the referral infomediary charge enrolled retailers a lump-sum payment, then:*

1. *When $k < 1 - b$, the optimal contracting policy for the referral infomediary is to adopt the exclusive strategy of enrolling only one retailer. The equilibrium contracting strategy is as follows: The referral service offers to charge $C_{ix} = \frac{b^2 k(1-k)}{(1-b)^2 - (1-2b)k}$ to a retailer i and $C_{jx} = b[(1-k)\frac{(1-b)^2 + bk}{(1-b)^2 - (1-2b)k} - 1]$ to the other retailer in the event that retailer i rejects C_{ix}. In equilibrium, retailer i accepts the offer and the profit of the referral infomediary is $\Pi = C_{ix} = \frac{b^2 k(1-k)}{(1-b)^2 - (1-2b)k}$.*

2. *When $k > 1 - b$, neither retailer will enroll for any positive payment demanded by the referral infomediary. The referral infomediary unravels and makes zero profit.*

The non-exclusive strategy of enrolling both retailers can never be optimal for the referral infomediary. As discussed in the previous section, the infomediary creates Bertrand competition between the enrolled retailers for the group of k consumers who use the service if both retailers are enrolled. The reduction in retailers' profit limits the payment that the infomediary can charge. Adopting the exclusive strategy always dominates as it allows the infomediary to charge the enrolled retailer for the benefit of exclusive access.

From Proposition 4, it is easy to verify that $\frac{\partial \Pi}{\partial k} > 0$ and $\frac{\partial \Pi}{\partial b} > 0$. The referral infomediary's profits accrue from offering access to a mechanism that provides an enrolled retailer the benefits of both demand re-allocation and the price discrimination ability that allows an enrolled dealer to better extract consumer surplus. The demand re-allocation effect increases with the reach while the price discrimination effect increases with a larger b. A higher b increases the incentive to price discriminate because it increases the difference between the price elasticities in the segments of users vs. the non-users of the referral service. In other words, a higher b increases the difference between the ratios γ_s and γ_I discussed earlier. Therefore, the profits of the referral service increase in both k and b.

Perhaps the more interesting point of this proposition is that it identifies the condition under which the referral infomediary can exist and make positive profits. Proposition 4 shows that the referral institution can exist as long as the reach of the institution is not too large (i.e., $k < 1 - b$). When the reach of the infomediary becomes too large, the loss of profits from the increased competition that the referral institution creates outweighs the benefits from the increased demand and the price discrimination ability that the enrolled retailer will have. As seen in Proposition 2, the profit of the enrolled retailer will be the same as that in a world without the infomediary. Consequently, no retailer will have an incentive to join the referral institution. Thus (and paradoxically) increasing reach can lead to an unraveling of the referral institution. Overall the message that emerges from this analysis is that an institution that acts as a demand re-allocation and a price discrimination mechanism for retailers cannot exist when it becomes too successful in expanding its reach.

It might be surprising that the referral infomediary breaks down at higher values of k even though its profit (given that it is viable) actually increases with k. Understanding this helps us to reveal some interesting features of the referral infomediary and the contract that it offers. Given that the referral

institution is viable, the profit of the referral infomediary with the exclusive strategy is $C_{ix} = \pi_1 - \pi_2 = (\pi_1 - \pi_0) + (\pi_0 - \pi_2)$, where π_0 is the retailer's profit in the world without the referral institution. The first component in the expression of C_{ix}, $(\pi_1 - \pi_0)$, is the net gain in profit for the enrolled retailer compared to the situation where neither retailer joins the referral service. The second component C_{ix}, $(\pi_0 - \pi_2)$, is the potential loss in profit for the enrolled retailer if it rejects the contract from the infomediary but its competitor enrolls in the service. In addition, the condition of $(\pi_1 - \pi_0) > 0$ must be satisfied before any retailer is willing to enroll in the referral service. Because π_1 decreases with k when k is large, the referral institution breaks down at high reach levels even though C_{ix} is still increasing in k (because $(\pi_0 - \pi_2)$ increases in k).

