Internet Intermediaries' Editorial Content Quality

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Abstract

Information intermediaries deliver information about a supplier's product. They are paid by those same suppliers they certify. This introduces conflicts of interests as the intermediaries want to retain customers by delivering truthful information about suppliers, while suppliers would want the intermediary to provide them with more customers than their quality would otherwise entitle them to.

The paper compares two options for information intermediaries: either propose a menu of contracts to the suppliers so that they reveal their type, or find out by themselves the type of the supplier. In the first case, a rent must be left to induce type revelation, in the other, the intermediary must incur a cost to determine the type of the supplier. The paper shows that competition leads to a more frequent use of direct revelation mechanisms at the expense of independent research by the intermediary.

The paper contributes to the literature on certification intermediaries in two sided markets by introducing a choice between relying on soft information or acquiring hard information about the side of the market to be certified, and by studying the influence of competition on contract choices in such an extended setting.

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Internet information intermediaries derive revenues from those same companies they are supposed to advise their clients about. This introduces conflicts of interest. This paper explores the efficiency of intermediation markets and examines the contractual arrangements governing the use of listing and directory services, such as Google or Yahoo. Billboard and click-through pricing are compared.[1] Billboard pricing guarantees an audience for a given price. Click-through is a pay-as-you-go scheme where advertisers pay only for the number of customers they actually got. Those two types of contract lead to different motivations for the intermediary. The first doesn't encourage it to monitor the relationship customer-supplier, since its result is not under its province anymore. The second gives more leeway to the intermediary and may force it to monitor the messages sent from the supplier to the customer through the intermediary: as it imposes no limits on how many customers a supplier may get, there is a risk that only the most profitable messages are transmitted, instead of those that are of interest to the customer. Those two dimensions (profitability to the supplier vs. interest to the customer) are not always concomitant.

The paper models Internet intermediaries as advisers to customers. Intermediaries receive queries for information about products or information. They answer those requests by providing an assessment or a ranking of the alternative offerings. Customers expect to be given an objective assessment of the adequateness between a supplier's good and their needs. Intermediaries are caught between repeat customers whom they want to retain, and suppliers who pay to get listed among the options available to customers. Intermediaries provide a forum for suppliers to make claims about their products. Those claims can be exaggerated, leading some customers to be misled into buying the product.

A two-sided media market is modeled where media outlets offer informational content to users and in turn sell their audience to the providers of that content. The intermediary contracts with suppliers to provide customers with information about their product, and users then decide, based on how objective the information was, whether to keep on using the intermediary's service. Competitors can divert an intermediary's clientele by offering content providers more advantageous contracting schemes. Since the intermediary's service is to offer information about a product, it loses customers if it cannot provide content.

This paper is concerned with the concentration of media markets, more particularly that of search engines on the Internet. Search engines control the access to information about products for many consumers and there is a natural tendency to monopolization of intermediation services. Indeed, it is often better from the point of view of welfare that there be an unique intermediary as this allows every member to benefit from maximum network effects – the value of an intermediary to its clients is in its pool of clients, and the larger that pool, the higher its value. The usual criticism of monopoly for information intermediation is that it leads to the price exclusion of too many players, so that a competitive setting can increase welfare by lowering prices for

intermediation services.

This paper considers another advantage of a monopoly in information intermediation; an intermediary who knows that customers will not switch to another intermediary when their client supplier doesn't fit their need will not be tempted to lie to the customers and tell them their client supplier is what they need. The usual criticism of that point of view is that with no threat from competition, a monopoly may choose to favor the information suppliers that are ready to pay the most to get their message across. This paper argues that having one dominant intermediary to which all consumers go every time they need to search for a product doesn't mean the market is monopolistic as long as consumers are free to switch from one intermediary to the other and there is free entry in intermediation markets. Imposing a monopoly may result in less objective information being transmitted even though it may increases the efficiency with which the intermediary directs customers to suppliers. Trying to dismantle a dominant intermediary (such as Google in the search engine market, for example) doesn't help either.

The paper also shows how competition favors the use of billboard pricing contracts. More efficient, click-through based contracts that depend on the information the intermediaries obtain on the potential audience for a product, are disadvantaged in competition. The best contracts are those that lead to objective revelation of information about the supplier, but are not so efficient that they don't leave enough customers for other intermediaries to serve. Click-through pricing, which was made possible thanks to better monitoring of customers' response to the information provided by an information intermediary, is not favored by competition; using a less efficient system reduces competitive pressure and leads to higher profits for intermediaries.

The rest of the introduction briefly presents information intermediation services on the Internet and paid-for placement systems for search engine rankings. It then goes on to a study of the types of contracts that are signed between intermediaries and suppliers in paid-for listing markets. A review of the literature is also provided. The nature of competition between intermediaries is relegated to the introduction to the third part of this paper.

Overview of the industry Google, a search engine, AOL, both an Internet service provider and a portal, Amazon, a book seller, mySimon, a comparison shopping service, FreeMarkets, an e-marketplace and exchange, all are among the many listing and directories services, online newspapers, newsletters and search engines that provide information to customers about products. Information intermediaries select information, organize it and present it to customers. By relying on such information intermediaries, the customer loses control over what he will be exposed to. He draws in exchange on the intermediary's vast repository of information, expertise on the range of products it offers, and experience in matching the customer's requirement to the alternatives on the market. Henshaw (2001) report that 80% of Internet users employ search

engines to locate information. Less than 20% view more than 2 pages of search results. This shows either that search engines provide an excellent service, or that customers are very confident they rank search results in an appropriate way. Either way, intermediaries play a crucial role on the Internet, and few suppliers can survive without them.

Most intermediaries rely in large part on fees paid by suppliers to get their product listed on the intermediary's website, mentioned in a newspaper, or favorably ranked in a search engine. Baye and Morgan (2000) calculated that more than two-third of the top 300 newspapers in the US market relied on advertising for more than half their revenues in 1997. This pattern is even more pronounced on the Internet, where customers have become used to get content for free. Intermediaries still claim that they are objective in their assessment of the suppliers and indeed sponsorship does not necessarily equates to bribery: a clear separation between paid-for and staff-provided content can be guaranteed in newspapers. No interest group will account for such a significant share of the intermediary's revenue that they can influence its content. Customers have access to a wide range of intermediaries, which ensures that an intermediary will be motivated to maintain a reputation for objectivity. Finally, suppliers who are ready to pay to get advertised presumably have something of value to offer to customers; an intermediary will act as a filter for information simply by making suppliers pay to broadcast.

