

Strategic Impact of Internet Referral Services on Channel Profits^{*}

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Abstract

Internet Referral Services, hosted either by independent third-party infomediaries or by manufacturers serve as “lead-generators” in electronic marketplaces, directing consumer traffic to particular retailers. In a model of price dispersion with mixed strategy equilibria, we investigate the competitive implications of these institutions on retailer and manufacturer pricing strategies as well as their impact on channel structures and distribution of profits. Offline, retailers face a higher customer acquisition cost. In return, they can engage in price discrimination. Online, they save on the acquisition costs, but lose the ability to price discriminate. This critical tradeoff drives firms’ equilibrium strategies.

The establishment of a referral service is a strategic decision by the manufacturer, in response to a third-party infomediary. It leads to an increase in channel profits and a reallocation of the increased surplus to the manufacturer, via the franchise fees. Further, it enables the manufacturer to respond to an infomediary, by giving itself a wider leeway to set the unit wholesale fee to the profit maximizing level. Interestingly, our results show that the manufacturer even benefits from the presence of the competing referral infomediary. Consistent with anecdotal evidence, our model predicts that while it is optimal for an infomediary to enroll only one retailer, it is optimal for a manufacturer to enroll both retailers. We discuss implications of referral services on channel coordination issues, and whether a two part tariff can be successfully used to maximize channel profits. Contrary to prior literature, we find that when retailers can price discriminate among consumers, the manufacturer may not set the wholesale price to marginal cost to coordinate the channel. Based on publicly available data, we numerically examine the predictions from our analytic model, and obtain results in accordance with anecdotal evidence. Our paper also has implications for the integration of the e-supply chain with the distribution chain, in industries such as the auto industry.

Keywords: *Referral Services, Price Dispersion, Franchise Fees, Acquisition Costs, Infomediary, Channel Management.*

1 Introduction

Consumers' affinity for neutral information has led to the emergence of a large number of independent sources on the Internet that offer high-quality information about firms' products, their availability and prices, at no cost to consumers. These infomediaries offer consumers the opportunity to get price quotes from enrolled brick-and-mortar retailers as well as invoice prices, reviews and specifications. While a referral service does not, in fact, "sell" any product, it does shift much of the consumer search process from the physical platform of the traditional retailer to the virtual world of the Web.

Consider the auto industry in the U.S. - an industry with \$ 500 billion in revenues (new cars and light trucks). Auto manufacturers are prohibited by franchise laws from selling directly to consumers. Both infomediaries and manufacturers now offer web-based referral services, which are growing in popularity. Industry-wide, 6% of all new vehicles in 2001 were sold through an online buying service, up from 4.7% in 2000.¹ In 2001, Autobytel generated an estimated \$17 billion in car sales.²

Given the advent of such third-party referral brokers, the major OEMs like GM and Ford have set up their own referral websites such as GMBuyPower.com and FordDirect.com. From these sites, consumers can configure a new car, receive the list price and be led to a dealer site for inventory and quotes. The payoff to improving such a referral website can be substantial. It is estimated that an \$800,000 effort to fix common website problems can create \$250,000 of additional leads per month at an average manufacturer site.³ Crucially, manufacturers provide referrals to dealers free of cost, while third-party infomediaries charge referral fees to participating dealers.

Selling directly establishes the manufacturer as a direct competitor to its reseller partner, potentially leading to channel conflict. Hence, firms in other industries are also beginning to use their own websites to steer consumers to retailers. For example, IBM takes orders for PCs over the Web, but redirects the sales to its distributors (Girishankar, 1998). Hewlett-

¹ "More Car Buyers Hitting the Web First," www.EcommerceTimes.com, 11/27/01.

² "Autobytel Survey," www.CNET.com, 06/25/02.

³ "Get ROI From Design", Forrester Report, June 2001.

Packard’s “Commerce Center” is not an on-line store per se—it simply gives business customers an easy, point-and-click way to order from an HP reseller.⁴ On the other hand, manufacturers compete with third-party infomediaries like CNET.com in the lead generation business. Clemons and Aron (2002) analyze several business models that have failed because of channel conflict, and the notable few that have survived and succeeded. Clemons, Gu and Row (2001) provide a theoretical framework to describe and define the features of “Newly Vulnerable Markets”.

The conventional wisdom on Internet referral infomediaries (or online buying services as they are increasingly being called), is that they are valuable to consumers because they reduce the search costs of comparing prices in electronic markets (Bakos 1997) and get binding price quotes from retailers. Less clear is the role of these infomediaries for the manufacturer and the retailers. In addition, a manufacturer’s entry into the online referral business has implications for pricing, allocation of channel profits and retail competition. The effect of such referral competition between a manufacturer and a third-party infomediary, on the division of channel profits has not been studied previously. Models that analyze firm conduct and coordination in distribution channels (Jeuland and Shugan, 1983; Moorthy, 1987; Ingene and Parry 1995), typically do not consider the influence of third-party infomediaries on channel strategies.⁵

In a related paper, Chen, Iyer and Padmanabhan 2002 (hereafter CIP) examine how an infomediary affects the market competition between retailers. They also consider the impact of changes in the reach of the infomediary, and also optimal contracts between the infomediary and enrolled retailer. Our paper differs from their work in many important areas. First, consumers in our model are heterogenous in two dimensions. While CIP (2002) consider heterogeneity only in consumer search behavior, we also consider heterogeneity in consumer valuations for the same product. Second, a key feature in our model is incorporation of a difference between online and offline acquisition costs incurred by retailers in serving each prospective customer. This is based on empirical evidence as pointed out by Scott-Morton and Zettelmeyer (2001). Third, another critical aspect in our model is a retailer’s ability to

⁴Garner, R. (1999). “Mad as hell,” June 1, 54, Sales & Marketing Management

⁵The literature on selling through multiple channels with price dispersion includes Hendershott and Zhang (2003)

infer consumer valuations offline. However, online they lose this ability. Fourth, and perhaps the most important difference is that the focus of our paper is the impact of an upstream manufacturer’s referral service on the behavior of downstream retailers and channel profits, given the presence of an infomediary. We also shed light on the consequences of referral services on channel coordination issues in our paper.

We consider a model with a distribution channel consisting of a manufacturer, an infomediary, and two retailers. We focus, in particular, on the response of the manufacturer to the presence of an infomediary. Since, consumers are heterogenous both in their valuations and in search behavior, price dispersion exists in equilibrium. Price dispersion has been extensively studied, both theoretically (Varian, 1980, and Narasimhan, 1988, for example) and empirically (Brynjolfsson and Smith, 2000 and Clemons, Hann and Hitt, 2002). There is a growing literature on the impact of the Internet and Internet based institutions on price competition (Baye and Morgan 2001). One goal of this paper is to bridge the vast literatures on channel management and price dispersion.

In our model, the online sales environment results in lower customer acquisition costs. However, it also offers retailers less information about a consumer’s willingness to pay. In the offline channel, consumers physically walk into stores, and retailers are able to determine willingness to pay, via a costly negotiation process. This enables them to discriminate offline between high and low valuation consumers. Online, they lose this ability to discriminate. In an industry such as the auto industry, purchases are infrequent, with significant time gaps. In such a setting, it is reasonable to think of consumer preferences changing from one purchase to the next, and hence of a lack of availability of consumer valuation information, online.

1.1 Research Questions and Results

In this setting, we examine the following questions.

- What strategic implications does the entry of a referral infomediary have for an upstream manufacturer? How do referral services, both independent and manufacturer-sponsored, affect the optimal pricing strategies of retailers in a channel?

- If a manufacturer cannot sell directly to consumers, can it still extract higher profits from the channel by diverting traffic online? How does the two-part tariff (wholesale price and franchise fee) change these circumstances?
- Should the manufacturer follow an exclusive or a non-exclusive strategy of enrolment vis-a-vis an infomediary? Can, and should it eliminate the referral infomediary?

We find that, first, the establishment of manufacturer referral services, along with the strategic utilization of the wholesale price leads to an increase in channel profits and a reallocation of some of the increased surplus, through its franchise fee, to the manufacturer. The impetus to increased profits comes from three sources: (i) mitigation of price competition among downstream retailers by the adjustment of the wholesale price by the manufacturers, (ii) retailers' ability to price discriminate between informed and uninformed consumers, and (iii) by the lowering of acquisition costs of each retailer due to diversion of traffic from the offline to the online channel. Under some conditions (when offline acquisition costs are high enough), the two-part tariff is able to achieve higher channel profits than those under a vertically integrated system.

Second, we find that the manufacturer even benefits from the presence of the infomediary, once it has established its own referral service. Basically the infomediary's referral price prevents the enrolled retailer from spiralling into aggravated price competition with the other retailer, by creating sufficient differentiation in consumers' search behavior. This leads to higher prices on an average for both retailers. Consequently, the manufacturer might not want to strategically eliminate the infomediary. In fact, it cannot eliminate the infomediary even if it wants to. It can adjust the wholesale price to reduce the advantage that the infomediary-enrolled retailer has due to price discrimination. However, the presence of the infomediary also reduces acquisition costs for the enrolled retailer, allowing the infomediary to capture some of the gains. Consequently as long as consumers are widely heterogeneous in their search behavior, the referral infomediary will continue to survive.

Third, we show that the optimal wholesale price (W) of the manufacturer offering a two-part tariff, is not equal to its marginal cost. Rather, it is set to equal the valuation of

the low type consumers in the market. This choice of W also maximizes the total channel profits. This is in contrast to prior literature where it has been shown that in a two-part tariff setting the wholesale price to marginal costs achieves channel coordination. This is driven by the fact that retailers can price discriminate in the offline channels. Basically, by charging a higher wholesale price the upstream manufacturer is able to enforce an equilibrium which leads to higher profits for each retailer, by alleviating price competition among the downstream players. Thus the establishment of a referral service by the manufacturer enables it to respond to the entry of an infomediary, by giving itself a wider leeway to set the unit wholesale fee to the profit maximizing level.

Fourth, average online prices are lower than offline prices for the retailer enrolled with the infomediary, for the high valuation consumers.⁶ Conversely, for the low valuation consumers, the average referral prices are higher than offline prices. Empirical evidence from Scott-Morton et al. (2003a), and Zettelmeyer et al.(2003), provides some testimony to this finding of price dispersion between offline and online channels. They also find evidence that lower prices are correlated with higher income levels. Further, the prices offered by retailers to users of the manufacturer’s referral service are higher than infomediary referral prices. This is similar in notion to an “MSRP” which is the highest possible price consumers are expected to pay under normal market conditions. Thus this result also reconciles well with practice and empirical evidence (Scott-Morton et al. 2003b).

Fifth, we show that a manufacturer has an incentive to enroll both retailers in its referral service. This is in accordance with anecdotal evidence, which suggests that a manufacturer does not differentiate between its dealers in this regard. One possible explanation of this practice could simply be to avoid the Robinson-Patman Act which prohibits manufacturers from discriminating between retailers. Our model shows that there is also a strategic incentive for the manufacturer to adopt a non-discriminatory policy and enroll both retailers in its referral service.

Finally, our model provides some insights into the closing efficiency of such referral services. Since in practice, a referral request is not a costless process, a significant parameter

⁶A similar result is shown by CIP (2002).

which all players need to keep in mind is the average closing ratio of this mechanism. This is because online buying services monitor the percentage of referrals that result in a sale, and if the percentage is too low, the dealer may be terminated and replaced by another dealer in that area. We find that our results are in accordance with anecdotal evidence.

This paper, therefore, offers a different viewpoint on how manufacturers can increase profits by diverting consumer traffic into online channels and optimally setting a two-part tariff. In the auto industry, manufacturers cannot directly sell to consumers. However, they can extract higher profits from the channel by increasing their franchise fee and changing their per-unit fee. This provides them with an incentive to reduce the acquisition costs in the channel by inducing more consumers to visit their online referral services. The tradeoff is that, since consumer purchases in this industry are infrequent, little information about consumers is available online without face-to-face interaction. Offline, a retailer is able to infer a consumer's willingness to pay by being exposed to cues like clothing and body language. We show that the cost savings dominate any losses due to the absence of online information. Further, in the presence of competition from a third party infomediary, a manufacturer can use a referral service as a device to regain some control over the channel. While we touch upon the channel coordination problem for a manufacturer using a two-part tariff and highlight circumstances when it can coordinate the channel, we abstract away from offering any mechanisms as solutions to the coordination problem. A complete analysis of channel coordination mechanisms will require a downward sloping demand curve, which is beyond the scope of our model.

The rest of this paper is organized as follows. Section 2 reviews the related research and presents the basic model. Section 3 examines a benchmark case when no referral services exist, while Section 4 analyzes the effect of the infomediary on retail competition. In Section 5 we examine the impact of manufacturer referral services on equilibrium strategies and policies, and provide some empirical corroboration of our results. Section 6 provides some business implications, while Section 7 concludes with a brief summary of the main results and some possible extensions. All proofs are relegated to the Appendix.

2 Model

2.1 Retailers and Manufacturer

We consider a market with a single manufacturer and two competing retailers, D_1 and D_2 . The manufacturer charges the retailers a franchise fee, F and optimally sets the wholesale price of the good charged to the retailers, W .

We analyze the retailing world under three scenarios: (i) with no referral services (ii) with a referral infomediary, and (iii) with a referral infomediary as well as a manufacturer referral website. The referrals are online, so in scenarios (ii) and (iii), the retailers make some online sales in addition to offline ones. All sales are offline in scenario (i).

Retailers incur an acquisition cost, δ , for each offline customer catered to. δ represents the difference in acquisition costs between offline and online customers. This includes the cost of time spent in providing product information and in negotiation, offering test drives, and completing paperwork. Ratchford, et al (2002) shows that the Internet leads to a considerable reduction in consumer time spent with dealer/manufacturer sources. Since our results depend only on the difference between offline and online acquisition costs, the online cost is set to a benchmark of zero. The tradeoff faced by a retailer is that, offline, it can perfectly observe a consumer's valuation via negotiation. This is tied to the offline acquisition cost; the negotiation process, while costly to the retailer, also yields greater information about a consumer's valuation for the good. Hence, the offline price offered to a consumer depends on this valuation, allowing for price discrimination. Online, the valuation is hidden from the retailer, so it loses the ability to price discriminate in this fashion.

2.2 Referral infomediary

The referral infomediary enrolls one retailer, D_2 , and allows consumers to obtain an online price quote from this retailer. The infomediary charges the retailer a fixed referral fee of K . Firms like Autobytel.com and Carpoint.com charge an average fixed monthly fee of around \$1,000 depending on dealer size and sales (Moon 2000). If the infomediary enrolled both retailers, Bertrand competition would prevail in the online segments, with prices equal to

marginal cost, as shown in the Appendix B.⁷ Therefore, the infomediary can charge a higher fee when it enrolls just one retailer. In practice, too, dealers are assigned exclusive geographic territories by infomediaries (see Moon 2000).

2.3 Consumers

The market consists of a unit mass of consumers. Consumers are heterogeneous both in terms of their valuation, and in their search behavior, which determines the market segment they belong to. A consumer's valuation for the good is either high, V^h , or low, V^ℓ , where $V^h > V^\ell > 0$. The proportion of high valuation consumers is λ_H , and that of low valuation consumers is $\lambda_L = 1 - \lambda_H$. Each consumer buys either zero or one unit of the product.

Consumers belong to different market segments. The notion of market segments allows for the existence of consumers with both different levels of awareness about alternate avenues for price quotes, and different search behaviors. Depending on the segment she belongs to, a consumer observes a different set of prices for the good. A consumer with valuation j ($j = h, \ell$) buys the product if her net utility is positive; i.e., $V^j - P_{\min} \geq 0$, where P_{\min} is the minimum price offered to this consumer.⁸

There are three distinct consumer segments: a proportion α_u of “uninformed” consumers who are unaware of the existence of an infomediary and obtain a price from just one retailer, a proportion α_p of “partially informed” consumers who obtain a price from one retailer and the referral infomediary (when it exists), and a proportion $1 - \alpha_u - \alpha_p$ of “fully informed” consumers, who obtain prices from both retailers as well as the referral infomediary. When the manufacturer has its own referral site, each of these three segments further subdivides into two: a proportion β of consumers in each segment behave exactly as before, whereas a proportion $1 - \beta$ obtains online prices via the manufacturer's website.