5. Extensions

5.1. Heterogeneity in the Reach of Infomediary and retailer Loyalty

In this section we discuss the key implications of relaxing two assumptions in the basic model. In the basic model we assumed that retailers were symmetric in terms of the sizes of their "own" (or loyal) segments of consumers. But in many markets retailers may differ w.r.t to the size of these segments. We now relax the assumption made in the basic model and let $b_1 > b_2$ without loss of generality (i.e. let R1 be the retailer with a larger size of the shoppers who only search at its store). We will label R1 as the "large" retailer and R2 as the "small" retailer. Furthermore, in the basic model we had also assumed that the reach of the institution, k, was the same across all the segments in the market. However, one can reasonably expect the reach of the Internet infomediary to be relatively greater among the comparison shoppers. The available empirical evidence (see for example Scott Morton et. al 2001) also indicates this to be the case. Relaxing the assumption w.r.t. k, we now let k_a be the reach of the institution in the comparison shopping segment, and k_b be the reach among the segments of b_1 and b_2 consumers who search only at their respective retailers. k_a and k_b can now be different. We provide the full analysis of this general model in Appendix B and only report the key findings here.

Consider first the effect of asymmetry in b_1 and b_2. Our analysis shows that, as long as the reach of the infomediary is symmetric across all segments, it is always optimal for the referral infomediary to exclusively enroll the large retailer in the market. In addition, the institution's profit increases as the retailers become more asymmetric (i.e. as b_1/b_2 increases). To understand this, note that the price discrimination ability conferred by the infomediary is more valuable for the retailer that has a larger size of loyal shoppers. In addition, enrolling the large retailer reduces the number of consumers who are likely to be poached (i.e., only b_2 consumers can be poached). This reduces the intensity of market competition and allows the infomediary to charge a higher price.

Now consider the case where there is also asymmetry on the reach dimension. We find that the infomediary's profit increases with k_a, the reach of the institution among the comparison shoppers. With

an increase in k_a, a greater number of comparison shoppers get two prices from the enrolled retailer R1. Thus, all else being equal, the competing non-enrolled retailer will get less demand from the comparison shopping segment (because its store price will now have to be lower than both prices offered by R1). The strategic response of R2 will therefore be to focus more on extracting surplus from the R2-shoppers. This reduces the overall intensity of price competition between the two retailers and allows the infomediary to extract a higher profit. Next, we find that the infomediary's profit increases with k_b, the reach among the segment of consumers who do not comparison shop, if the overall reach $(k_a + k_b)$ is small; and its profit decreases with k_b if the overall reach is sufficiently large. The intuition for this result is similar to that for the relationship between π_1 and k discussed in Section 4.1.1.

Finally, with asymmetry in reach it can be optimal for the infomediary to enroll the small but not the large retailer in a market. It turns out that the referral infomediary will find it optimal to exclusively enroll the small retailer if: (a) the reach of the institution among the comparison shoppers (i.e., k_a) is sufficiently large compared to that among the loyals (k_b); and (b) b_1 is sufficiently large as compared to b_2.

5.2. The Impact of Consumer Identification

We assumed in the basic model that the referral infomediary as well as the enrolled retailer(s) cannot distinguish between the comparison shoppers and the other consumers who use the referral service. However, the Internet institution or an enrolled retailer may over time develop the ability to identify consumer types and thereby allow the enrolled retailer to customize its price quotes accordingly. In this case[10], the enrolled retailer, R1, will be able to offer three different referral prices: p_{ae}, p_{be} and p_{ce}, for its own shoppers, R2's shoppers, and the comparison shoppers respectively. R1's profit function now is

$$
\begin{aligned}
\pi_1 \quad = \quad & (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbmin(p_1, p_{ae}) + \\
& kbH_2(p_{be})p_{be} + kaH_2(min(p_1, p_{ce}))min(p_1, p_{ce}).
\end{aligned}
\tag{6}
$$

We provide the full analysis of this case in Appendix B. Using the similar reasoning as in the basic model it can be shown that $p_{ae} = p_1$ and $p_1 \geq p_{ce}$ in the equilibrium. Similarly it can also be shown that $p_1 \geq p_{be}$ in the equilibrium. Therefore, we have that

$$
\pi_1 = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbp_1 + kbH_2(p_{be})p_{be} + kaH_2(p_{ce})p_{ce}
\tag{7}
$$

Again, following the same logic as we used in deriving the equilibrium of the basic model, we can prove that the lower bound of p_1 equals to the upper bound of both p_{be} and p_{ce} in equilibrium. From (7), we can also see that the optimization problem for R1 with regarding to p_{be} and p_{ce} are the same. Thus, p_{be}

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[10]We focus our discussion here on the case where only R1 enrolls in the referral institution because the infomediary uses exclusive contract in the equilibrium.

and p_{ce} have the same distribution in equilibrium, i.e. $H_{be}(p) = H_{ce}(p) = H_{1e}(p)$. Therefore, R2's profit function can be written as

$$\begin{aligned} \pi_2 &= (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + kbH_{be}(p_2)p_2 + kaH_{ce}(p_2)p_2 \qquad (8) \\ &= (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + (kb + ka)H_{1e}(p_2)p_2, \end{aligned}$$