Contracts in the Internet paid-for listing markets How do intermediaries manage their relationship with suppliers? Nadel (2000) shows how Internet intermediaries adopt different strategies that provide for differing levels of objectivity in the advice provided to customers. Google relies on an algorithm to rank search results, an algorithm that is based on objective measures such as the popularity of a website. It derives profits from placing paid-for results on top of its search results, in a separate box. CNET Networks on the other hand, displays only the products whose placement was paid for (http://shopper.cnet.com). The range of those strategies were expanded thanks to the Internet; it became possible to monitor the response of customers to announcements about a product. This paper will contrast two systems. The first one will be called billboard pricing ("BB") and consists in announcing a price for placement on a website. A certain number of customers will be exposed to information about the product. The supplier buys a certain number of impressions of the announcement. The second one will be called click-through pricing ("CT") and consists in announcing a price per customer directed to the supplier. There is no guarantee on the number of customers who will be exposed to the message of the supplier. Overall, three systems of CT pricing exist, from the supplier-oriented to the customer-oriented. The first determines the order in which suppliers will be ranked based on their willingness to pay. Bay9 (www.bay9.com), now Xuppa (www.xuppa.com) or Overture, which went public as Goto (www.goto.com) are examples. The second is based on a two or three-tiered system: the customer

can choose what type of results to use, as they are divided between general or sponsored results. About (www.about.com) offers the customer the possibility to search into specialized categories so as to eliminate eccentric results. Yahoo customers can choose results from Yahoo's directory, in which suppliers must pay to be included (http://sponsoredsites.yahoo.com/terms.html), or from a general search engine (Google until recently, and now a proprietary one). The third determines the ranking based on the judgment of previous customers on the website. For example, Google (http://adwords.google.com) determines the ranking of a supplier by using the rate at which customers click-through in reaction to that supplier's message . See also the appendix A to Pereira (2002) for a good description of search engines pricing strategies, or Ellam (2003) for a description of the Pay-Per-Click placement auctions of Overture and Google.

There are many ways to model the difference between the two types of placement systems. This paper takes the following view: An intermediary who wants to provide objective advice has two choices.

- It may contract on the number of customers the supplier may get. In that case, being guaranteed a certain level of audience, the supplier will have no motivation to hide the true quality of its product to the intermediary. This is the BB system, where the intermediary commits to a certain number of impressions, and chooses how to fulfill its contract while disappointing the least number of consumers possible.

- It may also decide to vary the number of customers the supplier will receive depending on its type. In that case, the supplier will not reveal its type to the intermediary (or its revelation will not be credible, as all will say they are of high quality). The intermediary will therefore have to check by itself the quality of the product of the supplier, which implies additional costs. This is the click-through contract, where an intermediary who wants to guarantee a certain level of service to the customers must limit, one way or another, the ability of the supplier to make exaggerated claims.

The second system obviously seems to be preferable, but it also is more costly for the intermediary: it has to gather information on the product it intermediates and monitor the relationship. In a competitive context, though, intermediaries would presumably be led to choose that system more often than if they were monopolies because it offers a higher level of service to customers. This paper shows this is not the case: intermediaries compete not only vis-à-vis customers, but also for suppliers. Suppliers constitute the content offering of the intermediary. The intermediaries must compete to attract suppliers who have to choose one channel to offer their goods. Suppliers cannot offer their goods at all intermediaries at the same time, either because an intermediary must limit the number of suppliers it promotes, or because suppliers must

sign exclusivity agreements with intermediaries, or finally because there are high fixed costs to establish a relationship with one intermediary.

An intermediary who checks the type of its supplier will be subject to more competitive pressure than one who doesn't: as it maximizes its return on each supplier by directing customers to each supplier according to the type of the supplier, other intermediaries are left with less customers to serve each period. They are therefore led to decrease the price they charge to suppliers so as to encourage them to leave competing intermediaries and come advertise on their site. This increased competition is shown to deter the use of a system of recommendation that relies on knowing the type of the supplier.

The dynamics of the industry's use of placement contracts This paper associates the use of the BB and the CT system with the level of competition in the market and the efficiency with which firms can ascertain the type of their suppliers and direct consumers accordingly. The paper predicts that the use of CT pricing would be discouraged when competition becomes keener but is encouraged as firms better track the type of the suppliers they serve.

It is therefore interesting to see whether there is a trend toward the use of one or the other system and whether that trend can be correlated both with the level of competition on the market and with the cost of monitoring suppliers' type. There are no global data available that deal specifically with trends in search engine placement contracts, but data dealing with global Internet advertising markets are available and can be used as a proxy.

There are many variations on the CT pricing system but it is accounting for an increasing proportion of Internet advertising. A recent article about on-line advertising, The Economist (2003) claims that CT pricing accounts for about $2 billion in Internet ad revenues, or a quarter of the total. Google and Overture are the main players in that kind of 'search-related' or 'pay-for-performance" placement. The Interactive Advertising Bureau, an association for online, interactive broadcasting, email, wireless and interactive television media companies, has been releasing annual reports on the evolution of the Internet advertising industry since 1997. Those show exponential growth of revenue from 1996 to 2000 (revenues doubled every year), followed by a period of contraction in 2001 and 2002. Industry concentration did increase over the years, especially with the shake-out in the first year of declining revenues, 2001. It is difficult to infer from those data whether the strength of competition did increase over the years, as the market has always been very concentrated: the top 10 ad-selling companies account for more than 70% of total revenues. On the one hand, it could be said that during the growth years there was room for new entrants and competition was probably less fierce than during the last few years. But at the same time, the shake-out in the industry in 2001, as well as the fact the industry became more and more concentrated, could point to lower levels of competition as the industry consolidated

and the companies that wanted to enter with aggressive tactics had to drop out.

(Graph 1 p. 7)

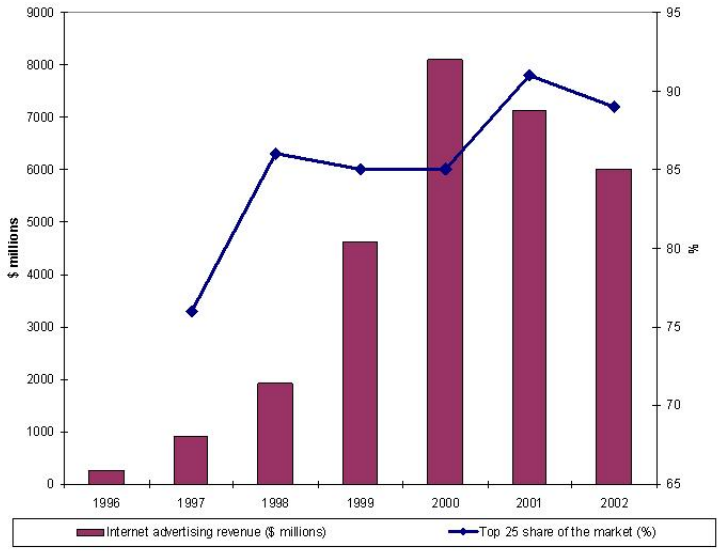

Figure 1: Internet advertising revenues and industry concentration

There is a trend toward more frequent use of performance-based pricing for placement at the expense both of CPM (impression based) pricing and hybrid forms of pricing that combine the two systems. Performance based pricing, which incluses cost per click, sale, lead or straight revenue share (such as affiliate marketing) is therefore on the rise.

(Graph 2 p. 8)

As argued above, it is difficult to know if the level of competition increased or decreased over the years However, as media-placement firms grow bigger and more experienced and as they establish long-term relationships with advertisers, they presumably become more efficient at using a performance based, CT system. The model allows to conclude from the apparent stability in competitive pressure in the market that the rise in the use of CT pricing systems comes from media-placement firms gaining experience, mass and technological know-how to deal with complex systems to sell placement on the Internet.