When a consumer approaches a retailer for a price quote, the retailer is unable to distinguish which market segment a consumer belongs to. In other words, either offline or online, a retailer cannot determine if a particular consumer belongs to the uninformed, partially or

⁷Since this has also been shown by CIP 2002 in their model, we do not make it a focus of our paper.

⁸To keep the setup generalized, we do not assume any correlation between consumer valuations and search behavior. While there is empirical evidence that higher income people are more likely to have access to the Internet, there is also countervailing evidence that they have more search costs.

fully informed segments. Offline, the retailer is able to determine the consumer's valuation for the product.

3 Offline World: No Referral Services Exist

We now analyze each of the three scenarios mentioned, in turn, starting with the case of no referral services. Each of the scenarios is described as a multi-stage game. We consider a subgame-perfect equilibrium of the game in each case, and therefore analyze the game via backward induction.

When neither the referral infomediary nor the manufacturer referral service exist, the stages in the game are as follows:

Stage 1: The manufacturer sets the franchise fee, F and the optimal wholesale price W for each retailer.⁹

Stage 2: Retailers simultaneously choose retail prices $(P_1(V^h), P_1(V^\ell))$ and $(P_2(V^h), P_2(V^\ell))$.

Stage 3: Consumers decide which product to buy.

Consider the three market segments:

(i) uninformed consumers, of market size α_u , observe just one offline price from one retailer.

We assume these consumers are equally likely to visit D_1 and D_2 .

(ii) partially informed consumers, of size α_p , behave in exactly the same way as uninformed consumers when there is no infomediary. Hence, these consumers also visit D_1 and D_2 with equal probability.

(iii) informed consumers, of size $1 - \alpha_u - \alpha_p$, obtain prices from both retailers.

The prices observed by consumers in different market segments are depicted in Figure 1. In the offline world, the retailers perfectly observe each consumer's valuation. Hence, the prices offered to consumers depend on their valuations, as shown in the figure.

Since consumer valuations are observed offline, this basic model reduces to that of Varian (1980). Using similar arguments as in Varian (1980) and Narasimhan (1988), we can show that no pure-strategy equilibrium exists in the subgame that starts at stage 2. There is,

⁹The assumption that the manufacturer charges a uniform wholesale price to both retailers stems from the non-discrimination requirements of the Robinson-Patman Act.

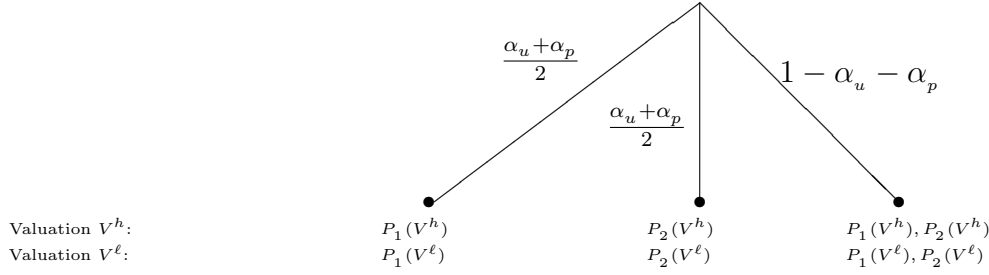


Figure 1: Prices observed by each consumer segment when no referral service exists

however, a symmetric mixed-strategy equilibrium in which both retailers have equal market shares and offer randomly chosen prices to the consumers.¹⁰ Retailers have monopoly power over those consumers who observe only one price, providing an incentive to charge higher prices. However, retailers also aim to attract those customers who observe multiple prices, which in turn, offers an incentive to reduce prices. The interplay of these two forces results in price dispersion. Let $G_j^i(P)$ denote the probability that retailer j , where $j = 1, 2$, sets a price higher than P for consumer type V_i , where $i = \ell, h$. For example, $G_1^h(P) = \text{Prob}(P_1(V^h) \geq P)$ where $P_1(V^h)$ is the price offered by D_1 to consumer type V^h . Since the equilibrium we consider is symmetric, both dealers adopt the same price distribution, $G^i(P)$, for each consumer type.

Lemma 1 (i) *The manufacturer optimally sets $W^o = V^\ell$.*

(ii) *In equilibrium, each retailer charges V^ℓ to low-type consumers and randomly chooses a price from the interval $[V^\ell, V^h]$ for the high-type consumers, with $G^h(P) = \frac{\alpha_u + \alpha_p}{2(1 - \alpha_u - \alpha_p)} \left(\frac{V^h - P}{P - W} \right)$.*

(iii) *the expected profit of the manufacturer is $\pi^o = (\alpha_u + \alpha_p)\lambda_h(V^h - V^\ell) + V^\ell - \delta$.*

The proof of this and all other results is in the Appendix. The market share of each retailer amongst consumers with valuation i is

$$E(S_i) = \int_{\hat{P}_i^h}^{V^i} \left\{ \frac{\alpha_p + \alpha_u}{2} + (1 - \alpha_p - \alpha_u)G_i(P) \right\} \left(-\frac{dG_i}{dP} \right) dP = \frac{1}{2}.$$

as expected. Now, at stage 1, the manufacturer chooses the maximum franchise fee such that the retailers earn a non-negative profit (else they will choose to not participate). In

¹⁰The problem of the existence of equilibria in discontinuous games has been already addressed by Theorem 5 of Dasgupta and Maskin (1986), and Maskin (1986) and, more recently by Reny (1999).

accordance with prior literature (for example, Rey and Stiglitz, 1995; Iyer 1998), we assume the large manufacturer wields bargaining power over the small retailers, who earn a reservation profit of zero. Therefore, the optimal franchise fee charged by the manufacturer is equal to the profit of each retailer, i.e.,

$$F = \frac{\alpha_u + \alpha_p}{2} (\lambda_H V^h + \lambda_L V^\ell - V^\ell) - \delta(1 - \frac{\alpha_u}{2} - \frac{\alpha_p}{2}).$$

If, retailers had a positive reservation profit, R , the equilibrium franchise fee would be $F = \frac{\alpha_u + \alpha_p}{2} (\lambda_H V^h + \lambda_L V^\ell - W) - \delta(1 - \frac{\alpha_u}{2} - \frac{\alpha_p}{2}) - R$. In later sections, this implies that the manufacturer and infomediary capture all the gains from increased channel profits. If the retailers also had some bargaining power, we would expect them to share in such gains.¹¹ Thus total channel profits are equal to

$$2F + W = (\alpha_u + \alpha_p) \lambda_H (V^h - V^\ell) + V^\ell - \delta(2 - \alpha_u - \alpha_p). \quad (1)$$

Moorthy (1987) showed that in a channel, a simple contract (i.e., two-part tariff) consisting of a fixed fee and a variable wholesale price is sufficient for coordination. Coordination in distribution channels implies the use of contracts to manage the behavior of independent retailers to achieve the profits that would have otherwise been generated under vertical integration. For the manufacturer this means designing a contract which (1) maximizes the total channel profits and (2) transfers the profits at the retail level back to the manufacturer. In contrast, in an uncoordinated channel arrangement, the manufacturer will sell the product to the retailers for a simple wholesale price.

A vertically integrated manufacturer selling directly offline, would accrue total profits equal to

$$\lambda_H V^h + \lambda_L V^\ell - \delta = \lambda_H (V^h - V^\ell) + V^\ell - \delta. \quad (2)$$

This expression represents the maximum achievable channel profits offline. From a comparison of the profits under the integrated and the decentralized system, i.e., equations (1) and (2), it is immediate that the two part-tariff is unable to achieve channel coordination since $\alpha_u + \alpha_p < 1$.

¹¹For instance, using a simultaneous Nash bargaining model, if we assume that the η is a measure of the retailers' bargaining power ($\eta \in (0, 1)$), then manufacturer would earn $(1 - \eta)F$ while the retailers would earn ηF .

4 Model with Referral Infomediary

Next, we consider a model in which a referral infomediary enrolls one retailer (specifically, D_2), and enables some consumers to obtain an online price from this retailer. There are now four stages to the game:

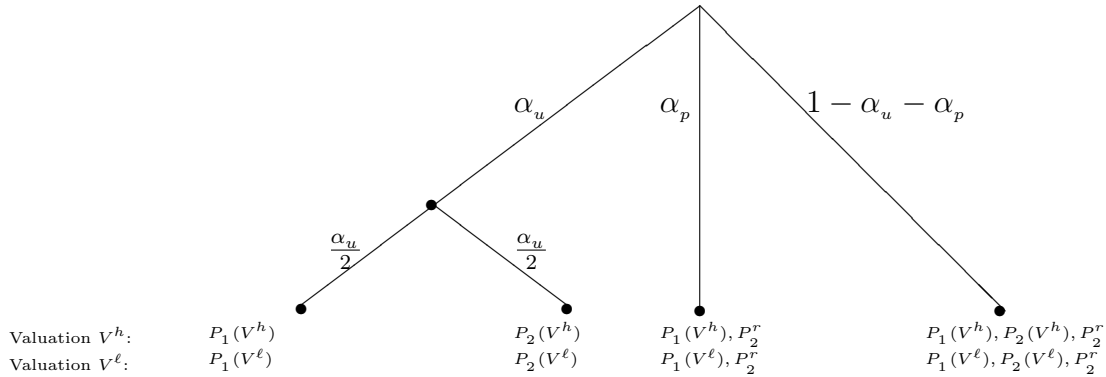
Stage 1: The manufacturer sets the franchise fee, F and wholesale price W .

Stage 2 : The referral infomediary enrolls D_2 , and sets a referral fee, K .

Stage 3: Retailers simultaneously choose prices. D_1 chooses $(P_1(V^h), P_1(V^\ell))$, as before, and D_2 chooses $(P_2(V^h), P_2(V^\ell))$ for offline consumers, and P_2^r for online consumers (who access the retailer via the referral infomediary).

Stage 4: Consumers decide which product to buy.

As before, uninformed consumers obtain just one offline price, and visit the two retailers in equal proportion. Partially informed consumers obtain an offline price from D_1 , and an online price from D_2 . These consumers find it easier to search online, so choose to obtain an online price, via the referral infomediary. Since this price comes from D_2 , they visit D_1 for an offline price. Fully informed consumers obtain an offline price from each retailer, as well as an online price from D_2 . The prices observed by consumers in different market segments are depicted in Figure 5. Note the difference with the model with no infomediary: offline consumers still obtain a price that depends on type, but online consumers must receive a price independent of type.



Retailers are now asymmetric in terms of the number of consumers who observe their

prices. This model, therefore, builds on Narasimhan (1988), who considers asymmetric firms. Further, D_2 can now quote more than one price to consumers in fully informed segment, allowing for price discrimination across segments. The model in this section is similar to CIP (2002), but with the multiple differences outlined in the Introduction.

Each retailer now has a captive segment of size $\frac{\alpha_u}{2}$ while a proportion α_p of the population see two prices, $(P_2^r, P_1(V^h))$ or $(P_2^r, P_1(V^\ell))$, depending upon their types V_i . In equilibrium, D_2 uses the infomediary as a price discriminating mechanism: it extracts full surplus from all offline consumers (i.e., these consumers are just charged their valuations), and a lower (random) price to online consumers.

In equilibrium, offline high type consumers are charged V^h . D_2 , in fact, captures the entire surplus from the high valuation customers in its captive uninformed segment, so that $P_2(V^h) = V^h$. The price quoted to the infomediary consumers, P_2^r is randomly chosen, and is used to compete against D_1 in the informed segments. Define $\hat{W} = \frac{V^\ell - \lambda_h V^h}{1 - \lambda_h}$. Then, $\lambda_h = \frac{V^\ell - \hat{w}}{V^h - \hat{w}}$.

Assumption 1 $\lambda_h \leq \frac{V^\ell}{V^h}$.

If the proportion of high-value consumers is very high, the retailers will find it optimal to ignore the low-value consumers, and sell only to the high-value consumers. In particular, the manufacturer will charge $W = V^h$ in the case that $\delta = 0$, or W as high as possible (but below V^h) when δ is positive. Define this latter value to be \bar{W} . In specific, this will involve $W > V^\ell$, so no low-value consumers will be served. However, the more interesting case of our model is that both types of consumers are served.

Notice also that it cannot be optimal for the manufacturer to charge any $W \in (V^\ell, \bar{W})$, since again the low-value consumers will be shut out of the market (since retailers will charge a price no lower than W). Hence, consider the choice of W in the region $[0, V^\ell]$. In the next Proposition, we show that the equilibrium changes as the manufacturer changes W . In particular, when the wholesale price is low, retailer prices are in turn low as expected. However, for $W \geq \hat{W}$, retailer prices are higher.

Proposition 1 (a) Suppose the manufacturer chooses a wholesale price $W \geq \hat{W}$. Then, there exists an equilibrium in which

(i) $P_2(V^h) = V^h$, and the prices $P_1(V^h)$ and P_2^r are randomly chosen from $[\hat{P}^h, V^h]$ where $\hat{P}^h = W + \frac{\alpha_u(V^h-W)}{(2-\alpha_u)}$. Further, $G_2^r(P) = \frac{\alpha_u(V^h-P)}{2(1-\alpha_u)(P-W)}$ and $G_1^h(P) = \frac{\alpha_u(V^h-W)}{(2-\alpha_u)(P-W)}$, with a mass point at V^h equal to $\frac{\alpha_u}{2-\alpha_u}$.

(ii) the prices $P_1(V^\ell)$ and $P_2(V^\ell)$ are randomly chosen from $[\hat{P}^\ell, V^\ell]$, where $\hat{P}^\ell = W + \frac{(\alpha_u+2\alpha_p)(V^\ell-W)}{2-\alpha_u}$. The price distributions satisfy $G_1^\ell(P) = \frac{\hat{P}^\ell-W}{P-W} - \frac{\alpha_u}{2(1-\alpha_u-\alpha_p)} \frac{P-\hat{P}^\ell}{P-W}$, with a mass point at V^ℓ equal to $\frac{2\alpha_p}{2-\alpha_u}$, and $G_2^\ell(P) = \frac{\alpha_u+2\alpha_p}{2(1-\alpha_u-\alpha_p)} \frac{V^\ell-P}{P-W}$.

(iii) D_2 may have lower sales but always has a higher gross profit than D_1 .

(b) Suppose the manufacturer chooses a wholesale price $W < \hat{W}$. Then, there exists an equilibrium in which

(i) $P_1(V^h) = P_2(V^h) = V^h$ and $P_2(V^\ell) = V^\ell$.

(ii) The prices $P_1(V^\ell)$ and P_2^r are randomly chosen from $[\hat{P}^\ell, V^\ell]$ where $\hat{P}^\ell = W + \frac{(V^\ell-W)\alpha_u}{(2-\alpha_u)}$. Further, $G_2^r(P) = \frac{\alpha_u(V^\ell-P)}{2(1-\alpha_u)(P-W)}$ and $G_1^\ell(P) = \frac{\alpha_u(V^\ell-W)}{\lambda_L(2-\alpha_u)(P-W)} - \frac{\lambda_H}{\lambda_L}$, with a mass point at V^ℓ equal to $\frac{\alpha_u}{\lambda_L(2-\alpha_u)} - \frac{\lambda_H}{\lambda_L}$.

(iii) D_2 always has higher sales and higher gross profits than Retailer 1.

The entry of the referral infomediary leads to an increase in competition between the two retailers. Essentially, D_2 now has two weapons: it uses P_2^r to compete with D_1 , and $P_2(V^h)$ and $P_2(V^\ell)$ to capture the entire consumer surplus from its captive uninformed segment. The online infomediary referral price, P_2^r , is therefore used to discriminate between uninformed and informed consumers. Since $P_2(V^h) = V^h$, it is immediate that the infomediary referral price is less than the offline price offered to high valuation consumers. This is consistent with the results of CIP(2002). Further Scott-Morton et al. (2001) point out that the average customer of Autobytel pays approximately 2% less for her car which corresponds to about \$450 of savings.

While at first glance it might seem odd that higher valuation customers purchasing from D_2 pay lower offline prices than the corresponding referral prices, Zettelmeyer et al. (2003a) find some testimony to this effect. They find that consumers with higher income, get lower

car prices via Autobytel. If we expect income and valuation to be correlated, then our result is in accordance with empirical result.