We obtain that in the equilibrium:

Proposition 5: *The optimal contracting policy for the referral infomediary is to adopt the exclusive strategy of enrolling only one retailer. The equilibrium contracting strategy is as follows: it charges $C_{ix} = b^2 \frac{1-(1-k)^2}{b+(1-2b)(1-k)^2}$ to a retailer i and charges $C_{jx} = \frac{(1-k)kb(1-b)}{b+(1-k)^2(1-2b)}$ to the other retailer in the event that retailer i rejects the offer. The equilibrium profit of the referral infomediary is $\Pi = C_{ix} = b^2 \frac{1-(1-k)^2}{b+(1-2b)(1-k)^2}$.*

Comparing the above results with those in Proposition 4, we can see that the referral infomediary's profits are higher with consumer identification. But the more important point is that with consumer identification, the institution will not unravel as the reach of the institution becomes high. In fact, it is now possible for the infomediary to exist for all values of k. This provides an interesting insight into the strategies that referral infomediaries should adopt as they evolve. *As the reach of the infomediary increases, it would also be important for the institution to make complementary investments in improving customer identification.* With customer identification the profits of the infomediary will always be increasing in reach regardless of the level of reach attained (i.e., $\frac{\partial \Pi}{\partial k} > 0$ always).

6. Conclusion and Future Research

Internet and E-commerce have wrought considerable changes to traditional business models across most industries. One aspect of this revolution has been the emergence of new intermediaries in distribution channels. For instance, Autobytel in the automobile channel, Healthcareadvocates.com in the healthcare channel and Avviva.com in the real-estate business. The rationale for these intermediaries and their implications for the traditional channel institutions and their performance is the focus of this paper.

We undertake this investigation in the context of the automobile industry. The reasons for this choice include (a) the relative visibility and maturity of the phenomenon in this industry relative to other industries, and (b) the availability of empirical observations of the consequence of these institutions for competitive markets and retailer behavior. Our interest in this phenomenon is motivated by what appears to us as important economic properties of these infomediaries. On the demand side, the referral infomediary performs the function of "price discovery." A consumer who uses the service can costlessly get an additional retail price quote before purchase. On the firm side, a referral service endows enrolled retailers with a price discrimination mechanism that allows better extraction of consumer surplus. A retailer that joins a referral service has the ability to price discriminate between consumers who come through the

referral infomediary and those who come directly to the retail store. These properties raise some very interesting research questions. For instance, how does the infomediary affect the individual incentives of a retailer to enroll in their service? What are the implications of the infomediary for the competition between retailers in a market? What is the optimal contractual policy that a referral infomediary should use to sell its service? This last question pertains to the problem of how a seller should contract for the sale of a price discrimination mechanism.

We find that the referral price will always be lower than the retail store price offered by the enrolled retailer. This result illustrates the role of the referral service as a competitive price discrimination mechanism and hence the rationale for lower online prices in the automobile industry. Our analytical results are consistent with the available empirical evidence on new car prices.

More importantly, we find that the profits of the enrolled retailer are in the form of an inverted U with respect to the reach of the referral service: i.e., profits first increase and then decrease with the reach of the institution. This result seems somewhat counter-intuitive. One would expect that the ability to price discriminate and to get additional demand must result in higher profits. However, the referral service also helps a retailer to poach on its competitors customers who were previously unavailable. The strategic response by the competitor is to price aggressively in order to protect its loyal base and this intensifies price competition leading to lower equilibrium profits. This competitive effect increases with the reach of the institution.

Our analysis of the contracting problem for the infomediary shows that the referral institution prefers an exclusive strategy (of allowing only one of the retailers to enroll) to a non-exclusive strategy. A non-exclusive strategy implies that consumers who use the web will get referral prices from both retailers. This creates Bertrand-type competition for these consumers. Consequently, once either one retailer becomes a member, the other retailer will make greater profits staying out even if the institution owner allows access for free.

Perhaps the most interesting result is that the referral institution can unravel (in the sense that neither retailer can gain any net profit from joining the institution) when its reach becomes very high. In this case, any retailer that joins the institution will be able to poach on a large proportion of the competitor's customers. The resulting price competition is so intense that the joining firm will make less profit than if it had not joined. It is perhaps this issue that is at the heart of the current attempts by referral services such as Autobytel to diversify into additional service areas such as financing and after-market services.