Literature This paper is related to the literature on two-sided markets and bias in advertising (Gaudeul and Jullien 2004). There are four roles that are typically ascribed to intermediaries: bringing together consumers and suppliers, setting the terms of the exchange, providing liquidity, and guaranteeing the performance and quality of the trade. This paper is concerned with that

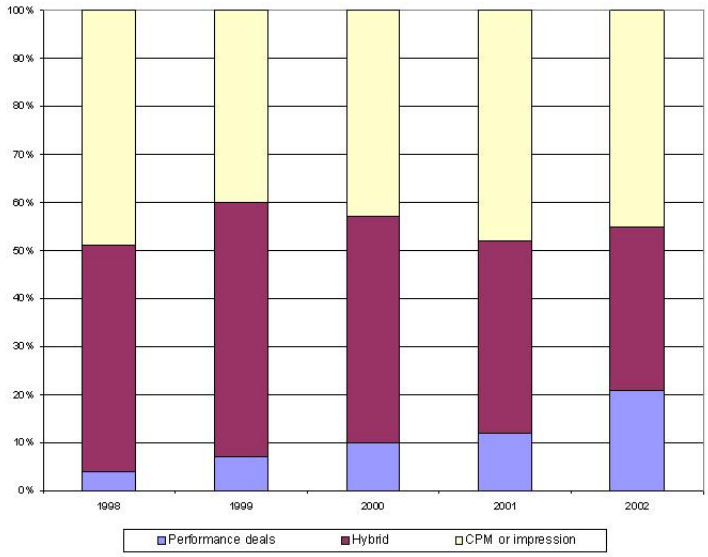

Figure 2: Click-through vs. billboard pricing

last role: how an intermediary can improve the quality of the information transmitted about the product of a supplier.

The literature can be divided depending on whether the intermediary has access to hard or soft information about a supplier's product. If the intermediary has access to hard information about the supplier's product, it can convey it credibly to customers. If the information is soft, then customers can infer the type of the supplier from the choice they make among a menu of incentive contracts offered by the intermediary. This paper accommodates those two possibilities by assuming the intermediary can choose to transform soft information into hard information at some cost (the cost to prove a claim). It proceeds to show that competition does not favor independent inquiry by the intermediary.

The literature focuses on the monopoly case because there are economies of scale in certification markets, which makes of them natural monopolies. This paper shows that a dominant intermediary had rather accommodate competitors than drive them out of the market as this allows it to set higher prices for its service.

Previous literature has been concerned with the role of intermediaries as a tool to foster competition between suppliers (Baye and Morgan 2000) or to spread information about products (Kotowitz and Mathewson 1979). The main concern is whether a monopoly intermediary's pricing strategy will result in the exclusion of some elements of each side of the market, and thus reduce information transmission. Baye and Morgan (2000) conclude that all consumers will participate while some suppliers will be excluded, while Corbett and Karmakar (1999) conclude the opposite will occur. That literature is an outgrowth of the literature on search, advertising and price competition, and this paper abstracts from such concerns. Closer to this model is a paper by

Bhargava and Feng (2002) studying the bias in the results provided by a search engine. Bhargava and Feng (2002) consider the choice of a search engine whether to provide paid placement in its result pages as a quality choice, by which consumers will judge its offering. There is a direct disutility for consumers from having a portion of their search results influenced by suppliers' payment. The intermediary chooses its 'quality' by balancing the need to attract many customers vs. the revenues generated from placement. However, their model doesn't explain why consumers should be concerned that some suppliers pay to have a high-ranking in search results. The present model shows that this may in fact be a bad indicator of quality: you can perfectly have all suppliers pay for listing, and the intermediary still giving out unbiased information about them.

Another strand of literature that is closely related to this paper is that where the intermediary is understood as a tool to balance the interests of both sides of the market. Caillaud and Jullien (2003) analyze competitive strategies in that setting, but their paper is still concerned with pricing and exclusion in homogeneous goods markets. Rochet and Tirole (2002) underline, like is done in this paper, the ambiguous effect of competition on the pricing of intermediary's services: because prices for the service of an intermediary are reduced on both sides, it is not clear whether competition favors the buyers' or the sellers' side. Their paper considers competition strategies that are similar to those considered in this paper; intermediaries compete to attract suppliers, who will determine the quality of their offering to consumers. The present paper is not concerned by the price the intermediary will charge to each side of the market, it is concerned by the objectivity of the information provided by the intermediary. Unlike other papers, competition is shown to improve the quality of service provided by the intermediaries even though competition for supplier-provided content deters them from using the more efficient CT contract. Contrary to the intuition, reduced revenues due to competition do not lead intermediaries to a 'race to the bottom', because deciding to cash in early leaves intermediaries even more exposed to competitors.

Other papers on the informational efficiency of intermediation markets are well exposed in Guerra (2001). That literature begins with Lizzeri (1999) and his paradoxical result that information intermediaries do not transmit information but only confiscate the surplus from the supplier-customer relationship. In that literature, Strausz (2003) is closely related to this paper and provides motivation for this paper's study of monopolistic but contestable intermediation markets.

The paper is organized as follows: the strategy of a monopoly intermediary is studied, and the properties of a Bayesian Nash equilibrium that sustains truth telling (objectivity) on the part of the intermediary are outlined. Competition is then introduced in the model. Its welfare consequences are studied. The paper concludes with possible extensions.

1 A monopoly intermediary

1.1 The model

Consider a market in which in each period $t = 1, 2, ..., \infty$ a different monopolistic information supplier enters with a good of quality q_S in such a quantity as to be potentially able to serve the whole consumer market. In each period a suppliers is drawn randomly from a mass of information suppliers divided in two types denoted H and L. A supplier who was drawn once cannot be drawn again and there is a constant renewal of the pool of suppliers. Suppliers of type H are in proportion λ. They derive net revenue r_H from selling their good of quality q_H. Suppliers of type L are in proportion $1 - \lambda$. They derive revenue r_L from selling their good of quality q_L. A supplier can be listed only at one intermediary. They live only one period. Suppliers know their own type. A supplier listed at intermediary i in period t receives q_{it} customers and pays the intermediary p_{it} per customers. His profit is therefore:

$$\pi_S = q_{it}(r_S - p_{it}) \quad (1)$$

$$S = (H, L) \quad (2)$$

A message (or a product) is composed of bits of information (or features). Each information (or feature) comes on top of the other to progressively build a message (or product) that will include all information (or features) that a consumer may require. Adding one information (or feature) is costly, but gains consumers – the information is more interesting or the product is more sophisticated.

Assumption 1 *Assume therefore that:*

$$q_L < q_H \quad (3)$$

$$r_L > r_H \quad (4)$$

That assumption is not required for the conclusions of the model to hold, but it allows to simplify the analysis. It is discussed at the end of the paper.

There is a mass 1 of customers with type q_C drawn from an uniform distribution over $[0, q_H]$ each period. A customer of type q_C values a good of quality q_S at $\overline{v}$ if $q_C < q_S$ and $\underline{v}$ if $q_C > q_S$.[2] Customers know their own type but not the type of a supplier before consuming its good. They learn it after consumption (experience goods). A customer who uses the service of the intermediary i at time t is told the quality of the good is q_{it}. Customers are infinitely lived. They

all have the same reservation value R for the service of the intermediary. Customers cannot communicate with each other. Their discount factor is δ.