Note that the heightened competition due to the entry of the infomediary results in the lowering of the minimum price \hat{P}^h charged by the retailers to the partially and fully informed segments, by an amount $\frac{2\alpha_p(V^h-W)}{(2-\alpha_u-\alpha_p)(2-\alpha_u)}$. As the size of the partially informed segment α_p increases, this minimum price falls. This is intuitive because, with the advent of the infomediary, the two firms compete more strongly for this particular segment. Further, the average offline prices for the low types also decrease.

Corollary 1.1 *Manufacturer profits are higher when it chooses a $W \geq \hat{W}$, compared to $W < \hat{W}$.*

This result shows that by strategically choosing the wholesale price the manufacturer is able to enforce the equilibrium which gives it higher profits. Note that prior literature has shown that setting a per unit fee equal to the manufacturer's marginal cost (which is zero in our model) can maximize manufacturer and channel profits. However, we show that this policy does not hold in the case when retailers can price discriminate among consumers. In particular, setting a wholesale price equal to 0 leads to an equilibrium where manufacturer profits are given by

$$\alpha_u(\lambda_H(V^h - V^\ell) + V^\ell) - \delta(2 - \alpha_u). \quad (3)$$

whereas setting a wholesale price equal to V^ℓ leads to the equilibrium wherein total manufacturer profits are

$$\alpha_u(\lambda_H(V^h - V^\ell)) + V^\ell - \delta(2 - \alpha_u). \quad (4)$$

The difference occurs because in the former, average prices are lower as retailers end up competing fiercely. Conversely, setting a higher wholesale price alleviates the extent of price competition between downstream retailers. Clearly then it is optimal for the manufacturer to utilize its wholesale pricing policy to maximize both its own profits and the channel profit. Given the equilibrium, we can now determine the sales and profit of each retailer. The

superscripts m and I on expected profits, franchise and referral fees, denote the scenarios with and without manufacturer referral services.

Due to the presence of the mass point, the average offline price of D_1 for the low valuation customers, $P_1(V^\ell)$, is higher than the average offline price of the infomediary enrolled retailer D_2 for low types, $P_2(V^\ell)$. This result reconciles well with empirical evidence of Scott-Morton et al., (2003) who show that average prices for an Autobytel affiliated dealer are lower than other dealers by about 0.5% even in the offline world.

In equilibrium D_1 makes all its sales at its physical store. This includes a portion $\frac{\lambda_H \alpha_u}{2}$ made at V^h to the high valuation consumers in the uninformed segment, a portion $\frac{\lambda_L \alpha_u}{2}$ made at V^ℓ to the low valuation consumers in the uninformed segment and a portion $\lambda_L (\frac{1-\alpha_u+\alpha_p}{2})$ made at V^ℓ to the low valuation consumers in the partially and fully informed segments. Using $P_1(V^h)$, it also makes sales $\lambda_H (\frac{(1-\alpha_u)^2}{2-\alpha_u})$, to the high valuation consumers in the partially and fully informed segments. D_2 makes some online sales, $\lambda_H (\frac{1-\alpha_u}{2-\alpha_u})$, at the referral price, P_2^r , in the partially and fully informed segments, and some offline sales $\lambda_L (\frac{1-\alpha_u-\alpha_p}{2})$ to the low valuation segments, in these two segments. Further, it makes some sales at its physical store in the uninformed segment ($\frac{\lambda_H \alpha_u}{2}$ and $\frac{\lambda_L \alpha_u}{2}$, respectively, to the high and low valuation consumers in this segment). Thus the “reach” of the infomediary is equal $1 - \alpha_u$, the sum of the partially and fully informed segments.

Sales made through the online referral mechanism incur no acquisition cost. However for every customer who walks in at the physical stores, retailers incur an acquisition cost of δ . The gross profit of D_2 (i.e., without accounting for the franchise and referral fees) is higher than that of D_1 due to three reasons: (i) there is a reallocation in its total sales (ii) its acquisition costs decrease since some consumers shift online, and (iii) its ability to price discriminate improves, and it can charge a monopoly price to the uninformed segment.

In equilibrium, the manufacturer will set its franchise fee equal to the lower of the two gross profits, that is, the expected gross profit of D_1 . The optimal referral fee charged by the infomediary will be the difference in profits between D_2 and D_1 . Compared to the offline situation, D_1 is now making its sales at a smaller expected price due to aggravated price competition. Further, it serves more prospective customers because all but D_2 's captive

(uninformed) customers visit D_1 . This leads to an increase in D_1 's acquisition costs. Thus the gross profit of D_1 (i.e., without subtracting off the fixed franchise fee) must decrease. Hence the franchise fee of the manufacturer decreases with the entry of the infomediary, as is evident from Proposition 2 below. The total channel profits are given by

$$2F^I + W + K^I = \left(\frac{\alpha_u(3 - 2\alpha_u)}{2 - \alpha_u}\right)(\lambda_H(V^h - V^\ell)) + V^\ell - \delta(2 - \alpha_u - \alpha_p). \quad (5)$$

Comparing this to the total channel profits in the absence of an infomediary, it is easy to show that the entry of the infomediary leads to an increase in total channel profits under some conditions. This is formally stated below.

Proposition 2 *Suppose $(1 - \alpha_u - 2\alpha_p\lambda_L) > 0$. Then,*

(i) *The optimal wholesale price for the manufacturer is $W^I = V^\ell$. This choice of W also maximizes total channel profits.*

(ii) *The optimal franchise and referral fees, respectively, are*

$$F^I = \lambda_H(V^h - V^\ell) \left(\frac{\alpha_u}{2}\right) - \delta\left(1 - \frac{\alpha_u}{2}\right).$$

$$K^I = \frac{\lambda_H \alpha_u (1 - \alpha_u)}{2 - \alpha_u}(V^h - V^\ell) + \alpha_p \delta.$$

(iii) *If $\frac{\alpha_u}{\alpha_p} > \frac{2 - \alpha_u}{1 - \alpha_u}$, total channel profits increase with the entry of the infomediary, so that $2F^I + K^I + V^\ell > 2F^o + V^\ell$.*

This choice of W goes some way towards channel coordination; total manufacturer and channel profits are maximized. However, since the infomediary is a competing third-party, the manufacturer cannot really extract all of the infomediary's profit. Even if the manufacturer adjusts the wholesale price to eliminate any advantage that the infomediary-enrolled retailer has due to price discrimination, it cannot eliminate acquisition costs that accrue in the offline channel. Consequently, the infomediary-enrolled retailer will benefit from enrolment and the infomediary will continue to survive, no matter how the manufacturer adjusts the two-part tariff. As a result, the manufacturer will be unable to extract all the channel profits. Thus this highlights that in the presence of third-party referral services, a two-part tariff is able to achieve only partial channel coordination.

Consider the condition $(1 - \alpha_u - 2\alpha_p\lambda_L) > 0$ in the statement of Proposition 2. In the absence of the infomediary, by setting the wholesale price at V^ℓ , the manufacturer is able

to prevent aggravated price competition between the retailers. This occurs because when $W = V^\ell$, the upper and lower bounds of the retailers' price distributions $P_1(V^\ell)$ and $P_2(V^\ell)$, collapse to a single monopoly price point of V^ℓ . This helps both the retailers to extract the whole consumer surplus from the low valuation consumers, even in the partially and fully informed segments. While this phenomenon still occurs in the presence of the infomediary, the wholesale price is set to V^ℓ only if the proportion of partially informed consumers or low valuation consumers is reasonably low. For instance, for any $\lambda_L \leq 0.5$, the optimality of this wholesale price will hold. Intuitively, a larger proportion of low valuation consumers provides retailers with a stronger incentive to charge a price lower than V^ℓ , since $P_1(V^\ell)$ and $P_2(V^\ell)$ are being randomized between \hat{P}^ℓ, V^ℓ . As a result, if λ_L becomes large, the manufacturer has a strong incentive to charge a lower wholesale price.

In a similar manner if $\alpha_u + 2\alpha_p$ increases, then it is immediate to see from the expression for \hat{P}^ℓ that the interval over which prices are being randomized for the low valuation consumers by both firms decreases. That is, price competition between the retailers is alleviated. Consequently, the manufacturer can now afford to decrease the wholesale price.

From (iii) of the above Proposition we infer that if the ratio of the number of uninformed to partially informed consumers is high enough, then the entry of the infomediary leads to an increase in the total channel profits. This occurs because with a high α_u , retailers are able to squeeze the surplus from a higher proportion of consumers (uninformed captive segment). Further, a lower α_p mitigates the price competition because the infomediary enrolled retailer now has fewer customers who see its price.

Corollary 2.1 *Higher acquisition costs are beneficial to the infomediary but detrimental for the manufacturer.*

Recall that the infomediary captures the difference in profits between the two retailers. With an increase in the acquisition costs, δ , there is an increase (decrease) in the referral (franchise) fee. This is because as δ increases, the profit of the non-enrolled retailer (which makes all its sales offline), decreases resulting in lower franchise fees for the manufacturer. The profit of the enrolled retailer also decreases but by a lower amount since it has fewer

offline customers. In particular, the enrolment with the infomediary gives it access to all the partially informed consumers and since these consumers get their prices online, D_2 makes that much savings in acquisition costs. The difference between the profits of the retailers therefore increases, thereby leading to a higher referral fee for the infomediary. Thus, higher acquisition costs are beneficial to the infomediary but detrimental to the manufacturer.

In sum, the presence of the infomediary leads to an increase in the gross profit of the enrolled retailer, and a corresponding decrease in the gross profit of the other retailer. This, in turn, leads to a lower franchise fee, and a decrease in the profits of the manufacturer. As a response to this, the manufacturer establishes its own referral services. As we show below this strategic decision leads to an increase in the profits of the manufacturer.

5 Manufacturer Establishes a Referral Service

Finally, we consider the scenario in which the manufacturer sets up its own referral websites, in response the presence of the infomediary. This game is derived from the previous game (which had the infomediary; see Figure 5 above) as follows. We assume that the manufacturer enrolls both retailers, such that at each of the four terminal nodes in Figure 5, a proportion β of the consumers continue to visit the physical stores, while the remaining proportion, $1 - \beta$, go to the corresponding retailer web site (via a manufacturer referral). Later, we highlight why the manufacturer is content enrolling both retailers rather than D_1 who is not enrolled with the infomediary.

The stages in this game are as follows:

Stage 1: The manufacturer sets the franchise fee, F , the wholesale price W , and establishes a referral web site.

Stage 2 : The referral infomediary enrolls D_2 , and sets a referral fee, K .

Stage 3: Retailers simultaneously choose prices. D_1 chooses $(P_1(V^h), P_1(V^\ell))$ for offline consumers, and P_1^m for online consumers who come through the manufacturer web site. D_2 chooses $(P_2(V^h), P_2(V^\ell))$ for offline consumers, P_2^m for online consumers, who come via the manufacturer web site, and P_2^r for online consumers who come via the referral infomediary.

Stage 4: Consumers decide which product to buy.

In terms of the stages, we allow the manufacturer to move first to capture the notion that it has significant market power, and can establish its franchise fee to capture rents from the dealers. The infomediary has less market power, and is, in a sense, the residual claimant on the profit of D_2 . The timing of the web site setup is not critical; we could alternatively have a stage 2.5 above, at which the manufacturer sets up its web site. In equilibrium, this will be anticipated by all players, and the fees set accordingly. The prices seen by consumers in different market segments are shown in Figure 6.

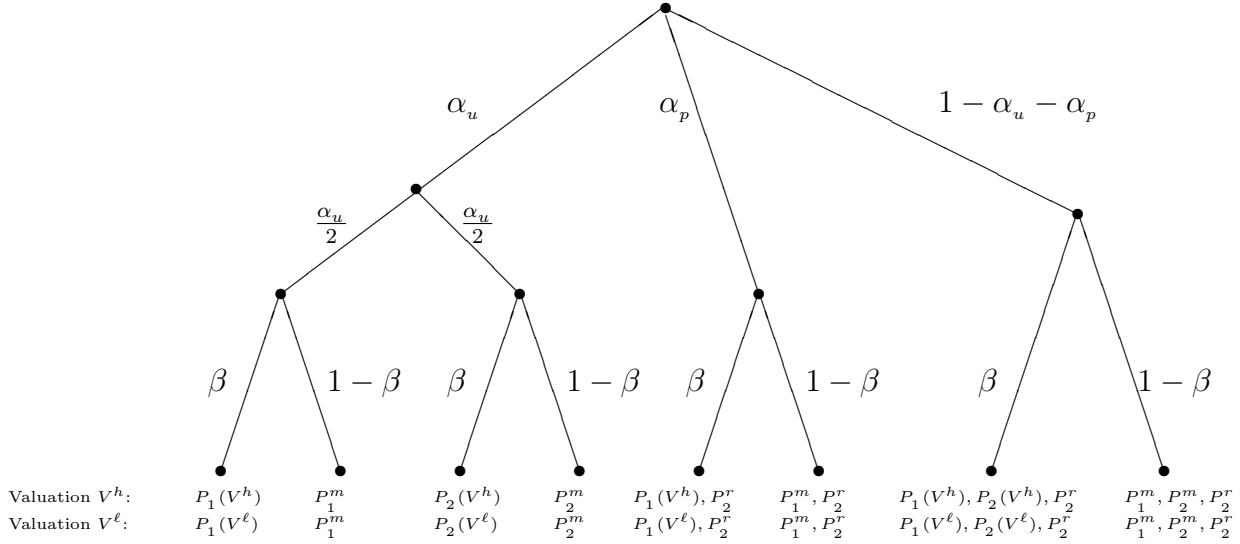


Figure 3: Different prices observed by each consumer segment

Each retailer continues to observe the type of the consumer at the physical store (i.e., in each of the four sub-segments of size β), and can quote a price to these consumers that depends on their type. However, the retailers do not observe the types of the consumers who come via the manufacturer web site. Hence, in the $(1 - \beta)$ sub-segments, the same prices must be quoted to both consumer types by a given retailer. We denote the online (manufacturer referral) prices of the two retailers as P_1^m and P_2^m .

In equilibrium, the price offered by D_2 to consumers who use the infomediary, P_2^r , follows the same distribution as before, in Proposition 1, in the world with only an infomediary and no manufacturer referrals. Consider the extreme case with only online consumers (i.e., $\beta = 0$). The structure of the game is then similar to the one with only an infomediary referral service. However since all consumers here are online, no information about consumer

valuations is available. Since the proportion of high valuation consumers is low, both retailers act as if all consumers had low valuations and set a highest price of V^ℓ , while randomizing prices in the partially and fully informed segments. Hence $G_2^r(P)$ remains the same as in Proposition 1.

This property then helps determine the rest of the equilibrium strategies. In particular, given the structure of the new game, it implies that the prices $P_1(V^\ell), P_1(V^h), P_2(V^\ell), P_2(V^h)$ are set as in the earlier game. Finally, P_1^m is chosen randomly over an interval as well. The equilibrium exhibited below holds for all values of $\beta \in [0, 1]$. Note that, if $\beta = 1$, we are back to the game of Figure 5, and the strategies shown below are equivalent to those in Proposition 1 (since $G_1^m(P)$ is not relevant when $\beta = 1$).

Proposition 3 (a) *Suppose the manufacturer chooses a wholesale price $W \geq \hat{W}$. Then, there exists an equilibrium in which:*

- (i) $P_1(V^\ell), P_1(V^h), P_2(V^\ell), P_2(V^h)$ and P_2^r are set exactly as in Proposition 1 (a),
- (ii) $P_2^m = V^h$, and P_1^m is randomly chosen over $[\hat{P}^h, V^h]$, where $\hat{P}^h = W + \frac{\alpha_u(V^h - W)}{(2 - \alpha_u)}$. Further, $G_1^m(P) = \frac{\alpha_u(V^h - W)}{(2 - \alpha_u)(P - W)}$, with a mass point at V^h equal to $\frac{\alpha_u}{2 - \alpha_u}$.

(b) *Suppose the manufacturer chooses a wholesale price $W \leq \hat{W}$. Then, there exists an equilibrium in which*

- i) $P_1(V^\ell), P_1(V^h), P_2(V^\ell), P_2(V^h)$ and P_2^r are set exactly as in Proposition 1 (b),
- (ii) $P_2^m = V^\ell$, and P_1^m is randomly chosen over $[\hat{P}^\ell, V^\ell]$, where $\hat{P}^\ell = W + \frac{\alpha_u(V^\ell - W)}{(2 - \alpha_u)}$. Further, $G_1^m(P) = \frac{\alpha_u(V^\ell - W)}{(2 - \alpha_u)(P - W)}$, with a mass point at V^ℓ equal to $\frac{\alpha_u}{2 - \alpha_u}$.