The phenomenon of infomediaries is new and this paper is an attempt at understanding the institution and its implications. There are several interesting areas for future research in this area. We do not explicitly model the role of the infomediary in allowing consumers to bargain with retailers. Consideration of this issue will help us better understand the broader economic question of how competition will be affected in markets moving from bargaining to posted prices. We study the implications of infomediaries for retailers and consumers. It would be useful to explore the implications of infomediaries for players further upstream

in the channel (i.e., manufacturers). Do infomediaries represent an alternative means for manufacturer's to structure downstream behavior?

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Appendix A:

Proof of Proposition 1

First we claim that there exists no pure strategy equilibrium in this game. The reasoning for this is as follows: a) Suppose one dealer, say R2, chooses a price p_2 that is not too low, then R1 would like to undercut p_2 with p_1 or p_{1e} by ϵ ($\epsilon \to 0$) in order to attract the comparison shoppers; b) Otherwise, R1 will set prices to the reservation price in order to maximize the profit from the consumers who do not comparison shop. A similar reasoning applies to R2's reactions to R1's choices of p_1 as well as p_{1e}.

We now derive the mixed strategy equilibrium for this case. Similar to the proofs of Proposition 2-5 in Narasimhan (1988), we have that in the mixed strategy equilibrium: 1) both the joint price support of p_1 and p_{1e}, i.e., $p_1 \bigcup p_{1e}$, and the price support of p_2 are continuous; 2) neither firm can have a probability mass point below 1 (the reservation price) in its (joint) price support; 3) at most one firm can have probability mass at 1 in its (joint) price support; and 4) the (joint) price support is from p_b to 1 for both firms, where p_b is to be solved.

Denote that $H_{11}(p) = Pr(p_1 \geq p)$, $H_{1e}(p) = Pr(p_{1e} \geq p)$, and $H_2(p) = Pr(p_2 \geq p)$. The profit function of R1 when it charges p_1 and p_{1e} can be written as

$$\pi_1 = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbmin(p_1, p_{1e}) + kbH_2(p_{1e})p_{1e} + kaH_2(min(p_1, p_{1e}))min(p_1, p_{1e}). \tag{1}$$

The first term in the right side of (1) is R1's profit from the R1-shoppers without an online referral. The second term is R1's profit from the comparison shoppers who do not use the referral service. The third term is R1's profit from the R1-shoppers who also get a referral. The fourth term is R1's profit from the R2-shoppers who now also use the referral service. The final term is R1's profit from the comparison shoppers who use the referral service and search at both R1 and R2's stores as well.

We first claim that no price pair (p_1, p_{1e}), where $p_1 < p_{1e}$, can be part of an equilibrium. The proof is as follows. Suppose a price pair (p_1, p_{1e}), where $p_1 < p_{1e}$, is in equilibrium. From (1), we have that

$$\pi_1 = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbp_1 + kbH_2(p_{1e})p_{1e} + kaH_2(p_1)p_1. \tag{2}$$

From (2), we can see that if $H_2(p_{1e})p_{1e} \geq H_2(p_1)p_1$, R1 will be better off by increasing p_1 to $p_1 = p_{1e}$. On the other hand, if $H_2(p_{1e})p_{1e} < H_2(p_1)p_1$, R1 will be better off by lowering p_{1e} to $p_{1e} = p_1$. Thus, $p_1 < p_{1e}$ can never be optimal, i.e. we have that $p_1 \geq p_{1e}$ in the equilibrium. Therefore, (1) can be reduced to

$$\begin{aligned} \pi_1 &= \pi_{11} + \pi_{1I} \\ \pi_{11} &= (1-k)bp_1 + (1-k)aH_2(p_1)p_1 \\ \pi_{1e} &= kbp_{1e} + kbH_2(p_{1e})p_{1e} + kaH_2(p_{1e})p_{1e}. \end{aligned} \tag{3}$$

According to the property of the mixed strategy Nash equilibrium, π_1 is invariant for all p_1 and p_{1e} on their equilibrium supports. From (3), we can see that given the other firm's price distribution, π_{11} is not dependant on p_{1e} and π_{1e} is not dependant on p_1. Thus, π_{11} should be invariant for all p_1 on the equilibrium price support and π_{1e} should be invariant for all p_{1e} on the equilibrium price support.