The customer's utility function is therefore:

$$\pi_C = \sum_{t=0}^{\infty} p_t(q_{it}, q_{Ct}, h_t)[(1_{q_{Ct} \leq q_{St}})\overline{v} + (1_{q_{Ct} > q_{St}})\underline{v}]\delta^t \quad (5)$$

$$q_{Ct} \hookrightarrow U[0, q_H] \quad (6)$$

with q_{Ct} the type of the customer at time t, q_{St} the type of the supplier at time t, and $p_t(q_{it}, q_{Ct}, h_t)$ the probability the customer buys the product of the supplier at time t knowing q_{it}, its own type and $h_t = (q_{it}, q_{Ct}, q_{St})_{t=1,...,t-1}$.

There is one infinitely lived intermediary i that can be of two types, H or L. Type H discount periods at rate δ_H and type L discount periods at rate δ_L, with $\delta_H > \delta_L$. Customers assign probability ε that the intermediary is of type L. Intermediary i does not know the type of its client supplier S and doesn't know the type of its customers. Each period, one supplier comes to the intermediary, who offers customers at a price p_{it} per customer. Suppliers choose to accept or reject the offer, and the intermediary then chooses a_{it} : whether to check the good of its supplier of type S at cost c and then learn its type q_S. It then directs q_{it} of its customers to the supplier. The mass of customers the intermediary receives each period is denoted m_{it} and depends on the strategy of the customers which will be exposed below.

The strategy of the intermediary consists in the choice of the triplet $\{p_{it}, a_{it}, q_{it}\}_{t=1,...,\infty}$ over time. The intermediary's profit function is:

$$\pi_i = \sum_{t=0}^{\infty} [p_{it} - c(a_{it})]\, q_{it} m_{it} \delta_i^t \quad (7)$$

$$a_{it} = (\text{check , not check}) \quad (8)$$

$$c(\text{check}) = c \quad (9)$$

$$c(\text{not check}) = 0 \quad (10)$$

How can an equilibrium be sustained where customers are never misled about the quality of the product on the intermediary? For that to happen, customers must punish intermediaries who misled them. Suppose customers adopts the following strategy: Stop using the intermediary's service if the supplier's good is found to be of value $\underline{v}$. That strategy is supported by the belief the intermediary's type is L whenever the supplier's good is found to be of low value. It is a rational belief which can be sustained in equilibrium under that strategy under some condition:

Denote V_H the expected value of the service provided by an intermediary of type H and V_L the expected value of the service provided by an intermediary of type L. The customers' strategy supports a Bayesian-Nash equilibrium with objective placement if:

$$V_H > R > V_L \tag{11}$$

and

$$(1-\varepsilon)V_H + \varepsilon V_L > R \tag{12}$$

The first condition ensures that customers want to use the service of an intermediary if they believe he is of type H but not if he is of type L, and the second ensures that in the absence of information about the intermediary's type, a customer will use its service.[3]

The intermediary's contract choice will first be examined, and then the condition on δ_H, δ_L and R under which an objective placement Bayesian-Nash equilibrium of the game can be sustained.

The contract choice by the intermediary will be studied only under the condition that $p_{it} < r_H, \forall t$. This eliminates the case where only one type of supplier can participate in the game.

1.2 The intermediary's contract choice

Suppose the intermediary does not check the type of the supplier.

Claim 1 *Intermediary i that doesn't check the type of its information suppliers will offer an unique contract $C = (p, q)$ with $p = r_H$ and $q = q_L$ if $\delta_i > \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$. Else, he offers $C = (p, q)$ with $p = r_H$ and $q = q_H$.*

Proof. In appendix A ■

The intermediary will offer a unique contract because of assumption 1 which prohibits offering differentiated contracts. This means the only contract the intermediary can offer if it wants to guarantee objective information revelation is one under which the supplier cannot claim having a quality higher than that of a low type supplier. Indeed, allowing more would lead a supplier of a low type to claim having higher quality than true.

Depending on its type (discount factor), the intermediary will choose either the objective information revelation contract where suppliers cannot claim to have a high quality product, or one which consists in allowing any supplier to claim he is of a high type. The more the quality

difference the lower is $\frac{q_L}{q_H}$ and the more the intermediary is tempted to lie as the gain from lying becomes greater. As the proportion λ of suppliers of high type increases the intermediary is tempted to offer the $C = (r_H, q_H)$ contract as there is lower probability it will lead to a bad outcome for the customers.

Note that the difference in revenue r_S that suppliers gain from customers visit doesn't enter into account as the intermediary must set its price at the lower of the two so as to allow participation by both types of intermediaries. The condition under which the intermediary indeed prefers both suppliers to participate are not studied, as the case where one type of supplier is excluded is trivial.

Notation 1 *Denote $C = (r_H, q)$ with BB_q.*

Suppose now the intermediary checks the type of the supplier. There is no point checking it if it doesn't make q_{it} depend on q_S. This means the intermediary will offer no guarantee on q_{it} and the contract offering will be a price p_{it} per customer directed.

Claim 2 *Intermediary i that checks the type of its supplier will set $p = r_H$ and direct $q_{it} = q_{St}$ customers each period, with $S = H$ or L. The intermediary will check the type of the supplier if $\delta_i \geq \min[\frac{r_H(q_H - Eq) + Eqc}{r_H(q_H - \frac{Eq^2}{q_H}) + \frac{Eq^2}{q_H}c}, \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}]$ and $c < \frac{\lambda r_H(q_H - q_L)}{\lambda q_H + (1-\lambda)q_L}$.*

Proof. In appendix B ■

Notation 2 *Denote CT the strategy that consists in setting $p = r_H$ and directing $q_{it} = q_{St}$ customers each period.*

The possibility to use a CT contract improves the range of δ for which the intermediary is able to sustain objective information revelation because unlike the objective BB contract, it doesn't limit it to directing only q_L customers each period irrespective of their type. For δ high, an intermediary using the BB system would have to limit himself to directing q_L customers each period so as to be certain to offer perfect service and not lose any customer.

The CT pricing system frees the intermediary to direct q_H customers to a supplier of type H. If the probability that such a supplier comes asking for service at the intermediary is high, or if q_H is very much higher than q_L, then the range of c for which the intermediary wants to use the CT pricing system widens. The click-through based system may be preferred to the placement system because it gives wider latitude to the intermediary to report truthfully to the consumer the information he has about the supplier.

Choosing the CT system has a cost since the intermediary cannot get suppliers to reveal their type as it doesn't guarantee them a given number of customers. That cost limits the range of c for which the CT contract is used. The CT pricing system is preferred for c relatively low. Indeed, the cost of gathering information about the supplier and the customers is then low enough, so that the gain in effectiveness from switching to the CT pricing system is high enough for the intermediary to prefer it to a BB pricing system.

The availability of the CT pricing system thus broadens the range (δ, c) where objective placement can be implemented. Since on the Internet the cost c of checking the quality of information and processing the information on each customers' click-through is presumably low, it is possible that the CT pricing system does indeed allow to sustain objective placement in case where it could not have been sustained under traditional BB pricing system. It thus can increase welfare in practice.