Notice that the expected infomediary referral price of D_2 is lower than its walk-in prices $P_2(V^h)$ or the manufacturer referral price P_2^m . There are two countervailing effects here. First, there is the price discrimination aspect: P_2^r is used as a competitive tool against D_1 . Second, there is a loss of information about consumer willingness to pay on the Internet. This prevents the retailer from practising online price discrimination based on consumer valuations. These two effects act in tandem with each other and bring down the infomediary referral prices. However retailers also gain from the fact that there is a potential savings in

the acquisition cost per online customer.

Corollary 3.1 *There exists a critical value of $\beta, \hat{\beta}$ beyond which the manufacturer will choose $W > \hat{W}$.*

Intuitively when the manufacturer chooses a higher wholesale price, retailers are forced to raise the minimum value of P_1^m higher than V^ℓ . Consequently the low valuation buyers who check online prices in the $(1 - \beta)$ segment are shut out off the market. Hence, depending on the proportion of consumers who check manufacturer referral prices, the manufacturer may chose a lower wholesale price. We derive this condition in the Appendix. Note that when $\alpha_u = 0$, the condition implies that manufacturer chooses $W > \hat{W}$. In a similar vein when $\beta - > 1$ or $\lambda_H - > 1$, the condition implies that $W > \hat{W}$, as we would expect.

In order to make analogous comparisons with the case when there are no manufacturer referral services, here onwards we focus on the equilibrium when the manufacturer chooses a $W > \hat{W}$.

Proposition 4 *In equilibrium in the $(1 - \beta)$ segment,*

- (i) *the retailers' expected sales are $E(S_1^m) = \lambda_H(\frac{1}{2-\alpha_u} - \frac{\alpha_u}{2})$, $E(S_2^m) = \lambda_H(\frac{1-\alpha_u}{2-\alpha_u} + \frac{\alpha_u}{2})$.*
- (ii) *The expected prices are:*

$$E(P_1^m) = \frac{4W(1 - \alpha_u)^2 + \alpha_u(2 - \alpha_u)V^h + 2\alpha_u(1 - \alpha_u)(\ln \frac{2-\alpha_u}{\alpha_u})(V^h - W)}{(2 - \alpha_u)^2}$$

$$E(P_2^r) = W + \frac{\alpha_u(\ln \frac{2-\alpha_u}{\alpha_u})(V^h - W)}{2(1 - \alpha_u)}$$

- (iii) *The expected profits are*

$$E(\pi_1^m) = (1 - \beta)\lambda_H(\frac{\alpha_u(V^h - W)}{2} - F)$$

$$E(\pi_2^m) = (1 - \beta)\lambda_H(\frac{\alpha_u(4 - 3\alpha_u)(V^h - W)}{2(2 - \alpha_u)} - F - K)$$

We observe that the expected price $E(P_2^r)$ increases with the size of the captive segment α_u (the increase is close to linear for higher values of α_u). An increase in the size of the captive segment α_u implies a decrease in the reach of the referral service (there are fewer consumers

in the partially and fully informed segments, the segments that use the infomediary). This increase in the captive uninformed segment of D_1 provides it an incentive to increase its online price, P_1^m . Now, D_2 can utilize this fact to its advantage by increasing its infomediary referral price, P_2^r . It is still able to compete successfully with D_1 in the partially and fully informed segments, thus increasing its profit. After the manufacturer adopts its own referral service, D_2 still retains an advantage over D_1 , both in terms of expected sales and gross profits (recall that these are the profits before the franchise fee and infomediary fee are subtracted out). However this advantage is considerably reduced, resulting in lower referral fees for the infomediary. Notice that when $\alpha_u = 1$, $E(P_1^m)$ and $E(P_1(V^h))$ are both equal to V^h . If all consumers are uninformed, then the retailers can charge monopoly prices to these captive consumers. We state the following corollary without proof (a proof is immediate from Proposition 4).

Corollary 4.1 *(i) In equilibrium, with the introduction of the manufacturer referral service, the retailer associated with the infomediary, D_2 , has higher expected sales and gross profits in the $(1 - \beta)$ segment. However, in the β segment, the sales of each retailer remain the same even after the introduction of the manufacturer referral service.*

(ii) The average manufacturer referral prices are higher than the average infomediary referral prices.

In the β segments, the market shares of the two retailers remain the same as in the world with an infomediary, but no manufacturer referrals. However in the $1 - \beta$ segments, on comparing the performance of D_2 when it enrolls with the infomediary to that of D_1 , we see that it experiences a higher market share. Hence, there is a strong incentive for D_2 (or more generally, for any one retailer) to enroll with the infomediary. An affiliation with the referral infomediary provides the retailer with the ability to price discriminate in its uninformed (captive) segment. It charges a monopoly price to all offline consumers, and uses the referral price to compete with the other retailer online. This increases its expected sales. Conversely, the retailer who remains out of the infomediary referral services incurs a significant loss in expected sales and profits. This highlights the “demand reallocation” mechanism of the referral service.

Recall that $G_1^h(P)$ has a positive mass at V^h which is exactly the same as that of $G_1^m(P)$. So that the expected sales of each retailer remain the same irrespective of manufacturer referral services. Since neither retailer wants to shut out the high valuation buyers, they do not charge more than V^h to online consumers. This is equivalent to assuming that all consumers have a high valuation. Therefore, since $G_2^r(P)$ follows the same distribution, we get the result that expected sales remain the same even with the entry of the manufacturer referral service.

Superficially, manufacturer and infomediary referrals are similar in that they put a customer in contact with a particular retailer. The difference between the two types of referral prices predicted by our model is consistent with empirical evidence found by Scott-Morton et al.(2003b). They find that while the referral process of third-party infomediaries helps consumers get lower prices, a referral from a manufacturer website to one of the manufacturer's dealerships does not help consumers obtain a lower price.

In equilibrium, the manufacturer again sets the franchise fee, F , so that the retailer with lower sales, D_1 , makes a zero profit. The infomediary then sets its fee, K , to capture the remaining profit of D_2 . Further, we show that for any value of the offline acquisition cost δ , the manufacturer makes a higher profit when it offers its own referral web site.

Define $X = (\alpha_u + 2\alpha_p)$.

Proposition 5 *Then if $(1 - \alpha_u\lambda_H - \beta\lambda_L X) > 0$*

(i) The optimal wholesale price for the manufacturer is $W^I = V^\ell$.

(ii) The optimal franchise and referral fees, respectively, are

$$F^m = \beta F^I + (1 - \beta)\lambda_H \left(\frac{\alpha_u}{2}\right)(V^h - V^\ell).$$

$$K^m = \beta K^I + (1 - \beta)\lambda_H \frac{\alpha_u(1-\alpha_u)}{(2-\alpha_u)}(V^h - V^\ell).$$

(iii) The manufacturer always earns a higher profit by opening up its own referral web site.

Consider the effects of the manufacturer referral service on the infomediary profit. Notice first that K^m is always positive, for any value of δ . Secondly, when $\beta = 1$, this is exactly equal to K^I . As β decreases to zero (i.e., more consumers shop online), K^m decreases while F^m increases. Thus as the manufacturer is able to divert more traffic onto online

channels, its profit increases while that of the infomediary decreases. Since the rate of increase in manufacturer profit is higher than the rate of decrease in infomediary profit, the total channel profits increase.¹²

Note that when $\beta = 0$, (that is, if all consumers were to search for prices on the online channels) the condition for the optimal wholesale price to be V^ℓ always holds since $(1 - \alpha_u \lambda_H) > 0$. In a similar vein, if $\beta = 1$, that is all consumers shift offline, $(1 - \alpha_u \lambda_H - \beta \lambda_L X)$ reduces to $1 - \alpha_u - 2\lambda_L \alpha_p$ as expected. This implies that for any $\beta \in (0, 1)$, the wholesale price will be set to V^ℓ for a much bigger region in the parameter space than the case when there is only an infomediary referral service. *Thus the establishment of a referral service by the manufacturer enables it to respond to the entry of an infomediary, by giving itself a wider leeway to set the unit fee to the earlier profit maximizing level.*

However for any value of δ , there is a reallocation of channel profits from the referral infomediary to the manufacturer, after the manufacturer introduces its own referral service. This results in higher manufacturer profits than in a world with only infomediary referral service.

Proposition 6 *There exists a critical value of acquisition cost, $\hat{\delta}$, such that for any δ larger than $\hat{\delta}$, the channel profits under a two-part tariff exceed the channel profits achievable offline under a vertically integrated manufacturer.*

Recall equation (2) which gives the channel profits if the manufacturer were to sell directly. We show that when, the manufacturer's two part tariff can result in higher profits than those accrued under a direct selling manufacturer. From Proposition 5, the optimal franchise and referral fees can be written as

$$\begin{aligned} F^m &= F^I + (1 - \beta)\delta(1 - \frac{\alpha_u}{2}) \\ K^m &= K^I - (1 - \beta)\alpha_p\delta. \end{aligned} \tag{6}$$

From this the total channel profits $2F^m + W + K^m =$

$$(\frac{\alpha_u(3 - 2\alpha_u)}{2 - \alpha_u})(\lambda_H(V^h - V^\ell)) + (1 - \beta)\lambda_H V^\ell - \beta\delta(2 - \alpha_u - \alpha_p). \tag{7}$$

¹²This follows from the fact that $\frac{\partial F^m}{\partial \beta} = \delta(1 - \frac{\alpha_u}{2}) > \frac{\partial K^m}{\partial \beta} = \delta\alpha_p$.

Compare this to equation (2). Notice that when $\beta = 0$ for instance, then channel profits with the two-part tariff are generally higher than those achieved under a centralized selling system. In sum, savings from customer acquisition costs online, can enable a decentralized manufacturer achieve higher channel profits than those achieved through direct selling.

However, if acquisition cost savings are not high enough, then an alternate strategy for manufacturers is to invest in technologies which can facilitate price discrimination online for customers visiting their referral services. The upshot of losing information about consumer valuations online is that manufacturer referral prices are higher than V^ℓ . This results in a proportion $(1 - \beta)\lambda_L$ of the consumers shut out from the market. If D_1 could identify consumers and set a price P_1^m based on their valuations, it would result in increased sales from the low valuation customers. While the franchise fees and referral fees would remain unchanged, it would lead to higher manufacturer and channel profits, by an amount equal to $V^\ell(1 - \beta)\lambda_L$. This increase would accrue from the per-unit fee component of the two-part tariff. Thus online price discrimination can lead to even higher profits than those attainable in a vertically integrated manufacturer.

If all consumers who shift online are the high valuation customers, then the manufacturer gains even more by establishing its own referral service. We can show that in such a scenario, the optimal franchise and referral fees can be written as

$$\begin{aligned} F^m &= \frac{(1 - \beta\lambda_L)}{\lambda_H} F^I + \frac{(1 - \beta)\delta}{\lambda_H} \left(1 - \frac{\alpha_u}{2}\right) \\ K^m &= \frac{(1 - \beta\lambda_L)}{\lambda_H} K^I - \frac{(1 - \beta)\alpha_p\delta}{\lambda_H}. \end{aligned} \quad (8)$$

From this the total channel profits $2F^m + W + K^m =$

$$\frac{(1 - \beta\lambda_L)}{\lambda_H} \left(\frac{\alpha_u(3 - 2\alpha_u)}{2 - \alpha_u} \right) (\lambda_H(V^h - V^\ell)) + V^\ell - \beta\delta(2 - \alpha_u - \alpha_p). \quad (9)$$

Compare this to equation 2. Notice that since $\beta < 1$ we have $\frac{(1 - \beta\lambda_L)}{\lambda_H} > 1$. Thus when $\beta = 0$ for instance, channel profits with the two-part tariff are always higher than those achieved under a centralized system.

The impetus toward an increased manufacturer profit comes from two sources. First it levels the playing field between the two retailers by providing D_1 with a weapon to price

discriminate between consumer segments online. Using the manufacturer's referral price P_1^m , D_1 is now able to compete more effectively against D_2 's infomediary referral price P_2^r for the partially and fully informed consumer segments. Second, there is a reduction in D_1 's acquisition costs as some consumers are served online. This increases profit in the channel, and enables the manufacturer to extract this increased profit via an increase in the franchise fee that it charges the retailers. Since eventual profits of each retailer are non-negative, there is no conflict of interest here between channel members. Thus the strategic decision by the manufacturer to adopt an online referral service affects both channel profits achievable and the allocation of profits among channel members.

5.1 Eliminating the Referral Infomediary

Is it possible for the manufacturer to drive the third-party infomediary out of the market? Rather, the more pertinent question is whether the manufacturer should try to do that? Recall that the infomediary's referral fee consists of two components, which creates an incentive for a retailer to enroll with the infomediary: (i) benefit from price discrimination and (ii) benefit from acquisition cost savings. Even if the manufacturer is willing to compensate retailers for all the acquisition costs incurred by them, i.e., $\delta = 0$, the referral fee still remains positive due to the price discrimination component. Hence, the infomediary will survive. Similarly, even if the wholesale price was strategically set to V^h , the referral fee would still be positive, due to the acquisition cost component. Hence, the only strategy for a manufacturer whose objective is to eliminate a third-party referral service, can adopt is a simultaneous two-pronged attack: (i) absorb all the acquisition costs and (ii) offer a wholesale price set to the valuation of the high type customer. Either one on its own is ineffective in unravelling the infomediary. Of course, this strategy comes at a price: both the manufacturer and channel profits are substantially lower. This implies that the manufacturer is content keeping the infomediary in business.

Corollary 6.1 *The manufacturer benefits from the presence of the competing referral infomediary.*

In fact, we find that the manufacturer even benefits from the presence of the infomediary, once it has established its own referral service. Basically the infomediary's referral price P_2^r prevents the enrolled retailer, D_2 from spiralling into aggravated price competition with D_1 , by creating sufficient differentiation in consumers' search behavior. In particular, the presence of the infomediary make D_2 asymmetric and stronger compared to D_1 . This happens because D_2 now has two online pricing tools: one via the manufacturer referral and the other via the infomediary referral. In contrast, D_1 only has one online pricing tool, that from the manufacturer referral service. Consequently this asymmetrization in the availability of online pricing tools, leads to higher prices on an average for both retailers, in both the offline and online segments. Consequently, the manufacturer might not want to strategically eliminate the infomediary.¹³

5.2 Manufacturer Enrols Only One Retailer

It can be argued that the manufacturer's referral service by enrolling both retailers, indiscriminately skims off a fraction of all consumers. Hence, prima facie it is unclear that differences in performance/conduct do not arise from this mechanical asymmetry between the manufacturer's referral service and the infomediary referral service. In order to alleviate this concern, we consider the scenario when the manufacturer enrolls only one retailer, say D_1 .¹⁴ The resultant consumer search schema is shown in Appendix B. We state the following corollary.

Corollary 6.2 *The manufacturer is equally better off enrolling only D_1 as it is by enrolling both retailers.*

For brevity we avoid the math but provide the intuition here. Notice from the schema in the Appendix B, that in the absence of D_2 being enrolled by the manufacturer, the two segments which get affected are the uninformed (captive) segment of D_2 and the fully informed consumers in the β segment. While the former does not impact profits of D_1 in any

¹³Proof of this is available from the authors upon request.

¹⁴It is trivial to show that enrolling only D_2 , leads to a further decrease in D_1 's profits and results in lower manufacturer profits.

way, it is presumable that the latter might do so. However, recall that P_2^m was priced at V^h , whereas P_1^m and P_2^r were randomized between (\hat{P}^h, V^h) . Consequently, D_1 was effectively competing only D_2 's infomediary referral price, P_2^r and not with D_2 's manufacturer referral price, P_2^m . Hence, the absence of P_2^m does not affect the profits of D_1 in any way and thus leaves the manufacturer's profits unchanged. However it does affect D_2 's profits. In fact it increases D_2 's profits by not enrolling it because in the captive segment D_2 can now sell to low valuation consumers offline using $P_2(V^\ell)$, rather than losing a proportion β of them online. But since the increase in profits of D_2 is captured by the infomediary, it leaves D_2 's net profits unchanged. In turn, this provides the manufacturer another incentive to decrease the infomediary's channel power.