We then claim that there is no more than one common point on the equilibrium supports of p_1 and p_{1e}. The proof is as follows. If there exists two prices, p_a and p_b,

on the supports of both p_1 and p_{1e}. From (3) and the invariance property in a mixed strategy equilibrium of π_{11} and π_{1e} as defined above, we have that

$$
\begin{aligned}
\pi_{11}(p_a) &= \pi_{11}(p_b) && (4) \\
&\Rightarrow (1-k)bp_a + (1-k)aH_2(p_a)p_a = (1-k)bp_b + (1-k)aH_2(p_b)p_b \\
&\Rightarrow \frac{p_bH_2(p_b) - p_aH_2(p_a)}{p_a - p_b} = \frac{b}{a},
\end{aligned}
$$

and

$$
\begin{aligned}
\pi_{1e}(p_a) &= \pi_{1e}(p_b) && (5) \\
&\Rightarrow kbp_a + kbH_2(p_a)p_a + kaH_2(p_a)p_a = kbp_b + kbH_2(p_b)p_b + kaH_2(p_b)p_b \\
&\Rightarrow \frac{p_bH_2(p_b) - p_aH_2(p_a)}{p_a - p_b} = \frac{b}{a+b},
\end{aligned}
$$

Comparing (4) with (5), we have that $\frac{b}{a} = \frac{b}{a+b} \Rightarrow b = 0$, which contradicts $b > 0$. Hence, the claim holds.

From the above, we have that in the equilibrium 1) the joint price support of p_1 and p_{1e} is continuous; 2) $p_1 \geq p_{1e}$; and 3) there is no more than one common point on the joint price support of p_1 and p_{1e}. Therefore, there exists a p_m so that p_1 is distributed from p_m to 1 and p_{1e} is distributed from p_b to p_m. From the earlier part of the proof, we have also shown that the price support is from p_b to 1 for p_2. This completes the proof of Proposition 1. The exact expressions for p_m and p_b will be given below along with the proof for Proposition 2.

Proof of Proposition 2

From Proposition 1, we have that for R1:

$$
\begin{aligned}
\pi_1 &= \pi_{11} + \pi_{1e} && (6) \\
\pi_{11} &= (1-k)bp_1 + (1-k)aH_2(p_1)p_1 \quad (p_m \leq p_1 \leq 1) \\
\pi_{1e} &= kbp_{1e} + kbH_2(p_{1e})p_{1e} + kaH_2(p_{1e})p_{1e} \quad (p_b \leq p_{1e} < p_m).
\end{aligned}
$$

Now let us look at R2's profit, π_2. We have that

$$
\pi_2 = (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + kbH_{1e}(p_2)p_2 + kaH_{1e}(p_2)p_2. \quad (7)
$$

The first term in the right side of (7) is R2's profit from the consumers who do not use the referral service and who are R2-shoppers. The second term is R2's profit from the comparison shoppers who do not use the referral service. The third term is R2's profit from its own shoppers who now use the referral service. The final term is R2's profit from the segment of comparison shoppers who also use the infomediary.

From the three invariance conditions that must be satisfied in a mixed strategy equilibrium, we have that

$$
\frac{d\pi_{11}}{dp_1} = 0, \frac{d\pi_{1e}}{dp_{1e}} = 0, \frac{d\pi_2}{dp_2} = 0 \quad (8)
$$

Denote $H_1(1) = q_1$, $H_2(1) = q_2$, and $H_{1e}(p_m) = q_{1e}$. From the proof of Proposition 1, we have that

$$
\begin{aligned}
H_{1e}(p_b) &= 1, H_1(p_m) = 0, H_2(p_b) = 1, q_{1e} = 1, q_1q_2 = 0 \text{ (if } q_1 < 1) \\
H_{1e}(p_b) &= 1, H_1(p_m) = 1, H_2(p_b) = 1, q_1 = 1, \ q_2 = 0 \text{ (otherwise)} && (9)
\end{aligned}
$$

2

The equations in (8) define a set of ordinary differential equations (ODE) with the

boundary conditions provided in (9). This system of ordinary differential equations can be solved using the standard techniques for solving ODEs (see for e.g., Rainville and Bediant 1974), which gives the equilibrium price distribution functions $H_1(p)$, $H_{1e}(p)$, and $H_2(p)$. Then the equilibrium solutions for $\pi_1, \pi_{11}, \pi_{1e}, \pi_2, q1, q1e, q2, E(p1)$, $E(p1e)$ and $E(p2)$ can be obtained from (6),(7),(9) and their definitions. The results along with the solutions for p_b and p_m are given in Proposition 1 and 2 in the paper. The cutoff condition $k < 1 - b$ corresponds to the condition for $q_1 < 1$ (i.e., $p_m < 1$).