The equilibrium choice of contracts can be represented in the (δ, c) plane:

(Graph 3 p. 14)
(Numerical example with $r_H = 1$, $r_L = 2$, $q_H = 3$, $q_L = 1$, $\lambda = 0.4$)

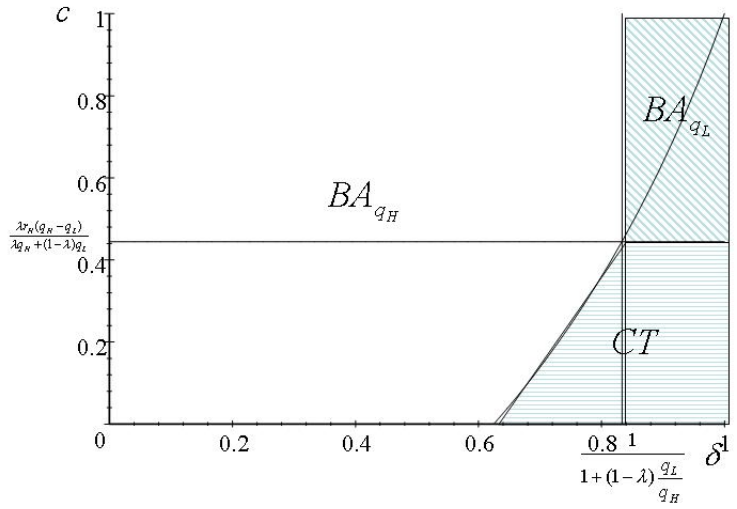

Figure 3: The monopoly's contract choices.

The intermediary's profit function can be represented for a moderate level of c where the CT contract will be preferred to the BB_{q_L} contract for δ high

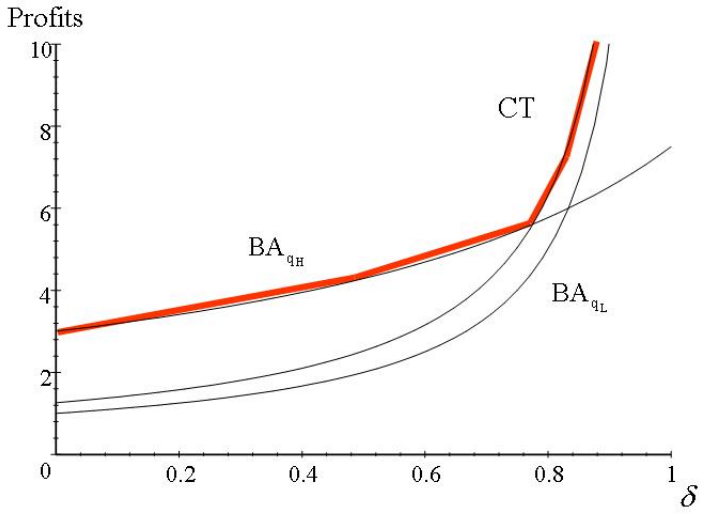

Figure 4: The monopoly's profit function for moderate levels of c ($c = 0.3$).

(Graph 4 p. 15)

This graph shows that the CT system allows the intermediary to increase profit compared to the CPM system and also increases the range of δ where a contract sustaining truthful information is chosen.

The condition for a Bayesian-Nash equilibrium with objective placement to exist can now be laid down:

Proposition 1 *Define* $\delta = \min[\frac{r_H(q_H - Eq) + Eqc}{r_H(q_H - \frac{Eq^2}{q_H}) + \frac{Eq^2}{q_H}c}, \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}]$ *An objective placement Bayesian-Nash equilibrium exists for*

$$\delta_L \leq \delta \leq \delta_H \tag{13}$$

and

$$\frac{Eq\overline{v} + (q_H - Eq)\underline{v}}{q_H} \leq R \leq \frac{(1-\varepsilon)q_L\overline{v} + \varepsilon(Eq\overline{v} + (q_H - Eq)\underline{v})}{q_H} \tag{14}$$

Proof. From claim 2 and the conditions laid down in the exposition of this model for a BNE equilibrium with truthful information revelation on the part of the intermediary to be sustained. ■

The first condition guarantees that an intermediary of a low type will use the BB_{q_H} contract, which consists in directing all customers to any supplier at hand, while an intermediary of a high type will use either a CT or a BB_{q_L} contract. The second condition ensures customers, when having found out an intermediary is of a low type, will not want to use its service anymore

because the expected value of that service is less than the reservation value (left side of the equation), while they are ready to use the service of an intermediary when they do not know its type (right side of the equation). Note that since the value of the service of an intermediary that uses the BB_{q_L} system is lower than that of one who uses the CT system, it is the value of the first one which is relevant to ensure the consumers use the service of the intermediaries irrespective of c.

Under those conditions, the system of belief of the customers is validated by the equilibrium behavior of intermediaries. Only low type intermediaries lie to the customer, while high type intermediaries guarantee perfect service. It is rational not to use the service of low type intermediaries because the expected value of their service is lower than the customer's reservation value.

Remark 1 *If $\delta_H < \delta$ or $\delta_L > \delta$, then there exists an equilibrium with misleading placement where either no customers use the service of the intermediary ($R > Eq\overline{v} + (q_H - Eq)\underline{v}$) or all do ($R < Eq\overline{v} + (q_H - Eq)\underline{v}$).*

The conditions under which one or the other pricing system will be preferred can be casually observed outside of the Internet setting. A retailer who buys a stylist's stock and then sells it himself, is an example of an intermediary that uses the BB contract, ensuring to the stylist a revenue and gaining the right to direct access to the goods. Presumably, the BB contract is used there because it would be very expensive to use the alternative CT system, where the goods would have to be shipped on demand after having determined the type of each incoming customers.

A fashion magazine, giving tips to consumers, and information about new trends, is a good example of an intermediary who prefers not taking the risk of buying the stocks of the supplier. It relies instead on a CT contract, based on the effective sales made by the supplier through its recommendations. Some paper magazines indeed offer coupon to their readers, allowing it to monitor how many customers went through with its advice. On-line intermediaries can monitor in real time the effect of their recommendations to customers, as they click through to the suppliers they reference under the form of links. In that case, the intermediary does not have to stock the supplier's good, the advising and selling are separate activities, so that the cost of advising the client does not include the product shipping and stocking costs. The CT system then makes sense because c is low. It would be worth gathering statistics to prove that intermediaries who use sophisticated technologies to determine the type of their advertisers or who operate in a domain where such information is easy to obtain, will tend to use the CT contract.

2 Competing intermediaries

Information markets are very concentrated, and intermediaries compete based on content. A model of competition must take those two factors into account. Customers will therefore be assumed to all go to the same intermediary in the first period, and then cascade to the next ones ranked by order of importance. Additionally, intermediaries will be assumed to compete on content alone, i.e. they are not able to directly divert customers from competing intermediaries. However, they will be assumed to have access to competing intermediaries' content suppliers, and to be able to make them offers so that they switch to their own service.

Those assumptions are justified below, after which an outline of the main results is provided.