This result reconciles itself very well with practice. Manufacturers like GM, Nissan and Ford follow a non-exclusive strategy of enrolling retailers in their referral services like GMbuypower.com, Nissandriven.com and Forddirect.com.¹⁵ One reason for adopting this strategy could be to avoid negative ramifications from the Robinson-Patman Act.¹⁶ Our model also provides an alternate rationale as to why a manufacturer may follow the non-exclusive practice of enrolling both retailers unlike a third-party infomediary which practices exclusivity.

5.3 Closing Ratios of Referral Services

In equilibrium, the number of online quotes provided to consumers exceeds the total number of sales via online referrals. A referral is not costless, since responding to an online request entails an investment in time for a retailer. A standard measure of sales efficiency in this context is the Closing Ratio (CR), defined as follows

$$CR = \frac{\text{Number of units sold}}{\text{Number of referrals received}}$$

A low closing ratio would imply an inability to convert referrals into sales, further sug-

¹⁵Clicking on the link to find a dealership on the Volvo design-and-build site, gets customers three dealer options, all with e-mail contacts.

¹⁶This Act prohibits manufacturers from discriminating between retailers unless explained by cost differences.

gesting high costs and low profits. This statistic also forms a pivotal basis on which a retailer is evaluated by the referral infomediary, thereby ensuring the viability of the referral institution. In particular, a low closing ratio implies low consumer satisfaction, and may lead to the retailer being dropped by the infomediary (Scott-Morton et al., 2003b). For example, in 1998-99, Autobytel dropped around 250 dealers (10% of its dealer base) because of negative customer feedback and low closing ratios (see Moon, 2000).

Table 1 shows the closing ratio for the different price quotes offered by retailers to the pure online, that is, the $(1 - \beta)$ segments. Comparing the online closing ratios for the retailers, we find that D_2 has a higher closing ratio for infomediary referrals than D_1 for manufacturer referrals. This reflects the ability of D_2 to price discriminate online as well, since this retailer obtains referrals via both the manufacturer and the infomediary.

Price Quote	Expected Sales	No. of Referrals	C.R.
D_1 manufacturer referral	$\lambda_H \left(\frac{1}{2-\alpha_u} - \frac{\alpha_u}{2} \right)$	$1 - \frac{\alpha_u}{2}$	$\frac{\lambda_H ((1-\alpha_u)^2 + 1)}{(2-\alpha_u)^2}$
D_2 manufacturer referral	$\frac{\lambda_H \alpha_u}{2}$	$1 - \frac{\alpha_u}{2} - \alpha_p$	$\frac{\lambda_H \alpha_u}{2-\alpha_u-2\alpha_p}$
D_2 infomediary referral (with manf. referral)	$\lambda_H \left(\frac{1-\alpha_u}{2-\alpha_u} \right)$	$(1 - \alpha_u)$	$\frac{\lambda_H}{2-\alpha_1}$
D_2 infomediary referral (w/o manf referral)	$E(S_1^I) - \frac{\alpha_u}{2}$	$(1 - \alpha_u)$	$\frac{E(S_1^I) - \frac{\alpha_u}{2}}{(1-\alpha_u)}$

Secondly, for D_2 , the closing ratio from manufacturer referrals can be higher than the ratio from infomediary referrals. In particular, if the size of the partially informed market segment (which has mass α_p) is large, the fully informed segment decreases. A proportion $(1 - \beta)$ of the latter segment obtains a quote from D_2 via a manufacturer referral. The size of the uninformed segment (which represents a closing ratio of 1) remains the same. Hence, a decrease in the fully informed segment leads to an overall increase in efficiency for manufacturer referrals to D_2 . Conversely, if the partially informed segment is small, D_2 has a higher closing ratio for infomediary referrals.

Anecdotal evidence suggests that, on the whole, manufacturer referral services experience a higher closing ratios than infomediarities.¹⁷ For example, GM, has one of the highest closing ratios in the referral business, greater than 20% while Microsoft CarPoint and AutoWeb have a CR of between 12% and 19 %. However, Carsdirect.com has a higher closing ratio

¹⁷ "Car Dealers Fumbling Web Potential," www.ECommerceTimes.com, 06/21/01.

than any other service, including the OEMs. These comparisons are summarized in the next Proposition.

Proposition 7 *The equilibrium closing ratios satisfy the following properties:*

(i) $CR_2^r > CR_1^m$: *the closing ratio for D_2 for sales via the infomediary exceeds the closing ratio of D_1 via the manufacturer referral site.*

(ii) *If $\alpha_p \geq \frac{(1-\lambda_H\alpha_u)(2-\alpha_u)}{2}$, then $CR_2^m > CR_2^r$: if the partially informed segment is large enough, the closing ratio of D_2 via the manufacturer referral site exceeds its closing ratio via the infomediary.*

5.4 Corroboration with Existing Empirical Evidence

We show in this subsection that, over a wide range of parameters, our model generates propositions which are empirically operationalizable. We discuss the parameter values used in this corroboration, followed by their implications for δ_c , K , and closing ratios.

First, consider the sizes of the different market segments. Klein and Ford (2001) in their survey of auto buyers point out that about 58% of consumers do not search at all. Additionally, about 22% of the buyers, exhibit moderate search behavior by searching some of the offline and online sources while about 20% are highly active information seekers who obtain multiple quotes from all possible sources. This sort of consumer search behavior is corroborated by a J.D.Powers study, which finds that about 41% of consumers surveyed used a referral service while buying a car, whereas the remaining 59% did not.¹⁸ Based on these data sources, we vary the value of α_u , the size of the uninformed segment in our model, from zero to 0.5. Further, Ratchford, Lee and Talukdar (2002) find that 40% of buyers used online sources (i.e., manufacturer and third-party websites). Based on this we vary the β from 0.6 to 1.

On acquisition costs, Scott-Morton, Zettelmeyer and Risso (2001) show that the average cost to a dealer of an offline sale (\$1,575) is \$675 higher than the cost to a sale via Autobytel (\$900). They further mention a NADA study, which shows that a dealer's average new car

¹⁸ "Microsoft CarPoint," HBS Case study, August 2000.

sales personnel and marketing costs (\$1,275) are reduced by \$1,000 by virtue of sales through Internet referral services. We vary the proportion of high valuation buyers, λ_H , from zero to 0.4. Based on actual average gross margin of dealers (see Moon, 2000), we take $(V^h - W)$ to be 3500 and $(V^\ell - W)$ to be 1500.

Using these ranges for the parameters, we compute δ_c , the critical value of the acquisition cost, K , the infomediary referral fee, and closing ratios. We choose $\alpha_u \in [0, 0.5]$. Figure ?? below demonstrates the critical value, δ_c . If the actual acquisition cost, δ , lies above the line, the manufacturer's profit increases after it establishes its own referral service. As seen from the figure, the maximal δ_c over this parameter range is \$700, close to the lower bound of empirically observed difference between offline and online acquisition costs (\$675–\$1,000).

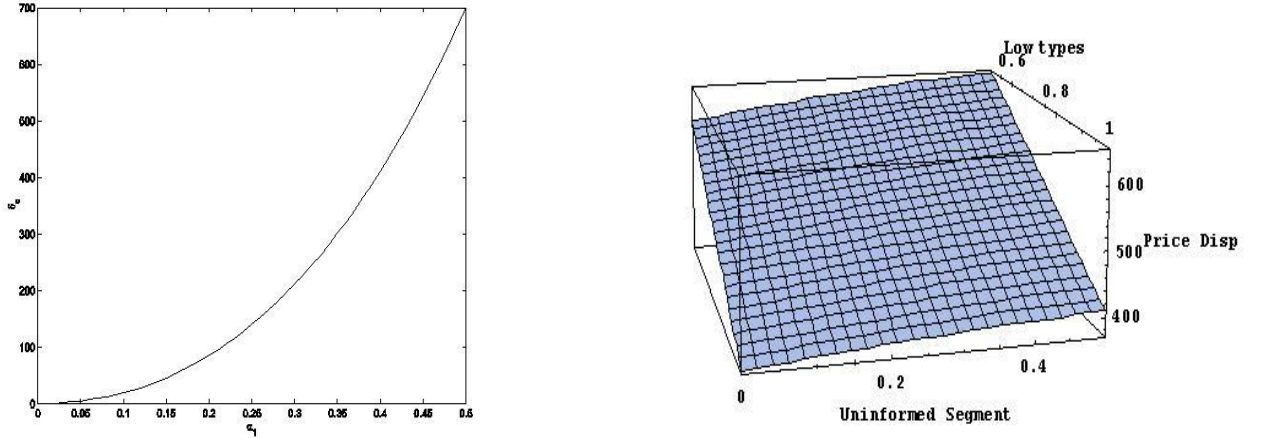


Figure 4: (a) Critical Value of Acquisition Cost (b) Difference in prices between offline and online channels.

Next we consider the price differences between offline and online channels. Scott-Morton, Zettelmeyer and Risso (2003a) show that the average Autobytel customer sees a contract price about \$500 less than the non-referral offline prices. For the parameters we consider, the difference between the expected low valuation offline and the expected online infomediary referral price quotes (for D_2 , the retailer associated with the infomediary), ranges between \$400 and \$650.

Finally, we numerically estimate the closing ratios of the referral services. We find that the CR of D_2 via manufacturer referral services ranges between 10% and 30%, and is similar to the closing ratio for offline sales. According to anecdotal evidence, Forddirect.com has a CR of 17% and GMBuypower.com has a CR of greater than 20%.¹⁹ Between May through October, 2001 GM tested a system of providing sales leads or referrals to Chevrolet dealers in the Washington, D.C., area. According to GM, about 25% of such referrals were closed, which was roughly the same proportion as that of walk-in leads closed through physical showrooms. The numerical parameterization, therefore, highlights the robustness of the model and the main results.

The CR from the infomediary referral price in our model is between 20% – 30%, slightly higher than industry evidence.²⁰ One reason for this may be that we do not consider inter-brand competition in our model. If consumers search amongst multiple brands before completing a purchase, there will be multiple referrals for a single sale, thereby resulting in lower closing ratios.

6 Business Implications

We present a model with multiple consumer types, multiple information structures and multiple channels. Our analysis suggests that when manufacturers cannot directly sell to consumers, either due to legal restrictions or to avoid “channel conflict” with their retailers, the online referral model turns out to be a strategic tool for them to increase their channel power and profits. In particular, diverting traffic from offline to online channels leads to a reduction in retailers’ acquisition costs, and increases their ability to price discriminate by exploiting the differences in consumers’ price search behavior. This happens despite retailers having to forgo information about consumer valuations online. That is, selling online results in the loss of the ability to distinguish between the high and the low valuation customers. On the other hand, acquisition costs borne by dealers are lower for online customers. This critical tradeoff, between higher information offline versus lower acquisition costs online,

¹⁹[www.trilogy.com/Sections/Industries/Automotive/Customers/FordDirect -Success-Story.cfm](http://www.trilogy.com/Sections/Industries/Automotive/Customers/FordDirect-Success-Story.cfm)

²⁰<http://www.investorville.com/ubb/Forum2/HTML/000040.html>

determines the equilibrium results.

We find that Internet referral services have the potential to solve customer, retailer and manufacturer problems. On the demand side, the referral services help consumers to costlessly get an additional retail price quote before purchase. On the firm side, a referral mechanism endows enrolled retailers with a tool to practice price discrimination (between online and walk-in customers) and enable a significant reduction of their acquisition costs. Manufacturer referral sites can also be used to serve as a link between the demand side and supply side in B2B exchanges. By using the click stream data from the GMBuypower.com site, GM suppliers can sense market demand and react accordingly at Covisint. Thus there are implications for the Build-To-Order Model that auto manufacturers are progressing towards at a rapid pace.

Another implication of our model is that in markets with relatively inelastic market demand or high brand loyalty, the optimal wholesale price to coordinate the channel can be higher than the manufacturer's marginal cost. In particular, in markets characterized by the presence of heterogeneity in consumer valuations, the manufacturer finds it optimal to set the wholesale price equal to the valuation of low type consumers, in order to alleviate price competition between downstream retailers. A higher brand loyalty also ensures that consumer leads emanating from manufacturer websites are more likely to be converted into sales. Spencer Hondros, Chairman of the General Motors Dealer Information Technology Advisory Board, says, "a consensus is building among dealers that the leads coming from OEM referral sites are of a higher quality than those coming from independent referral services."

The strategic decision by the manufacturer to invest in the online referral marketplace, increases the overall profits in the channel. The extent to which overall profits increase depend on the relative composition of consumer types in the market and their valuations. While in our model the manufacturer captures this increase, we expect the actual allocation of profits among channel members to vary, depending on the bargaining power of each agent. Since each retailer accrues an increase in gross profits, there need not be a conflict of interest between channel members.

In the presence of intra-brand competition, some of the increased profit from diverting traffic online may be used to provide higher service levels offline. If, for example, there is self-selection into online versus offline channels, the consumers who stay offline may be more service conscious. This creates an incentive to provide high levels of end-to-end service by dealers, and has recently been an important issue with auto manufacturers. Since service satisfaction often translates to repeat sales in the future, online manufacturer referrals can be a significant tool to ensure increased profits by maximizing a “customer’s life time value.”

Another interesting implication of our paper is that in the presence of a competing third-party, a manufacturer will be able to achieve full channel coordination using a two-part tariff only under either of two circumstances: First, the manufacturer may be able to influence consumer search behavior in a way that consumers stop buying from infomediary enrolled retailers. This could potentially be done through heavy investments in advertising or providing consumers with adequate incentives for visiting and buying from manufacturer’s referral services. A host of car makers are taking the soft-sell approach to advertising on the Web, and some are actually seeing their campaigns convert prospects to buyers. Lexus chose this tack when it launched a co-branded site with MSN last spring dubbed “Luxury for Living.”²¹ In a similar vein, GM’s alliance with AOL is also intended to steer traffic to its website. However, this mechanism to achieve channel coordination occurs at the cost of reduced profits for the manufacturer. This then hints at the fact that a manufacturer may prefer having an uncoordinated channel when competing against an independent infomediary.

A second possibility is if manufacturers invest in e-CRM packages to collect more information about consumers who visit their referral services. This can enable their dealers to practice price discrimination online by inferring consumer valuations. Based on the modular CRM system from E.piphany, automaker Nissan has been working to improve its understanding of customer preferences.²² Increasingly, GMBuypower.com also is investing in technologies to enable such personalized pricing initiatives online.²³

²¹Visit Lexus.MSN.com, and one can listen to a jazz recording, read up on the latest in Mediterranean rock climbing, learn how to build up an expensive wine collection, and get tips on choosing perfume to “make you smell like a million bucks.” (“Carmakers Try the Web Soft Sell,” www.ebusinessiq.com, 9/12/03.)

²²“Nissan: eCRM Driven,” Jason Compton, www.ebusinessiq.com, 3/20/03.

²³www-scf.usc.edu/~whalley/GMBuypower.txt

A final implication from our results is that once manufacturers have established their referral services, they should not strive to eliminate third-party referral services. The competing infomediary referral service actually helps rather than hurts manufacturers, by preventing Bertrand pricing among manufacturer referral prices. This in turn leads to higher profits for the manufacturer.

7 Conclusion and Extensions

In today's environment of IT-intensive marketing, the Internet is dramatically changing traditional channels of sales and distribution. New players enter and existing structures and roles change, leaving traditional players struggling to decide which strategy to pursue. The auto industry, for example, has witnessed some restructuring of business models, such that manufacturers can gain a stronger toehold in the distribution chain instead of allowing third-party intermediaries to dictate terms. Using a game-theoretic model, we investigate the competitive implications of these newly emerging technology-based institutions on retailer prices and their impact on channel structures and profits. We show that channel profits are a function of acquisition costs, heterogeneity in consumer valuations and search behavior, retailers' inter-channel price discrimination opportunities and the wholesale price set by the manufacturer.

The phenomenon of referral services is new and this paper is an attempt at understanding such business models and their implications. It is important to note that, although our analysis is conducted in the context of a simple model, many of our assumptions can be relaxed without altering the nature of our conclusions. For example, the model can be extended to the case in which the informed segment decide to get both prices from the same retailer: its infomediary referral price and the manufacturer referral price or walk-in price. Second, we could allow for a possibility of bargaining or sequential search behavior amongst consumers. In this case, either a Bertrand equilibrium results, with both retailers pricing at marginal cost, or, if retailers adopt a price-matching guarantee, they can sustain a collusive outcome with prices equal to V^ℓ . A logical extension would be to examine inter-brand competition with two manufacturers in the given set up. The increased competition

would then lead to both retailers garnering some of the increased channel profits, due to the enhanced bargaining power arising from the threat of defection.