Proof of Proposition 3

In this subgame, firms are in Bertrand competition for the $ka + 2kb$ consumers who use the infomediary. Therefore, $p_{ie} = 0$. For the remaining market, a size of $(1 - k)b$ consumers each will buy from R1 (R2) and pay $p_1(p_2)$, a size of $(1 - k)a$ of consumers will buy from the dealer with lower store price. Thus, the competition in this case between the two firms using p_1 and p_2 is as if there was no infomediary but with the market size scaled down by $1 - k$. Therefore $\pi_i = (1 - k)b$ and $H_i(p) = \frac{b}{a}(\frac{1}{p} - 1)$ in the equilibrium.

Proof of Proposition 4

As discussed in the paper, if neither dealer enrolls, $\pi_i^N = b$. From Proposition 2, if only one dealer enrolls (say R1), we have that $\pi_1^S = b(1 - k)\frac{(1-b)^2 + bk}{(1-b)^2 - (1-2b)k}$ and $\pi_2^S = b[\frac{(1-b)^2(1-k)}{(1-b)^2 - (1-2b)k}]$ if $k < 1 - b$; or $\pi_1^S = b$ and $\pi_2^S = b(1-b)$ if $k \geq 1 - b$. From Proposition 3, if both dealers enroll, we have that $\pi_i^B = b(1-k)$.

Because, $\pi_2^B \geq \pi_2^S$ (the relationship holds with equality only if $k = 0$ or $1 - 2b = a = 0$), R2 will choose not to enroll if R1 enrolls. Thus both dealers enrolling in the infomediary cannot be an equilibrium. Hence the non-exclusive strategy can never be optimal for the infomediary.

For the case where only one dealer enrolls in equilibrium, we must have that $\pi_1^S > \pi_i^N$, which will hold if and only if $k < 1 - b$. The limp-sum payment the infomediary can charge (i.e. its profit) under this scenario is $\pi_1^S - \pi_2^S$, which can be achieved by charging $\pi_1^S - \pi_2^S$ to R1 and by (threatening) to charge $\pi_1^S - \pi_1^S$ to R2 if R1 rejects the offer. The threat is credible because $\pi_1^S - \pi_1^S > 0$ when $k < 1 - b$. This leads to the optimal contract and equilibrium profit for the infomediary as stated in Proposition 4.

Computing the Distributions of Realized (Observed) Prices

A size of $(1 - k)b$ R1-shoppers (R2-shoppers) always buy from R1 (R2) and pay $p_1(p_2)$ so that the observed price distributions pertaining to them is $H_1(p)$ $(H_2(p))$. A size of $(1 - k)a$ comparison shoppers pay $min(p_1, p_2)$, the observed price distribution from them given that they buy from R1 is $Pr(p_1 \geq p)|\min(p_1,p_2) = p_1) = \int_p^1 -H_2(p)dH_1(p)$; the observed price distribution from them given that they buy from R2 is $Pr(p_2 \geq p)|\min(p_1,p_2) = p_2) = \int_p^1 -H_1(p)dH_2(p)$. A size of kb R1-shoppers always buy from R1 and pay p_{1e} so that the observed price distribution pertaining to

3

them is $H_{1e}(p)$. A size of $ka + kb$ comparison shoppers pay $min(p_{1e}, p_2)$, the observed price distribution from them given that they buy from R1 is $Pr(p_{1e} \geq p)|\min(p_{1e}, p_2) = p_{1e}) = \int_p^{p_m} -H_2(p)dH_{1e}(p)$; the observed price distribution from them given that they buy from R2 is $Pr(p_2 \geq p)|\min(p_{1e}, p_2) = p_2) = \int_p^1 -H_{1e}(p)dH_2(p)$. The above distributions can be derived using the solutions in Proposition 2. Given those realized (observed) price distributions and the size of the segments, the average observed prices and price variances for different firms as well as for different segments can then be derived based on their definitions. After obtaining the closed-form solutions for the observed prices and price variances, we can calculate the values for those observed prices and price variances numerically across the full ranges of k and b. Because both k and b are within $[0, 1]$, we are able to examine the relationship of those measures w.r.t. k and b across the complete ranges of them in any precision needed. The key findings are reported in the paper.

Appendix B:

Heterogeneity in Infomediary Reach and Dealer Loyalty

The case where neither dealer enrolls is same to the case in Narasimhan (1988) where

firms have asymmetric loyalty, we have that $\pi_1 = b_1$ and $\pi_2 = \frac{(b_2 + a)b_1}{b_1 + a}$ if $b_1 > b_2$; or $\pi_2 = b_2$ and $\pi_1 = \frac{(b_1 + a)b_2}{b_2 + a}$ otherwise.