The intermediation market is modeled after the organization of the Internet intermediation markets, where there is both a dominant intermediary and easy switching from one intermediary to the other. On Internet information markets, there is one dominant intermediary, and then a multitude of lesser intermediaries that are ranked by order of importance. The dominant, number one choice intermediary can be pictured as Yahoo, which reached 51 percent of the worldwide Internet population and consistently is a leading web destination (Nielsen/Netrating 2001 for SearchEngineWatch.com) It can also be pictured as AOL, which is the dominant ISP in the US (26% of Internet subscribers in the US, with MSN a distant second with 9%) and is very successful at retaining its customers into its private portal offering; most AOL users never go far beyond what AOL-sanctioned suppliers offer them. Finally, Google can also be pictured as the reference intermediary. Indeed, in January 2004 and according to a Nielsen/Netrating survey Google ranked as the top Internet search destination before Yahoo, MSN and AOL. There are different types of intermediaries, "general interest" like those evoked here, and those that are specialized in a category, like CNET for technology products. Each category has its own dominant intermediary. Smith and Brynjolffson (2001) and Johnson, Moe, Fader, Bellman, and Lohse (2001) mention various statistics that show how consumers are indeed very loyal to the dominant intermediary in a category of product. Amazon customers, for example, pay their service an average of 5% more than services of less well known intermediaries. The large majority of customers remain loyal to one intermediary for all their searches in one product category.

There are few observations on the patterns and nature of competition between listing services trying to obtain sponsored search revenues. It will therefore have to be modeled after similar industries. Competition between intermediaries will be modeled after observations of the way competition in the publishing industry works and also from seeing how Internet media suppliers try to acquire content through aggressive deals and acquisition of content producers. Competition

for content is a feature of the publishing industry. Intermediaries must leave enough profit to those who provide content (news, entertainment, etc) so that they don't move, they and their audience, to competing intermediaries.

Most journals, when they agree to publish a work, want what is called 'first publication rights', that is, they want the exclusive rights to publish this work before any other journal. This is a way to protect themselves against opportunistic switching of authors to competitors, which would leave them with no content to publish.

Publishing houses compete by trying to hire the better or most promising author at another publisher. A constant in media markets is that people who produce successful programs, write good articles, or more generally are the main attractor of audience to a channel tend to get enticed away from their first employer once they have attracted the attention from other, bigger intermediaries. Some TV and radios specialize in breeding such new talents, which are then sold to bigger, more powerful media outlets. This shows the importance of content providers to intermediaries, and their possible diversion from their initial employer.

On the Internet, AOL and Time Warner merged just so as to create synergies that the exclusive right by AOL to distribute Time Warner's content over the Internet would create. For example, AOL is the only one to offer 'Harry Potter' paraphernalia on its site and this enhances its appeal to customers. This was a way for AOL to ensure it wouldn't have to compete with other intermediaries for Time Warner content. Another example illustrating the threat of vertical foreclosure by dominant intermediaries on the Internet was pointed out by the European commission when examining the AOL/Time Warner vertical merger. The merged entity had preferred access to Bertelsmann's content, and in particular its music library. This gave it the possibility to foreclose downstream competitors. In the Vivendi/Seagram/Canal + merger, the pooling of Seagram's Universal Music arm and Vivendi's Internet portal Vizzavi rose similar concerns. Finally, when Google bought Pyra, a blog hoster,[4] there were widely shared concerns that other search engines would see their access to Pyra's administered blogs limited. There is therefore clearly the possibility for intermediaries to monopolize the content offered by their suppliers, as illustrated by those mergers involving intermediaries and content suppliers, and there is therefore an incentive for competing intermediaries to break up that monopoly. In those examples like in others, contracts based on performance (the number of viewers attracted) coexist with fixed term contracts that guarantee a certain level of revenue for the content provider. The media outlet may have exclusivity provisions written into their agreement to launch the career of those information providers, entertainers or journalists, but those are generally limited in time. Another way to avoid problems is also the strategy by some journals, such as The Economist, to not credit their articles to individual journalists. Outsiders are then less able to spot talents. The essential feature of competition in this model is that information suppliers – music groups, think tanks, individ-

ual reporters, etc. – are first hired by information intermediaries – majors, newspapers, radios, televisions... – and then receive competitive offers that are aimed not so much at enlarging the product offering of the competing intermediaries than at weakening the product offering of their closest competitor. Indeed, in the present model, an intermediary does not gain anything directly from diverting a supplier from a competitor, he only gains the customers of that competitor.

The literature on competition in information markets frequently is concerned by potential degradation in overall service in the market (Santos and Scheinkman (2001) in financial markets, Anderson and Coate (2000) in the case of radio and television advertising for example). In the present model, competition gives more freedom of choice to the customers so that not serving them today may lead them to go to another intermediary. The intermediary is then tempted to exploit them now by pretending to have a valuable service to offer even if that is not the case. He knows that if he doesn't, the customer will possibly be lost to another intermediary. This is what is called the 'race to the bottom'. However, since even bad intermediaries may sometime direct customers correctly, while good intermediaries are the only ones to sometime not direct customers, the customer has a better a-posteriori on an intermediary who did not direct him in a previous period than on one who directed him, and will therefore want to use its service again. This will be shown to limit the opportunistic exploitation of customers, and to maintain the possibility of a well functioning intermediation system; there is no complete unraveling of the quality of service.

Competition will be shown to lead to a possible decrease in the efficiency of an individual intermediary, who will exercise less editorial control over its paid-for content. Indeed, competition will favor the use of rigid BB contracts at the expense of the use of CT contracts; the range of values for δ and c such that the BB system is used will be widened compared to the monopoly setting. Competition will however increase overall welfare, because clients now have the opportunity to switch information provider if they are not satisfied with their present one. As customers are now more mobile, the intermediary would be tempted to exploit them and send them to any announcer at hand, instead of attempting to retain them. Indeed, any customer who is rightly told the supplier's good is not valuable will go to another intermediary who may have a good that is to the customer's taste. Therefore, it would seem to not be very worth-wile trying to advise customers truthfully. However, an intermediary who chooses to lie to customers will be subject to even more competitive pressure from other intermediaries than if he provided the customers with an objective service. Indeed, if an intermediaries tries to monopolize its audience, the other intermediaries will be more motivated to divert suppliers from that intermediary in order to break its monopoly. The price that can be charged to the supplier will have to be set low enough so as to provide the supplier with enough profit for that supplier not to be tempted to sell exclusivity

to another intermediary. The profit that is left to the supplier will be proportionally higher when the incentives of the competing intermediary to get the clients of the other intermediary rise, and that incentive rises in proportion with the number of customers the other intermediary keeps for himself in each period. The objectivity of an intermediary will therefore become greater due to competition.

Competition thus increases welfare most of the time, both because customers have access to more products each period – if an intermediary doesn't have the product he wants, he can go to another intermediary who may have his desired product – but also because it puts pressure on the intermediaries to behave well. Competition therefore brings about an improvement in efficiency, quite apart from the fact the customers have access to more options each period – they can get advice from many intermediaries.[5]

2.1 The model

There is an infinity of intermediaries that are ranked from 1 to infinity by consumers. This ranking determines in which order they will get visited by consumers. All customers go to the first intermediary in the first period. They then go on to the next-ranked intermediary if the product offered by the first intermediary does not correspond to their taste. Intermediaries and customers are infinitely lived, while suppliers are active only one period. One supplier can contract with only one intermediary each period[6], but he can receive many offers prior to settling with one intermediary. Those offers can be conditioned on the contracts offered by other intermediaries.

The timing of the game is as follows:

1) One supplier comes to each intermediary. The intermediary announces p_{it} and/or q_{it}. The supplier accepts the intermediary's contract or not. If they accept, the intermediary chooses a_{it}.