8 Appendix

Proof of Lemma 1

First, suppose the manufacturer chooses some $W \leq V^\ell$.²⁴ Suppose there is a symmetric equilibrium, so that both retailers use the same strategy. We construct this strategy, and then show it satisfies the required properties of an equilibrium.

Each retailer observes the type of each consumer, and hence charges a price contingent on this type. If a retailer sold only to its monopoly segment, the optimal price to type i ($i = \ell, h$) is just V^i . Now, suppose, for each retailer, P_i^m ($i = \ell, h$) is randomly chosen over $[\hat{P}_i, P_i^m]$. Then, its profit from consumer type i at any price in this interval must be the same, and must equal the profit at price V^i . Define $\gamma = \frac{\alpha_u + \alpha_p}{2}$ (so that $1 - \alpha_u - \alpha_p = 1 - 2\gamma$). At the price V^i , a retailer sells only to its captive segment, and its profit from consumer type i is $\lambda_i \gamma (V^i - W)$.

Suppose the mixed strategy has no mass points (the distribution we derive satisfies this property). At some price P in the support of its mixed strategy, a retailer sells to its captive segment, and also captures $G_i(P)$ of the competitive segment. Hence, its profit from consumer type i is $\lambda_i (\gamma + G_i(P)(1 - 2\gamma)) (P - W)$. Hence, $(\gamma + G_i(P)(1 - 2\gamma)) (P - W) = \gamma (V^i - W)$. This implies $G_i(P) = \frac{\gamma}{1 - 2\gamma} \left(\frac{V^i - P}{P - W} \right)$ (where $\frac{\gamma}{1 - 2\gamma} = \frac{\alpha_u + \alpha_p}{2(1 - \alpha_u - \alpha_p)}$).

The lower bound on the support of the mixed strategy is found by setting $G_i(\hat{P}_i^h) = 1$, which yields $\hat{P}_i^h = \frac{1 - 2\gamma}{1 - \gamma} W + \frac{\gamma}{1 - \gamma} V^i$. Substituting for γ , we have $\hat{P}_i^h = \frac{2(1 - \alpha_u - \alpha_p)}{2 - \alpha_u - \alpha_p} W + \frac{\alpha_u + \alpha_p}{2 - \alpha_u - \alpha_p} V^i$.

Next, we show that this is an equilibrium. Note that $G_i(P^m) = 0$, so the mixed strategy has no mass points. Consider retailer 1. For all prices $P \in [\hat{P}_i^h, P_i^m]$, retailer 1 earns the same profit from consumer type i (by construction). If it charges $P > P_i^m$, it loses all consumers of type i , leading to a lower profit. If it charges $P < \hat{P}_i^h$, it captures the same market share as at \hat{P}_i^h , $(1 - \frac{\alpha_u + \alpha_p}{2})$, at a lower price. Hence, it makes a lower profit than at \hat{P}_i^h . Therefore, retailer 1 has no profitable deviation. By symmetry, neither does retailer 2. Hence, the strategies postulated constitute an equilibrium.

²⁴Note that it cannot be optimal for the manufacturer to choose $W > V^\ell$. The maximal channel profit in the latter case is $\lambda_h(V^h - \delta)$. As long as λ_h is lower than $\frac{V^\ell}{V^h}$, this is not optimal.

Let $g_i = -\frac{dG_i}{dP}$. Note that the market share of each retailer is $\frac{1}{2}$ (by symmetry). Hence, for each retailer, the consumer acquisition cost is $-\frac{\delta}{2}$. The expected profit of each retailer is

$$\begin{aligned}\pi &= \lambda_L \int_{\hat{P}_\ell^h}^{V^\ell} \left\{ \frac{\alpha_u + \alpha_p}{2} + (1 - \alpha_u - \alpha_p)G_\ell(P) \right\} (P - W) g_\ell(P) dP + \\ &\quad \lambda_H \int_{\hat{P}_h^h}^{V^h} \left\{ \frac{\alpha_u + \alpha_p}{2} + (1 - \alpha_u - \alpha_p)G_h(P) \right\} (P - W) g_h(P) dP - \frac{\delta}{2} - F \\ &= \frac{\alpha_u + \alpha_p}{2} (\lambda_H V^h + \lambda_L V^\ell - W) - \frac{\delta}{2} - F.\end{aligned}$$

Now, the manufacturer's profit is $\Pi_o = 2F + W = (\alpha_u + \alpha_p)(\lambda_H V^h + \lambda_L V^\ell - W) - \delta + W = (\alpha_u + \alpha_p)(\lambda_H V^h + \lambda_L V^\ell) - \delta + (1 - \alpha_u - \alpha_p)W$. Since $W \leq V^\ell$, this is maximized at $W^* = V^\ell$. Substituting $W = V^\ell$ into the equilibrium pricing and profit expressions derived above yields the statement of the Lemma. \blacksquare

Proof of Proposition 1

(i) As in Lemma 1, we first derive the mixed strategies for the players and then demonstrate that these constitute an equilibrium. Consider $P_1(V^h)$, the price charged by D_1 to the high consumer type. In equilibrium, D_1 should make the same profit by charging any price P in the support of the mixed strategy as from charging a monopoly price V^h . Hence, $\frac{\alpha_u}{2}(P - W) + (1 - \alpha_u - \alpha_p + \alpha_p)(P - W)G_2^r(P) - F = \frac{\alpha_u}{2}(V^h - W) - F$, which implies $G_2^r(P) = \frac{\alpha_u(V^h - P)}{2(1 - \alpha_u)(P - W)}$.

Setting $G_2^r(P) = 1$ yields the lower bound of the support of the equilibrium strategy, $\hat{P}^h = \frac{(V^h - W)\alpha_u}{2 - \alpha_u} + W$. Note that this lower bound, \hat{P}^h , must be the same for each firm. Suppose $\hat{P}_1^h < \hat{P}_2^h$. Then, by charging $\hat{P}_1^h + \epsilon$ (for some $\epsilon \in (0, \hat{P}_2^h - \hat{P}_1^h)$), D_1 earns a higher profit than from any price $P \in (\hat{P}_1^h, \hat{P}_1^h + \epsilon)$. Hence, it cannot be an equilibrium to have $\hat{P}_1^h < \hat{P}_2^h$. By the same logic, it cannot be that $\hat{P}_2^h < \hat{P}_1^h$, so it must be that $\hat{P}_1^h = \hat{P}_2^h = \hat{P}^h$.

Now, for D_2 , the profit from any price P in the support of its mixed strategy P_2^r should be equal to that from charging the lower bound \hat{P}^h . First, note that the highest price that P_2^r will be set to is V^h . Further, in equilibrium $P_1(V^h)$ is being randomized. Hence, consumers of type V^h who observe P_2^r will buy either at $P_1(V^h)$ or at P_2^r . Therefore, $\lambda_H(1 - \alpha_u)(P - W)G_1^h = \lambda_H(1 - \alpha_u)(\hat{P}^h - W)G_1^h$ which implies $G_1^h = \frac{(\hat{P}^h - W)}{(P - W)} = \frac{\alpha_u(V^h - W)}{(2 - \alpha_u)(P - W)}$.

Now, consider $P_2(V^h)$ and $P_2(V^\ell)$. Since P_2^r is always greater than V^ℓ , no consumer of type V^ℓ will buy at P_2^r . Hence, the equilibrium strategies for consumers of type V^ℓ exactly parallel those demonstrated by Narasimhan (1988).

(ii) Next, we prove that the conjectured strategies constitute an equilibrium. Consider D_1 first. Since all its sales are offline, it knows the consumer type before it chooses its price for each consumer. Hence, a deviation in $P_1(V^h)$ ($P_1(V^\ell)$) does not affect its profit from consumers of type V^ℓ (V^h). That is, it is sufficient to rule out deviations in each of $P_1(V^h)$ and $P_1(V^\ell)$ in isolation. By construction, G_1^h and G_1^ℓ are best responses, ruling out such deviations.

Next, consider firm 2. Here, we need to rule out the possibility of a joint deviation in P_2^r , $P_2(V^h)$, and $P_2(V^\ell)$.

By construction, $G_1^h(P)$ and $G_2^r(P)$ are best responses. Hence, neither retailer can gain by charging any other price $P_1(V^h)$ and P_2^r . Now, suppose firm 1 sets $P_1(V^h) < V^h$. Since, at any price in the region $[V^\ell, V^h]$, it obtains the same sales amongst high value consumers as at V^h , this prices lead to lower profits, and will not be chosen. Suppose it chooses a price $P_1(V^h) = P < V^\ell$. Then, compared to charging $P_1(V^h) = V^h$, in its own captive segment it loses an amount $\lambda_H \frac{\alpha_u}{2} (V^h - P)$. In the other two segments, it wins over some sales from D_2 . Specifically, in these segments, it gains $\lambda_H(1 - \alpha_u)G_2^r(P)(P - W)$. To sustain the equilibrium, we require the net gain to be non-positive. Substituting $G_2^r(P) = \frac{\alpha_u(V^h - P)}{2(1 - \alpha_u)(P - W)}$, this implies $V^\ell \leq V^h$, which is true by assumption. Hence, no deviation from $P_1(V^h) = V^h$ is profitable.

Next, consider $P_2(V^h)$. At any price $P \in [V^\ell, V^h]$, D_2 sells only to its own captive segment, $\frac{\alpha_u}{2}$, of the high type consumer. Since sales are unchanged at all these prices, V^h is optimal in this set.

Now, consider D_2 charging a price $\tilde{P} < V^h$ to the high type consumers. Compared to setting $P_2(V^h) = V^h$, in its captive segment it loses $\lambda_H \frac{\alpha_u}{2} (V^h - \tilde{P})$. In the non-captive segments (of total mass $(1 - \alpha_u)$), it is already capturing the entire market for the high types, since $\max P_2^r = V^h > P_1(V^h)$. Hence, it merely cannibalizes its own sales in this segment, for an additional loss of $\lambda_H(1 - \alpha_u) G_2^r(P) (V^h - P)$. Therefore, this is not a profitable deviation.

Next, we look at possible joint deviations for D_2 . The equilibrium profits for D_2 can be written as follows.

$$\begin{aligned} \pi_2(P_2^r, P_2(V^h), P_2(V^\ell)) = & \frac{\alpha_u}{2} (\lambda_H P_2(V^h) + \lambda_L P_2(V^\ell) - W) + \alpha_p (\lambda_H G_1^h(P_2^r)(P_2^r - W) + \\ & \lambda_L (G_1^\ell(P_2^r)(P_2^r - W) 1_{P_2^r \leq V^\ell} + (1 - \alpha_u - \alpha_p) \lambda_H G_1^h(\text{Min}\{P_2^r, P_2(V^h)\})(\text{Min}\{P_2^r, P_2(V^h)\} - W) + \end{aligned}$$

$$\lambda_L G_1^\ell(\text{Min}\{P_2^r, P_2(V^\ell)\})(\text{Min}\{P_2^r, P_2(V^\ell)\} - W). \quad (10)$$

For any deviation to occur profits need to be higher than the equilibrium profits given by

$$\begin{aligned} & \frac{\alpha_u}{2}(\lambda_H(V^h - W) + \lambda_L(V^\ell - W)) + \alpha_p \lambda_H G_1^h(P_2^r)(P_2^r - W) + \\ & (1 - \alpha_u - \alpha_p)(\lambda_H G_1^h(P_2^r)(P_2^r - W) + \lambda_L G_1^\ell(P)(P_2^r - W)). \end{aligned} \quad (11)$$

Suppose $V^\ell < P_2^r < \hat{P}^h$ and $P_2(V^h) < V^h$. There could be two possibilities here: (i) $P_2^r < P_2(V^h)$ (ii) $P_2^r > P_2(V^h)$. From the first scenario, it turns out that $\min\{P_2^r, P_2(V^h)\}$ is less than \hat{P}^h . So $G_1^h(\text{Min}\{P_2^r, P_2(V^h)\}) = 1$. In the same vein, $G_1^\ell(\text{Min}\{P_2^r, P_2(V^\ell)\}) = 0$ and $(\text{Min}P - W) < (\hat{P}^h - W)$. It can be shown that each of the terms in equation (10) turn out to be lower than or equal to the corresponding terms in equation (11). Hence, neither retailer has a profitable deviation. In a similar manner, we can show that if $P_2^r \leq V^\ell$, and $P_2(V^\ell) < P_2^r$, with $P_2(V^h) = V^h$, then neither retailer can deviate to any profitable equilibrium unless P_2^r is randomized between \hat{P}^ℓ and V^h . However if W is low enough to make this deviation profitable, then the competitive response of D_1 will be to decrease the average price. This in turn, leads to lower franchise fees for the manufacturer. Hence the manufacturer can prevent this deviation by D_2 by setting W high enough. Thus, the specified strategies constitute an equilibrium.

(ii) We now proceed to derive the expected sales of each retailer. As before, let $g_i = -\frac{dG_i}{dP}$. Retailer D_1 sells to all of its captive segment, of size $\frac{\alpha_u}{2}$. In the other two segments, of size $(1 - \alpha_u)$, it sells to the high consumer type, and only if $P_2^r > P_1(V^h)$, which happens with probability $G_2^r(P)$ for any price P in the support of $G_1^\ell(P)$. While in the segment of size α_p it sells to all the low type consumers, in the segment $1 - \alpha_u - \alpha_p$, it sells to the low types only if $P_1(V^\ell) < P_2(V^\ell)$ which happens with the probability $G_2^\ell(P)$. Therefore, the expected sales of D_1 are given by

$$\begin{aligned} E(S_1^I) &= \frac{\alpha_u}{2} + \lambda_L \alpha_p + \lambda_H \int_{\hat{P}^h}^{V^h} (1 - \alpha_u) G_2^r(P) g_1^h(P) dP + \lambda_L \int_{\hat{P}^\ell}^{V^\ell} (1 - \alpha_u - \alpha_p) G_2^\ell(P) g_1^\ell(P) dP \\ &= \frac{\lambda_H (1 - \alpha_u)^2}{2 - \alpha_u} + \frac{\alpha_u}{2} + \lambda_L \alpha_p + \lambda_L \frac{(1 - \alpha_u - \alpha_p)(2 - \alpha_u - 2\alpha_p)}{2(2 - \alpha_u)}. \end{aligned} \quad (12)$$

Similarly, we can derive the expected sales of retailer D_2 as

$$\begin{aligned} E(S_2^I) &= \frac{\alpha_u}{2} + \lambda_H \int_{\hat{P}^h}^{V^h} (1 - \alpha_u) G_1^h(P) g_2^r(P) dP + \lambda_L \int_{\hat{P}^\ell}^{V^\ell} (1 - \alpha_u - \alpha_p) G_1^\ell(P) g_2^\ell(P) dP \\ &= \frac{\lambda_H (1 - \alpha_u)}{2 - \alpha_u} + \frac{\alpha_u}{2} + \lambda_L \frac{(1 - \alpha_u - \alpha_p)(2 - \alpha_u + 2\alpha_p)}{2(2 - \alpha_u)}. \end{aligned} \quad (13)$$

As expected, the retailers' total sales sum to 1.

(b) Proof of Alternate Equilibrium

(i) As in Lemma 1, we first derive the mixed strategies for the players and then demonstrate that these constitute an equilibrium. Consider $P_1(V^\ell)$, the price charged by D_1 to the low consumer type. In equilibrium, D_1 should make the same profit by charging any price P in the support of the mixed strategy as from charging a monopoly price V^ℓ . Hence, $\frac{\alpha_u}{2}(P - W) + (1 - \alpha_u - \alpha_p + \alpha_p)(P - W)G_2^r(P) - F = \frac{\alpha_u}{2}(V^\ell - W) - F$, which implies $G_2^r(P) = \frac{\alpha_u(V^\ell - P)}{2(1 - \alpha_u)(P - W)}$.