Consider the situation where only one dealer enrolls. Following an analysis similar to that for Proposition 1, we can show that the nature of equilibrium price support is unchanged here. Therefore, the profit function for R1 is

$$
\begin{aligned}
\pi_1 &= \pi_{11} + \pi_{1e}, \text{ where} &(10)\\
\pi_{11} &= (1 - k_b)bp_1 + (1 - k_a)aH_2(p_1)p_1 \quad (p_m \leq p_1 \leq 1)\\
\pi_{1e} &= k_b bp_{1e} + k_b bH_2(p_{1e})p_{1e} + k_a aH_2(p_{1e})p_{1e} \quad (p_b \leq p_{1e} \leq p_m),
\end{aligned}
$$

and the profit function for R2 is

$$
\pi_2 = (1 - k_b)bp_2 + (1 - k_a)aH_{11}(p_2)p_2 + k_b bH_{1e}(p_2)p_2 + k_a aH_{1e}(p_2)p_2. \quad (11)
$$

Solving the set of differential equations similar to the one that we did for Proposition 2 but with the profit functions given above, we obtain the following equilibrium results.

Define $H_{2m} = \frac{\frac{(1-k_b)b_2 + (1-k_a)a}{(b_2 + a)}(k_b b_1 + k_b b_2 + k_a a) - k_b b_1}{(k_b b_2 + k_a a)}$. If $H_{2m} > 0$ and $\frac{(1-k_b)(b_1 - b_2 H_{2m})}{[(1-k_b)b_1 + (1-k_a)aH_{2m}]} >$

0, then $\pi_{11} = (1 - k_b)b_1$, $\pi_{1e} = [k_b b_1 + (k_b b_2 + k_a a)H_{2m}]p_m$, $\pi_2 = (b_2 + a)p_b$, $p_m = \frac{\pi_{11}}{[(1-k_b)b_1 + (1-k_a)aH_{2m}]}$, $p_b = \frac{\pi_{12}}{(k_b b_1 + k_b b_2 + k_a a)}$.

If $H_{2m} > 0$ and $\frac{(1-k_b)(b_1 - b_2 H_{2m})}{[(1-k_b)b_1 + (1-k_a)aH_{2m}]} < 0$, then $\pi_{11} = [(1 - k_b)b_1 + (1 -$

$k_a)aH_{2m}]p_m$, $\pi_{1e} = (k_b b_1 + k_b b_2 + k_a a)p_b$, $\pi_2 = (1 - k_b)b_2$, $p_m = \frac{\pi_2}{[(1-k_b)b_2 + (1-k_a)a]}$, $p_b = \pi_2/(b_2 + a)$.

If $H_{2m} < 0$, then $\pi_{11} = (1 - k_b)b_1$, $\pi_{1e} = k_b b_1$, $\pi_2 = (b_2 + a)p_b$, $p_m = 1$, and

$p_b = \frac{k_b b_1}{(k_b b_1 + k_b b_2 + k_a a)}$.

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Also, we have that $H_{11}(p) = \frac{\pi_2}{(1-k_a)ap} - \frac{(1-k_b)b_2}{(1-k_a)a}$, $(1 > p > p_m)$; $H_{12}(p) = \frac{\pi_2}{(k_b b_2 + k_a a)p} - \frac{(1-k_b)b_2 + (1-k_a)a}{(k_b b_2 + k_a a)}$, $(p_m > p > p_b)$; $H_2(p) = \frac{\pi_{11}}{(1-k_a)ap} - \frac{(1-k_b)b_1}{(1-k_a)a}$, $(1 > p > p_m)$; and $H_2(p) = \frac{\pi_{12}}{(k_b b_2 + k_a a)p} - \frac{k_b b_1}{(k_b b_2 + k_a a)}$, $(p_m > p > p_b)$.

For the case where both dealers enroll in the infomediary, firms are in Bertrand

competition for the $k_a a + 2k_b b$ consumers who use the infomediary. Therefore, $p_{ie} = 0$. For the remaining market, the competition is similar to the case in Narasimhan (1988) where R1 has $(1 - k_b)b_1$ loyal consumers, R2 has $(1 - k_b)b_2$ loyal consumers, and there are $(1 - k_a)a$ switchers. Therefore $\pi_i = (1 - k_b)b_i$ and $\pi_j = \frac{[(1-k_b)b_j + (1-k_a)a](1-k_b)b_i}{(1-k_b)b_i + (1-k_a)a}$ if $b_i \geq b_j$.

Following the same logic as discussed in the proof for Proposition 4, we still have that the infomediary uses exclusive contract in equilibrium. It charges $\pi_1^S - \pi_2^S$ to R1 and (credibly) threatens to charge $\pi_1^S - \pi_1^S$ to R2 if R1 rejects the offer provided that $\pi_1^S - \pi_1^S > 0$. If $\pi_1^S - \pi_1^S \leq 0$, which will happen if $k_a \to 1$ and/or $k_b \to 1$, the infomediary unravels and gets no profit.