2) Intermediaries offer payments to suppliers at other intermediaries. Suppliers decide to accept or not. A supplier who accepts leaves the intermediary it contracted with in first stage. It can accept only one offer by one intermediary.

3) Intermediaries who have a supplier direct q_{it} consumers to the supplier.

5) Consumers buy the product of the supplier, and learn q_{St}.

6) Consumers choose which intermediary's service to use next period.

The consumer's expected utility function will take the following form:

$$\pi_C = \sum_{t=0}^{\infty}\sum_{i=1}^{\infty} p_{it}(q_{it}, q_{Ct}, h_t)[(1_{q_{Ct}\leq q_{St}})\overline{v} + (1_{q_{Ct}>q_{St}})\underline{v}]\delta^t \tag{15}$$

$$q_{Ct} \hookrightarrow U[0, q_H] \tag{16}$$

with q_{Ct} the type of the customer at time t, q_{St} the type of the supplier at time t, and $p_{it}(q_{it}, q_{Ct}, h_t)$ the probability the customer buys the product of the intermediary $i's$ supplier at time t knowing q_{it}, its own type and $h_t = (q_{it}, q_{Ct}, q_{St})_{t=1,...,t-1;i=1,...,t-1}$. p_{it} is defined in a unique way by the strategy of the consumer.

Suppose consumers adopt the following strategy: Go to intermediary 1 in the first period. Buy a supplier's good if $q_{it} \geq q_{Ct}$. Go to intermediary i in period $t+1$ if $q_{Ct} \leq q_{S_it}$. Go to intermediary $i+1$ in period $t+1$ if $q_{i(t+1)} < q_{C(t+1)}$, or $q_{Ct} > q_{S_it}$. q_{Ct} is the type of the consumer in period t, q_{S_it} is the type of intermediary i 's supplier in period t, and q_{it} is intermediary $i's$ announcement about the type of its supplier in period t (it translates in this system in the number of consumers who buy the supplier's product).

In the same way and using the same exposition as in the part 2, there is a Bayesian-Nash equilibrium of this game with objective placement if there is separation of type of the intermediaries, i.e.

$$V_H > R > V_L \tag{17}$$

and

$$(1-\varepsilon)V_H + \varepsilon V_L > R \tag{18}$$

The first condition ensures that customers want to use the service of an intermediary if they believe he is of type H but not if he is of type L, and the second ensures that in the absence of information about the intermediary's type, a customer will use its service. Under those conditions, beliefs and strategies of customers are rational.

The following graph shows how customers cascade from one intermediary to the next: A customer goes to intermediary 1 in the first period. If directed to a supplier, he consumes its product. If that one is inadequate, he goes to intermediary 2 next period. If he is not directed to a supplier, he goes to intermediary 2 in the same first period. He keeps on going from intermediary to intermediary until he is directed, but whatever happens, he will go back to intermediary 1 in period 2 because his a-priori on intermediary 1 can only have improved when that one didn't direct him in period 1.

(Graph 5 p. 22)

The intermediary's contract choice will first be examined, and then the condition on δ_H, δ_L and R under which a Bayesian-Nash equilibrium of the game can be sustained.

Before doing so, let's make an assumption on the parameters of the model:

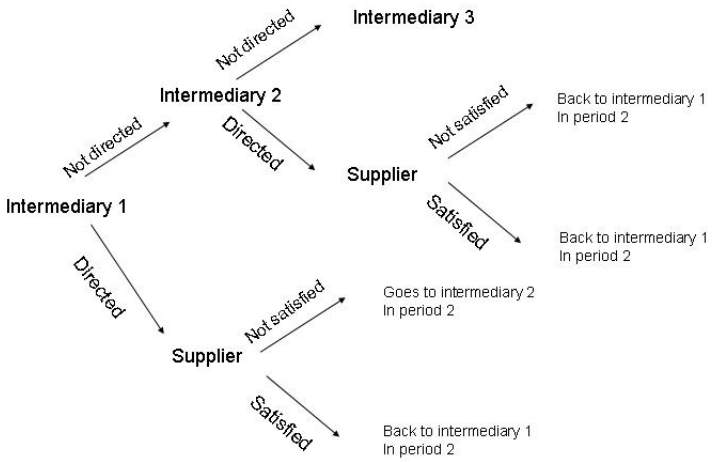

Figure 5: The customers' paths when there are many intermediaries.

Assumption 2

$$\frac{r_L}{r_H} - 1 \geq \frac{\lambda}{2}(\frac{q_H}{q_L} - 1) \tag{19}$$

This assumption is not necessary but simplifies the analysis.

2.2 Analysis of the model

This model makes the study of competition rather simple: all intermediaries are in the same position vis-à-vis the next intermediary than the previous intermediary is vis-à-vis themselves. Therefore, in equilibrium, they all follow the same strategy since they all are bound by the same constraints.

If a supplier that got into a contractual relationship with an intermediary in stage 1 agrees not to be listed at that intermediary anymore, then that intermediary will be left with nobody to direct his customers to, and customers will have to go to the next intermediary.

The strategy followed by one intermediary must therefore take into account the possibility that the **next** intermediary offers payments that would make one or both types of supplier break their contract.

This puts a bound on the profit per-customer that the intermediary can make, if he is to deter the next intermediary from breaking its contract with its suppliers. This bound is the ratio of the cost of breaking a contract to the number of customers gained by breaking a contract. The cost of buying out a supplier is the payment to compensate him for his lost profits, i.e. what he would make had he stayed at the competing intermediary.

$$\text{Profit per customer of the intermediary} < \frac{\text{Profit of the supplier}}{\text{Number of customers gained by asking for exclusivity}}$$

The $(n+1)^{th}$ intermediary is ready to pay a supplier an amount which is equivalent to the benefit it gets from that n^{th} intermediary not being able to directs its customers, and this is equal to the additional number of customers intermediary $n+1$ gains by hiring away the competitor's supplier, times the profit it makes with those additional customers. Other intermediaries farther away in the ranking of intermediaries have less incentive to buy exclusivity from the suppliers of that intermediary. An intermediary is motivated to pay suppliers not to go to intermediaries that are far removed from them in the 'line of succession' so as to accelerate the rate at which customers finally come to them. but that incentive is always lower than the incentive for the next-in-line intermediary, so that only those must be taken into account. For example, the $(n+2)^{th}$ intermediary is ready to pay $n's$ supplier not to accept customers from the n^{th} intermediary, but less so than the $(n+1)^{th}$ intermediary would be ready to do: the number of customers gained is less and farther away in time, so that it is the constraint vis-à-vis the $(n+1)^{th}$ intermediary that bounds profits.

It is not possible, when attempting to break a supplier-intermediary contracts, to know the type of the supplier at the intermediary. A payment that would motivate suppliers of type L to break its contract will also lead suppliers of type H to do so: Suppliers of type L make higher profits than suppliers of type H for any choice of contracts by the intermediary, so that buying exclusivity from suppliers of type L will also encourage suppliers of type H to deviate.

It is therefore more efficient to make suppliers of type H only deviate instead of both types: they are less expensive to distract from a competing intermediary – their profit per customer is lower – and the intermediary gets a higher return (number of customers) from them. Even though the probability that a given supplier accepts is lowered – there is only probability λ that he is of type $H-$, suppliers of type H are those that can serve a higher number of customers and this gives their deviation more impact than the deviation of suppliers of type L.