Setting $G_2^r(P) = 1$ yields the lower bound, of the support of the equilibrium strategy, $\hat{P}^h = \frac{(V^\ell - W)\alpha_u}{2 - \alpha_u} + W$. Note that this lower bound, \hat{P}^h , must be the same for each firm. Suppose $\hat{P}_1^h < \hat{P}_2^h$. Then, by charging $\hat{P}_1^h + \epsilon$ (for some $\epsilon \in (0, \hat{P}_2^h - \hat{P}_1^h)$), D_1 earns a higher profit than from any price $P \in (\hat{P}_1^h, \hat{P}_1^h + \epsilon)$. Hence, it cannot be an equilibrium to have $\hat{P}_1^h < \hat{P}_2^h$. By the same logic, it cannot be that $\hat{P}_2^h < \hat{P}_1^h$, so it must be that $\hat{P}_1^h = \hat{P}_2^h = \hat{P}^h$.

Now, for D_2 , the profit from any price P in the support of its mixed strategy P_2^r should be equal to that from charging the lower bound \hat{P}^h . First, note that, given assumption 1 (i), the highest that P_2^r will be set to is V^ℓ .²⁵ Further, in equilibrium $P_1(V^h) = V^h$. Hence, all consumers of type V^h who observe P_2^r will buy at the latter price. Therefore, $\lambda_H(1 - \alpha_u)(P_2^r - W) + \lambda_L(1 - \alpha_u)(P_2^r - W)G_1^\ell(P) = (\lambda_H + \lambda_L)(1 - \alpha_u)(\hat{P}^h - W)$ which implies $G_1^\ell(P) = \frac{(\hat{P}^h - W)}{\lambda_L(P - W)} - \frac{\lambda_H}{\lambda_L}$.

(ii) Next, we prove that the conjectured strategies constitute an equilibrium. By construction, $G_1^\ell(P)$ and $G_2^r(P)$ are best responses. Hence, neither retailer can gain by charging any other price $P_1(V^\ell)$ and P_2^r . Now, suppose firm 1 sets $P_1(V^h) < V^h$. Since, at any price in the region $[V^\ell, V^h]$, it obtains the same sales amongst high value consumers as at V^h , this prices lead to lower profits, and will not be chosen. Suppose it chooses a price $P_1(V^h) = P < V^\ell$. Then, compared to charging $P_1(V^h) = V^h$, in its own captive segment it loses an amount $\lambda_H \frac{\alpha_u}{2} (V^h - P)$. In the other two segments, it wins over some sales from D_2 . Specifically, in these segments, it gains $\lambda_H(1 - \alpha_u)G_2^r(P)(P - W)$. To sustain the equilibrium, we require the net gain to be non-positive. Substituting $G_2^r(P) = \frac{\alpha_u(V^\ell - P)}{2(1 - \alpha_u)(P - W)}$, this implies $V^\ell \leq V^h$, which is true by assumption. Hence, no deviation from $P_1(V^h) = V^h$ is profitable.

²⁵Since $(\lambda_H + \lambda_L)V^\ell \geq \lambda_H V^h$, charging any price in the region $(V^\ell, V^h]$ leads to lower profit, since no lower valuation consumers will buy at such a price.

Next we show that $P_2(V^h) = V^h$. At any price $P \in [V^\ell, V^h]$, D_2 sells only to its own captive segment, $\frac{\alpha_u}{2}$, of the high type consumer. Since sales are unchanged at all these prices, V^h is optimal in this set.

Now, consider D_2 charging a price $\tilde{P} < V^\ell$ to the high type consumers. Compared to setting $P_2(V^h) = V^\ell$, in its captive segment it loses $\lambda_H \frac{\alpha_u}{2} (V^h - \tilde{P})$. In the non-captive segments (of total mass $(1 - \alpha_u)$), it is already capturing the entire market for the high types, since $\max P_2^r = V^\ell < P_1(V^h) = V^h$. Hence, it merely cannibalizes its own sales in this segment, for an additional loss of $\lambda_H (1 - \alpha_u) G_2^r(P) (V^\ell - P)$. Therefore, this is not a profitable deviation.

Finally we show that it is not optimal for D_2 to set $P_2(V^\ell) < V^\ell$. Suppose it does charge $P_2(V^\ell) < V^\ell$. There are three effects on profit, compared to charging $P_2(V^\ell) = V^\ell$:

- (a) in its captive segment, it loses $\lambda_L \frac{\alpha_u}{2} (V^\ell - P_2(V^\ell))$,
- (b) in the segment of mass $(1 - \alpha_u - \alpha_p)$, if $P < P_2^r < V^\ell$, it cannibalizes its own sales, and loses an amount $\lambda_L (1 - \alpha_u - \alpha_p) G_1^\ell(P) G_2^r(P) \text{Prob}(P_2^r < P_1(V^\ell) \mid P_2^r > P) \{E(P_2^r \mid P < P_2^r < P_1(V^\ell)) - P_2(V^\ell)\}$, where $E(P_2^r \mid P < P_2^r < P_1(V^\ell))$ is the expected price at which the cannibalized sales were being made (the conditioning event is that $P < P_2^r < P_1(V^\ell)$).
- (c) finally, in the segment of mass $(1 - \alpha_u - \alpha_p)$, if $P < V^\ell < P_2^r$, it wins some sales over from D_1 , leading to a gain $\lambda_L (1 - \alpha_u - \alpha_p) G_1^\ell(P) G_2^r(P) \text{Prob}(P_1(V^\ell) < P_2^r \mid P < P_1(V^\ell)) (P - W)$.

Replacing the relevant expressions for $G_1^\ell(P)$ and $G_2^r(P)$, and evaluating the conditional probabilities and expectations, we find that, in overall terms, the firm loses some profit.²⁶ Hence, it will not deviate to $P_2(V^h) < V^\ell$. Since neither retailers has a profitable deviation, the specified strategies constitute an equilibrium.

(ii) As before, let $g_i = -\frac{dG_i}{dP}$. Retailer D_1 sells to all of its captive segment, of size $\frac{\alpha_u}{2}$. In other two segments, of size $(1 - \alpha_u)$, it sells only to the low consumer type, and only if $P_2^r > P_1(V^\ell)$, which happens with probability $G_2^r(P)$ for any price P in the support of $G_1^\ell(P)$. Therefore, the expected sales of D_1 are given by

$$E(S_1) = \frac{\alpha_u}{2} + \lambda_L \int_{\hat{P}^h}^{P^m} (1 - \alpha_u) G_2^r(P) g_1^\ell(P) dP = \frac{1}{2 - \alpha_u} - \frac{\alpha_u}{2}. \quad (14)$$

²⁶For brevity, algebraic details that do not provide insight into the model are omitted here and in a few other places of the appendix, and are available from the authors on request.

Similarly, we can derive the expected sales of retailer D_2 as

$$E(S_2) = \frac{\alpha_u}{2} + \lambda_L \int_{\hat{P}^h}^{P^m} (1 - \alpha_u) G_1^\ell(P) g_2^\ell(P) dP + \lambda_H (1 - \alpha_u) = 1 - \left(\frac{1}{2 - \alpha_u} - \frac{\alpha_u}{2} \right) \quad (15)$$

As expected, the retailers' total sales sum to 1.

Finally, we show that $E(S_1) < \frac{1}{2} < E(S_2)$. This will be true as long as $E(S_1) < E(S_2)$, since $E(S_1) + E(S_2) = 1$. Now, $E(S_1) < E(S_2)$ if and only if

$$1 - \frac{1}{2 - \alpha_u} + \frac{\alpha_u}{2} > \frac{1}{2 - \alpha_u} - \frac{\alpha_u}{2} \iff 1 > \frac{2}{2 - \alpha_u} - \alpha_u,$$

or, $\alpha_u^2 - \alpha_u < 0$, which is true since $0 < \alpha_u < 1$. ■

Proof of Corollary 1

For brevity we avoid the intermediate steps of calculating retailers' profits in the alternate equilibrium. When $W < \hat{W}$, the total profits of the manufacturer are $2F + W$ given by

$$2 \left(\frac{\alpha_u \lambda_H (V^h - W)}{2} + \frac{\alpha_u (1 - \alpha_u) (V^\ell - W)}{2 - \alpha_u} + \frac{\alpha_u (V^\ell - W)}{2} \left(\frac{\alpha_u}{2 - \alpha_u} - \lambda_H \right) \right) - \delta(2 - \alpha_u) + W. \quad (16)$$

After some algebraic simplification we can show that at $W = 0$ this equation reduces to $\alpha_u (\lambda_H (V^h + V^\ell) + V^\ell) - \delta(2 - \alpha_u)$. Further, equation (16) is increasing in W till $W = \hat{W}$. At $W = \hat{W}$, equation (16) is equal to

$$\frac{V^\ell - \lambda_H V^h}{\lambda_L} + \alpha_u (\lambda_H V^h + \lambda_L V^\ell - \frac{V^\ell - \lambda_H V^h}{\lambda_L}) - \delta(2 - \alpha_u). \quad (17)$$

Taking the difference between equation (4) in the text and equation (17) given above, we have it equal to $\frac{(1 - \alpha_u)(\lambda_H (V^h - V^\ell))}{\lambda_L} > 0$. ■

Proof of Proposition 2

(i) The expected infomediary referral price is $E(P_2^r) = \int_{\hat{P}^h}^{V^h} P g_2^\ell(P) dP = W + \frac{\alpha_u (\ln \frac{2 - \alpha_u}{\alpha_u}) (V^h - W)}{2(1 - \alpha_u)}$ and the expected price charged by D_1 to the low consumer type is $E(P_1(V^\ell)) = (1 - G_1^\ell(P^m)) \int_{\hat{P}^h}^{P^m} P g_1^\ell(P) dP + G_1^\ell(P^m) P^m$. Here, we account for the mass point (of mass $G_1^\ell(P^m)$) at $P^m = V^\ell$. Carrying out the integration for these last two equations yields the statements in the proposition.

(ii) Similarly, the expected profit of retailer D_1 , is

$$E(\pi_1^I) = \lambda_H \int_{\hat{P}^h}^{V^h} \left(\frac{\alpha_u}{2} + (1 - \alpha_u) G_2^r(P) \right) (P - W) g_1^h(P) dP + \lambda_H \left(\frac{\alpha_u}{2} \right) \left(\frac{\alpha_u}{2 - \alpha_u} \right) (V^h - W)$$

$$\begin{aligned}
& +\lambda_L \int_{\hat{P}^\ell}^{V^\ell} \left(\frac{\alpha_u}{2} + \alpha_p + (1 - \alpha_u)G_2^\ell(P) \right) (P - W) g_1^\ell(P) dP + \lambda_L \left(\frac{\alpha_u}{2} + \alpha_p \right) \frac{2\alpha_p}{2 - \alpha_u} (V^\ell - W) - \\
& \delta \left(1 - \frac{\alpha_u}{2} \right) - F = \\
& \frac{\alpha_u}{2} \lambda_H (V^h - W) + \lambda_L \left(\frac{\alpha_u + 2\alpha_p}{2} \right) (V^\ell - W) - \delta \left(1 - \frac{\alpha_u}{2} \right) - F,
\end{aligned}$$

and the expected profit of retailer D_2 is

$$\begin{aligned}
E(\pi_2^I) = & \frac{\alpha_u}{2} \lambda_H (V^h - W) + \frac{\alpha_u(1 - \alpha_u) \lambda_H (V^h - W)}{2 - \alpha_u} + \lambda_L \left(\frac{\alpha_u}{2} + \alpha_p \right) \left(\frac{2 - \alpha_u - 2\alpha_p}{2 - \alpha_u} \right) (V^\ell - W) \\
& - \left(1 - \frac{\alpha_u}{2} - \alpha_p \right) \delta - F - K.
\end{aligned}$$

The manufacturer optimally maximizes its franchise fee, subject to the condition that both dealers must earn a non-negative expected profit (else they will exit the market). Let $\tilde{\pi}_i$ be the gross profits of retailer i (that is, without subtracting off the franchise or infomediary fees). Then, in equilibrium,

$$F^* = \min\{E(\tilde{\pi}_1), E(\tilde{\pi}_2)\} = \frac{\alpha_u}{2} \lambda_H (V^h - V^\ell) - \delta \left(1 - \frac{\alpha_u}{2} \right).$$

Now, the infomediary sets the maximum referral fee at which D_2 earns a non-negative profit. This is defined by the K^* at which $E(\tilde{\pi}_2) - F^* - K^* = 0$, or

$$K^* = E(\tilde{\pi}_2) - F^* = \frac{\lambda_H \alpha_u (1 - \alpha_u)}{2 - \alpha_u} (V^h - V^\ell) + \alpha_p \delta.$$

Note that $K^* > 0$ (since both terms are positive), which confirms that $E(\tilde{\pi}_1) < E(\tilde{\pi}_2)$.

The total profits of the manufacturer $2F + W = \alpha_u \lambda_H (V^h - W) + \lambda_L (\alpha_u + 2\alpha_p)(V^\ell - W) + W - \delta(2 - \alpha_u)$. This expression is increasing in W if $(1 - \alpha_u - 2\lambda_L \alpha_p) > 0$. Hence the manufacturer should charge W as high as possible if $(1 - \alpha_u - 2\lambda_L \alpha_p) > 0$. At $W = V^\ell$, the manufacturer's total profit is $= \alpha_u \lambda_H (V^h - V^\ell) + V^\ell - \delta(2 - \alpha_u)$.

If the manufacturer were to charge $W = V^h$, then its total profits would be equal to $\lambda_H V^h - 2\delta(1 - \frac{\alpha_u}{2})$. Hence, the optimal $W = V^\ell$ iff

$$\alpha_u \lambda_H (V^h - V^\ell) + V^\ell \geq \lambda_H V^h \iff \lambda_H \leq \frac{V^\ell}{\alpha_u V^\ell + (1 - \alpha_u) V^h}.$$

which is true since $\lambda_H \leq \frac{V^\ell}{V^h}$.

(iii) This choice of W also maximizes total channel profits. This follows from comparing $2F^I + K^I + W$ at $W = V^\ell$ with the total channel profits when $W = V^h$.

Now total channel profits =

$$\frac{\alpha_u \lambda_H (3 - 2\alpha_u)}{(2 - \alpha_u)} (V^h - V^\ell) + V^\ell - \delta(2 - \alpha_u - \alpha_p).$$

For this to be greater than $\lambda_H V^h - \delta(2 - \alpha_u - \alpha_p)$, we need $\lambda_H \leq \frac{V^\ell}{V^h}$ which is true. \blacksquare

Proof of Proposition 3

We proceed with a series of steps.

Step 1 First, suppose $\beta = 0$, so that there are no consumers at the physical stores. We derive the equilibrium strategies for this case, and show that $G_2^r(P)$ is the same as in the world with only an infomediary.

From the profit invariance condition of a mixed strategy equilibrium, D_1 should make the same profit from any price P in the support of its mixed strategy as it would at a monopoly price. Since D_1 cannot differentiate across consumer types when $\beta = 0$, it must be the case that its monopoly price is $P^m = V^h$ (as shown in Proposition 1, this yields a higher profit than V^ℓ). Hence, $(\lambda_L + \lambda_H) \frac{\alpha_u}{2}(P - W) + (1 - \alpha_u)(P - W)G_2^r(P) - F = (\lambda_L + \lambda_H) \frac{\alpha_u}{2}(P^m - W) - F$ and $G_2^r(P) = \frac{\alpha_u(V^h - P)}{2(1 - \alpha_u)(P - W)}$. Therefore, the distribution of P_2^r , $G_2^r(P)$, is identical to that in Proposition 1. This further yields that $\hat{P}^h = \frac{\alpha_u(V^h - W)}{2 - \alpha_u} + W$, as before. Similarly for D_2 , profit from pricing at any $P \in [\hat{P}^h, V^h]$ should be the same as the profit from pricing at \hat{P}^h . Hence, $(\lambda_L + \lambda_H) \left(\frac{\alpha_u}{2}(P_2^m - W) + (1 - \alpha_u) G_1^m(P) (P - W) \right) - K = (\lambda_L + \lambda_H) \left(\frac{\alpha_u}{2}(P_2^m - W) + (1 - \alpha_u) G_1^m(\hat{P}^h) (\hat{P}^h - W) \right) - K$ which implies $G_1^m(P) = \frac{(\hat{P}^h - W)}{(P_2^r - W)} = \frac{\alpha_u(V^h - W)}{(2 - \alpha_u)(P - W)}$.