The Impact of Consumer Identification

Consider the case where only one dealer enrolls in the infomediary. The enrolled dealer, R1, can offer three different referral prices: p_{ae}, p_{be} and p_{ce}, for its own shoppers, R2's shoppers, and comparison shoppers respectively. R1's profit function now is

$$
\begin{aligned}
\pi_1 =\ & (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbmin(p_1, p_{ae}) + \\
& kbH_2(p_{be})p_{be} + kaH_2(min(p_1, p_{ce}))min(p_1, p_{ce}).
\end{aligned} \tag{12}
$$

From (12), it is obvious that $p_{ae} = p_1$ and $p_1 \geq p_{ce}$ in equilibrium. Following the same logic that we used in deriving the equilibrium of the basic model, we also have that $p_1 \geq p_{ce}$ in the equilibrium. Therefore, we have that

$$
\pi_1 = (1-k)bp_1 + (1-k)aH_2(p_1)p_1 + kbp_1 + kbH_2(p_{be})p_{be} + kaH_2(p_{ce})p_{ce} \tag{13}
$$

Again, following the same logic that we used in deriving the equilibrium of the basic model, we can prove that the lower bound of p_1 equals to the upper bound of p_{be} and p_{ce} in equilibrium. From (13), we can also see that the optimization problem for R1 with regarding to p_{be} and p_{ce} are the same. Thus, p_{be} and p_{ce} have the same distribution in the equilibrium, i.e. $H_{be}(p) = H_{ce}(p) = H_{1e}(p)$. Therefore, R2's profit function is

$$
\begin{aligned}
\pi_2 =\ & (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + kbH_{be}(p_2)p_2 + kaH_{ce}(p_2)p_2 \\
=\ & (1-k)bp_2 + (1-k)aH_{11}(p_2)p_2 + (kb + ka)H_{1e}(p_2)p_2,
\end{aligned} \tag{14}
$$

which is the same as in the basic model. The equilibrium solutions can then be derived using an approach similar to that used for the basic model. We obtain that in the equilibrium $\pi_{1e} = b + \frac{(1-k)kb(1-b)}{b+(1-k)^2(1-2b)}$, where $\pi_{11} = b$, $\pi_{1e} = \frac{(1-k)kb(1-b)}{b+(1-k)^2(1-2b)}$; $\pi_2 = \frac{(1-k)b(1-b)}{b+(1-k)^2(1-2b)}$; $p_m = \frac{b}{b+(1-k)^2a}$; $p_b = \frac{(1-k)b}{b+(1-k)^2a}$; $H_{11}(p) = \frac{\pi_2}{(1-k)(1-2b)p} - \frac{b}{(1-2b)}$; $H_{1e}(p) = \frac{\pi_2}{k(1-b)p} - \frac{(1-k)b}{k(1-b)}$; $H_2(p) = \frac{b}{(1-k)a}(\frac{1}{p}-1)$ for $(p_{1m} < p < 1)$, $H_2(p) = \frac{\pi_{1e}}{(1-b)kp}$ for $(p_b < p < p_m)$; $q_1 = \frac{b - b(1-k)^2}{b+(1-2b)(1-k)^2}$; $q_2 = 0$; $E(p_1) = \frac{\pi_2}{(1-k)(1-2b)}\ln(\frac{1}{p_m}) + q_1$; $E(p_{1e}) = \frac{\pi_2}{k(1-b)}\ln(\frac{1}{(1-k)})$; $E(p_2) = \frac{b}{a}\ln(\frac{1}{p_m}) + \frac{\pi_{1e}}{k(1-b)}\ln(\frac{1}{1-k})$.

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The equilibrium profits for each firm when neither firm enrolls and both firms enroll in the infomediary are the same as those in the basic model. Applying the same proof as that for Proposition 4, we have that the infomediary will use an exclusive contract by charging $\pi_1^S - \pi_2^S = b^2 \frac{1-(1-k)^2}{b+(1-2b)(1-k)^2}$ with a threat to charge $\pi_1^S - \pi_1^S = \frac{(1-k)kb(1-b)}{b+(1-k)^2(1-2b)}$ to R2 if R1 rejects the offer given that $\pi_1^S - \pi_1^S > 0$. Since $\pi_1^S - \pi_1^S > 0$ holds for any $k < 1$, the infomediary will not unravel in this case with consumer identification.

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