Next, for the $\beta = 0$ case, we show that the strategies exhibited in the Proposition do constitute an equilibrium. Note that $P^m = V^h$ is the monopoly price that for D_1 in its captive segment. If P_2^r is set to any price above this, D_2 will make no sales at P_2^r , so it must price at or below V^h . Further, by construction, $G_1^m(P)$ and $G_2^r(P)$ are best responses by the dealers, so a deviation to prices below \hat{P}^h is not profitable either.

Finally, consider $G_2^m(P)$. First, observe that any price above V^h is sub-optimal, compared to V^h , since it loses all consumers in this segment.²⁷ Suppose D_2 sets $P_2^m = P < V^h$. There are three effects on profit, as compared to charging $P_2^m = V^h$.

- (a) in its captive segment, of size $\frac{\alpha_u}{2}$, it loses $(\lambda_L + \lambda_H) \frac{\alpha_u}{2}(V^h - P) = \frac{\alpha_u}{2}(V^h - P)$,
- (b) in the segment of mass $(1 - \alpha_u - \alpha_p)$, if $P < P_2^r < P_1^m$, it cannibalizes its own sales, and

²⁷The same argument as in footnote 25 works here.

loses an amount $(\lambda_L + \lambda_H) (1 - \alpha_u - \alpha_p) G_1^m(P) G_2^r(P) \text{Prob}(P_2^r < P_1^m \mid P_2^r > P) \{E(P_2^r \mid P < P_2^r < P_1^m) - P\}$, where $E(P_2^r \mid P < P_2^r < P_1^m)$ is the expected price at which the cannibalized sales were being made (the conditioning event is that $P < P_2^r < P_1^m$),

(c) finally, in the segment of mass $(1 - \alpha_u - \alpha_p)$, if $P < P_1^m < P_2^r$, it wins some sales over from D_1 , leading to a gain $(\lambda_L + \lambda_H) (1 - \alpha_u - \alpha_p) G_1^m(P) G_2^r(P) \text{Prob}(P_1^m < P_2^r \mid P < P_1^m) (P - W)$.

Replacing the relevant expressions for $G_1^m(P)$ and $G_2^r(P)$, and evaluating the conditional probabilities and expectations, we find that, in overall terms, the firm loses some profit. Hence, it will not deviate to $P_2^m < V^h$.

Step 2 Suppose $\beta = 1$. Then, the strategies exhibited constitute an equilibrium.

This step follows immediately from Proposition 1; for $\beta = 1$, the game reduces to the game in Figure 5.

Step 3: For all values of $\beta \in (0, 1)$, the strategies exhibited constitute an equilibrium.

Notice that $G_2^r(P)$, the distribution of P_2^r , is exactly identical in the two cases $\beta = 0$ and $\beta = 1$. Further, there is no consumer who observes both an offline price and a manufacturer referral price. That is, $P_1(V^h), P_1(V^\ell), P_2(V^h), P_2(V^\ell)$ are set as best responses only to each other and P_2^r , and are not affected by P_1^m, P_2^m . Similarly, P_1^m, P_2^m are set as best responses only to each other and P_2^r . Hence, it is immediate that, given that $G_2^r(P)$ is the same in both cases, when $\beta > 0$, $P_1(V^h), G_1^\ell(P), P_2(V^h), P_2(V^\ell)$, and $G_1^m(P), P_2^m$, are mutual best responses. Finally, since $G_2^r(P)$ is a best response for both the $\beta = 0$ and $\beta = 1$ cases, it must continue to be so when $\beta \in (0, 1)$.

Step 4: Proof of the alternate equilibrium follows in the same manner and is available from the authors upon request. ■

Proof of Corollary 3.1

For brevity we avoid the intermediate steps of calculating retailers' profits in the alternate equilibrium. When $W < \hat{W}$, the maximum profits of the manufacturer are $2F + W$ given by

$$\frac{V^\ell - \lambda_H V^h}{\lambda_L} + \frac{\alpha_u (\lambda_H (V^h + \lambda_L \beta (V^h - V^\ell)) - V^\ell \lambda_H)}{\lambda_L}.$$

Compare this to the maximum profits made by the manufacturer when it choose $W > \hat{W}$,

$$\alpha_u \lambda_H (V^h - V^\ell) + V^\ell (\lambda_H + \beta \lambda_L).$$

The difference is given by

$$(1 - \alpha_u)(V^h \lambda_H - V^\ell) + \lambda_H \lambda_L (V^h \alpha_u (1 - \beta) + V^\ell (1 - \alpha_u)(1 - \beta) + V^\ell \frac{(\beta - \alpha_u)}{\lambda_H}).$$

Since the difference is linear in β , one can derive the critical value of β .

Note that when $\alpha_u = 1$, the condition reduces to $(1 - \beta)(V^h - \frac{V^\ell}{\lambda_H}) < 0$. Similarly when $\beta = 1$, the condition is $(1 - \alpha_u)(V^h \lambda_H - V^\ell + \frac{V^\ell}{\lambda_H}) > 0$, and when $\lambda_H = 1$, the condition becomes equal to $(V^h - V^\ell)(1 - \alpha_u) > 0$. ■

Proof of Proposition 4

(i) First, note that the strategies of both firms in the β segments of the market have not changed. Hence, the expected sales of D_1 in these segments amount to as those from before (from Proposition 1). Consider the sales of D_1 in the $(1 - \beta)$ segments. Its expected sales here amount to $\lambda_H (1 - \beta) \left(\frac{\alpha_u}{2} + \int_{\hat{P}^h}^{V^h} (1 - \alpha_u) G_2^r(P) g_1^m(P) dP \right) = \lambda_H (1 - \beta) \left(\frac{1}{2 - \alpha_u} - \frac{\alpha_u}{2} \right)$. Since the total size of the market is constant, the expected sales of D_2 are $E(S_2^m) = 1 - E(S_1^m) = 1 - \lambda_H (1 - \beta) \left(\frac{1}{2 - \alpha_u} - \frac{\alpha_u}{2} \right)$.

(ii) The expected manufacturer referral price of D_1 (accounting for the mass point at P^m) is $E(P_1^m) = (1 - G_1^m(V^h)) \int_{\hat{P}^h}^{V^h} P g_1^m(P) dP + G_1^m(V^h) V^h$, which yields the expression in the statement of the Proposition. The expected infomediary price of D_2 , $E(P_2^r)$ does not change, compared to Proposition 1, since the distribution of P_2^r is the same in equilibrium. Hence it is given by $E(P_2^r) = \int_{\hat{P}^h}^{P^m} P g_2^r(P) dP = W + \frac{\alpha_u (\ln \frac{2 - \alpha_u}{\alpha_u}) (V^h - W)}{2(1 - \alpha_u)}$.

(iii) The profit of D_1 is

$$\begin{aligned} E(\pi_1^m) &= \beta E(\pi_1^I) + (1 - \beta) \lambda_H \int_{\hat{P}^h}^{P^m} \left(\frac{\alpha_u}{2} + (1 - \alpha_u) G_2^r(P) \right) (P - W) g_1^m(P) dP - F^w \\ &= \beta E(\pi_1^I) + (1 - \beta) \lambda_H \left(\frac{\alpha_u (V^h - W)}{2} \right) - F^m. \end{aligned}$$

The profit of D_2 , $E(\pi_2^m)$, is

$$\begin{aligned} &\beta E(\pi_2^I) + (1 - \beta) \lambda_H \left\{ \frac{\alpha_u}{2} (V^\ell - W) + \int_{\hat{P}^h}^{P^m} (1 - \alpha_u) G_1^m(P) (P - W) g_2^r(P) dP \right\} - F^m - K^m \\ &= \beta E(\pi_2^I) + (1 - \beta) \lambda_H \left(\frac{\alpha_u (4 - 3\alpha_u) (V^h - W)}{2(2 - \alpha_u)} \right) - F^m - K^m. \end{aligned} \quad \blacksquare$$

Proof of Proposition 5

(i) The optimal values of F^m and K^m follow immediately from the expressions for $E(\pi_1^m)$ and $E(\pi_2^m)$ in Proposition 4, following the same logic as in Proposition 2. Hence

$$F^m = \beta F^I + (1 - \beta) \lambda_H \left(\frac{\alpha_u (V^h - V^\ell)}{2} \right)$$

$$K^m = \beta K^I + (1 - \beta) \lambda_H \left(\frac{\alpha_u (1 - \alpha_u) (V^h - V^\ell)}{2 - \alpha_u} \right). \quad (18)$$

(ii) Note that the total sales of the product are the same in both cases, with and without manufacturer referrals. Hence, the difference in the manufacturer's profit is just $F^m - F^I$. Further, in each case, the optimal franchise fee is exactly equal to the gross profits of retailer 1 (that is, the profits without subtracting out the franchise fee). To show that $F^m > F^I$, we show that the difference in the gross profits of D_1 is positive.

From Proposition 2 and Proposition 4, the difference in the gross profits of D_1 after the establishment of the manufacturer's referral service is

$$(1 - \beta) \left(\frac{\alpha_u \lambda_H (V^h - V^\ell)}{2} - E(\pi_1^o) \right) = (1 - \beta) \left(1 - \frac{\alpha_u}{2} \right) \delta.$$

Since $(1 - \beta) > 0$, this difference is positive. ■

Proof of Proposition 6

Recall equation (18) which gives the optimal manufacturer and referral fees when the manufacturer establishes referral services. From this we have the following equations:

$$F^m = \beta F^I + (1 - \beta) (F^I + \delta (1 - \frac{\alpha_u}{2})) = F^I + (1 - \beta) \delta (1 - \frac{\alpha_u}{2}). \quad (19)$$

$$K^m = \beta K^I + (1 - \beta) \left(\frac{\alpha_u \lambda_H (1 - \alpha_u) (V^h - V^\ell)}{2 - \alpha_u} \right) = K^I - (1 - \beta) \alpha_p \delta. \quad (20)$$

Hence

$$2F^m + K^m + W = (2F^I + K^I) + (1 - \beta) \delta (2 - \alpha_u - \alpha_p) + (1 - \beta) \lambda_H V^\ell,$$

which then reduces to equation (9). Compare this to equation (2) and take the difference. We get

$$\left(\alpha_u \frac{(3 - 2\alpha_u)}{(2 - \alpha_u)} - 1 \right) (\lambda_H (V^h - V^\ell)) + \delta (1 - \beta) (2 - \alpha_u - \alpha_p) + V^\ell ((1 - \beta) \lambda_H - 1).$$

Now $\frac{\alpha_u (3 - 2\alpha_u)}{2 - \alpha_u} < 1$, so the first term is always negative. The third term is also always negative. However, $\beta < 1$ and $(2 - \alpha_u - \alpha_p) > 1$, so the second term could be positive or negative. Since the equation is linear, one can find a critical value of δ or a critical value of β , beyond which this difference is always positive. ■

Proof of Proposition 7

(i) From Table 5.3, $CR(P_1^m) \leq CR(P_2^r)$ if and only if

$$\frac{\lambda_H((1 - \alpha_u)^2 + 1)}{(2 - \alpha_u)^2} \leq \frac{\lambda_H}{2 - \alpha_u} \iff ((1 - \alpha_u)^2 + 1) \leq 2 - \alpha_u.$$

This is true if $2 - 2\alpha_u + \alpha_u^2 \leq 2 - \alpha_u$ or, $\alpha_u - \alpha_u^2 \geq 0$, which is true since $0 \leq \alpha_u \leq 1$.

(ii) From Table 5.3, $CR(P_2^m) \geq CR(P_2^r)$ if and only if

$$\alpha_u \lambda_H (2 - \alpha_u) > 2 - \alpha_u - 2\alpha_p \implies \alpha_p \geq \frac{(1 - \lambda_H \alpha_u)(2 - \alpha_u)}{2} \quad \blacksquare$$

8.1 Appendix B

8.2 What if the Infomediary Enrols both Retailers

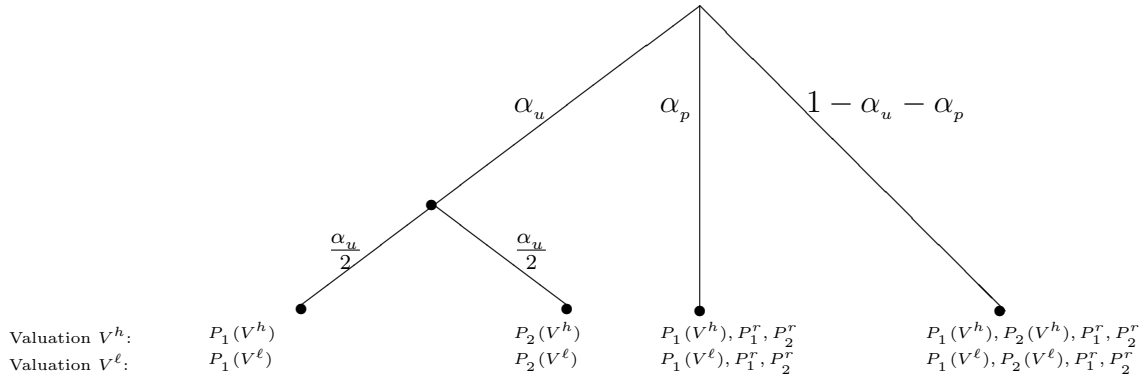


Figure 5: Different prices observed by each consumer segment

In this case the equilibrium prices are $P_1(V^h) = P_2(V^h) = V^h$ and $P_1(V^\ell) = P_2(V^\ell) = V^\ell$. $P_1^r = P_2^r = W$. This gives profits of each retailer $= \lambda_H(\frac{\alpha_u}{2}(V^h - W) + \lambda_L(\frac{\alpha_u}{2}(V^\ell - W) + \alpha_p(W - W) + (1 - \alpha_u - \alpha_p)(W - W) - \delta(1 - \frac{\alpha_u}{2}) = \frac{\alpha_u}{2}(\lambda_H V^h + \lambda_L V^\ell - W) - \delta(1 - \frac{\alpha_u}{2})$. It is immediate to show that the gross profits of each retailer are either less than (for D_2) or equal to (for D_1) the profits when neither of them are enrolled with the infomediary. *Hence the infomediary will enroll only one retailer. This also implies that only one retailer will wish to enroll with the infomediary.*

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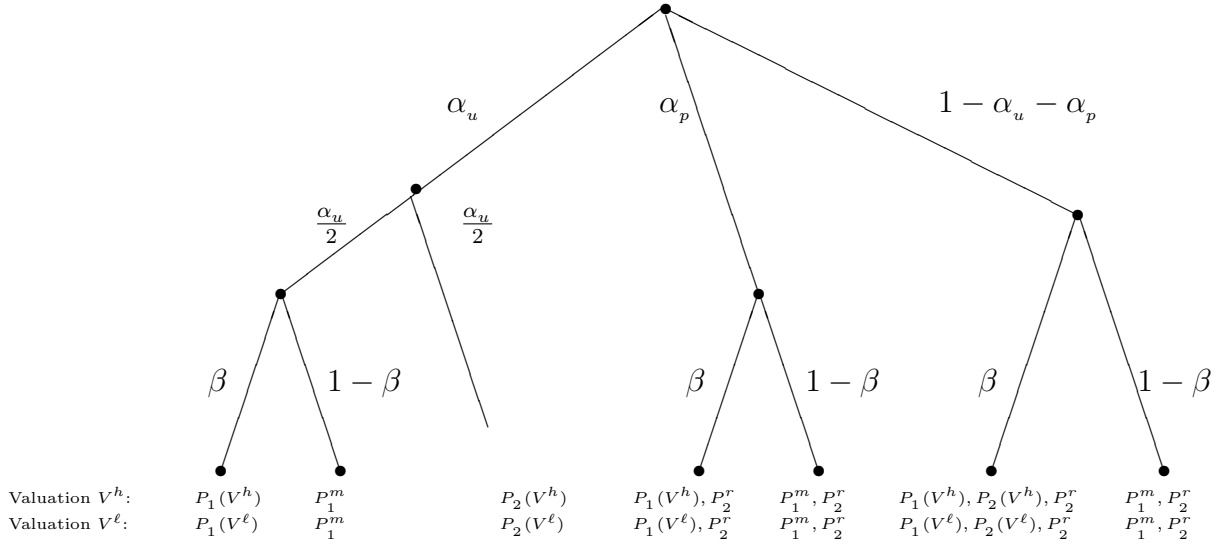


Figure 6: Different Prices Observed by Each Segment if Manufacturer Enrolls One Retailer

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