The intermediaries will choose the strategy that forces the next intermediary to pay the highest possible price per additional customer gained, while minimizing that number of customers that can be gained. This is indeed the strategy that allows it to make the highest profits. All intermediaries will follow that strategy; they will not want to adopt another strategy that would make it more efficient for their direct competitor (the next intermediary) to buy exclusivity.

As mentioned above, the intermediaries will choose the type of contract which gives the highest profit given the contract choice of the previous intermediary. Each intermediary will choose the same type of contract, since they are all in the same position vis-a-vis the previous intermediary, and therefore, their optimal contract is the same.

From the monopoly case, the contracts of interest are the CT contract where $\widetilde{q}_{it} = q_{S_i t}$, $\forall t$,

and the two BB contracts, BB_{q_L} and BB_{q_H}.

The intermediaries' profit functions are calculated in the proof of the next proposition. The only change from the proofs of propositions 1 and 2 is that a no-deviation constraint must be added, whereby no intermediary is willing to pay a supplier to break his contract with an intermediary. This holds if a supplier makes more profit by staying put at a first intermediary than what a second intermediary would gain by getting that supplier not to accept any customer from that first intermediary.

Claim 3 *Under competition, intermediary i will prefer the BB_{q_L} contract to the BB_{q_H} if $\delta_i \geq \frac{1}{1+2(1-\lambda)\frac{q_L}{q_H}}$.*

Proof. In appendix C ■

The intermediaries make a lower profit per customer than in the monopoly case because the contracts must be robust to deviation by suppliers. That lowering is more pronounced for contracts that result in lying to customers than for those that result in objective, truthful placement. This explains for example why the BB_{q_L} contract is used for any $\delta \geq \frac{1}{1+2(1-\lambda)\frac{q_L}{q_H}}$ instead of only for $\delta \geq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$ when there was a monopoly.

The intermediary should have been more willing to exploit all its customers in each periods, since the per customer revenue is lower due to competitive pressure. However, that pressure on prices applies on all choices of a pricing system. This is why there are less intermediaries choosing to lie to customers than in the monopoly case. The range for which the BB_{q_L} system is used is increased versus the monopoly case, because the lower is the number of customers promised to the supplier, the lower will be the incentive to buy exclusivity from suppliers. Indeed, when the BB_{q_L} system is used, a competing intermediary will gain only λq_L clients by buying exclusivity from type H suppliers, while it would gain λq_H clients if the BB_{q_H} system was used. Therefore, the intermediary using the BB_{q_H} system will have to lower prices by a greater amount relative to the monopoly case than is required when using the BB_{q_L} system.

As in the monopoly case, the CT system is used only when it results in objective placement, and must be compared first to the BB_{q_L} system when δ is high and then to the BB_{q_H} system, which is the second best. The following proposition shows in what domain the objective placement systems will be used:

Claim 4 *Intermediary i will do objective placement in competition if*

$$\delta_i \geq \min[\frac{r_H(q_H - Eq) + Eqc}{r_H(q_H - \frac{Eq^2}{q_H}) + \frac{Eq^2}{q_H}c}, \frac{1}{1 + 2(1-\lambda)\frac{q_L}{q_H}}] \tag{20}$$

In that δ range, the CT contract will be chosen for any $c \leq r_H(1 - \frac{q_L(2q_H)}{Eq(q_H+q_L)})$ while the BB_{q_L} contract will be chosen for $c \geq r_H(1 - \frac{q_L(2q_H)}{Eq(q_H+q_L)})$.

Proof. In appendix D ■

The following graph shows the profit per customer of the intermediaries as δ increases. Comparing this with the monopoly case, profits are lower, but the lowering is more pronounced for δ low than for δ high, which explains why objective placement is more frequent. However, while in the monopoly case the CT pricing system was used for δ high, here, it is more efficient to use the BB_{q_L} system.

(Graph 6 p. 25)

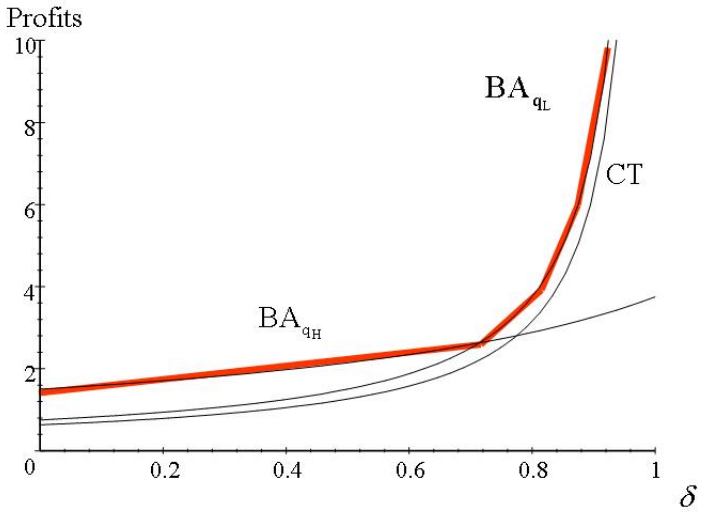

Figure 6: The profits per customer when there is competition.

This graph, which superposes the two graphs representing profits per customers in the monopoly and in the competitive case, shows how the range where objective placement is used is broadened (arrows), but while CT was used by a monopoly for δ high, it is BB_{q_L} which is used by an intermediary in a competitive setting:

(Graph 7 p. 26)

Comparing the profit obtained under the different pricing systems, the objective placement systems are used more often than in the monopoly case, but the most efficient objective placement system, CT is used less often.

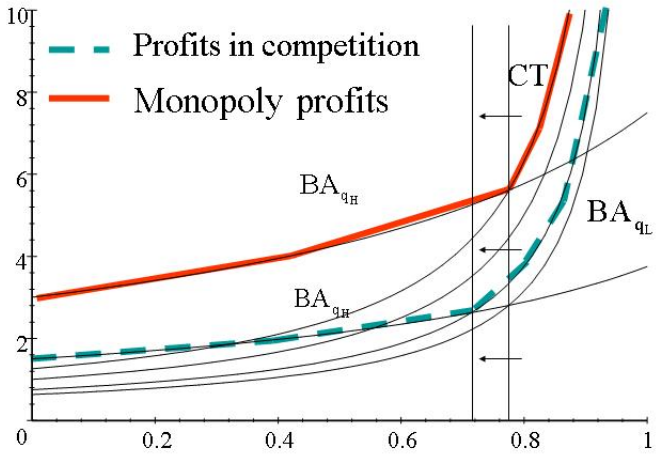

Figure 7: The profits per customer when there is competition compared with a monopoly setting.

The CT pricing system is used less often than in the monopoly case, because the BB$_{q_L}$ pricing system is more robust to suppliers' deviation. When the CT pricing system is used and leads to objective revelation of the type of the supplier to the customers, a deviation by suppliers of type H leads the intermediary to lose q_H customers with probability $1-\lambda$, while it loses only q_L customers when BB$_{q_L}$, the similar truthful revelation system under the BB pricing system, is used. This means the BB pricing system is less sensitive to the bribing strategies of other intermediaries. The intermediary therefore doesn't need to leave so much profit to the supplier to avoid him deviating. The BB pricing system will therefore be used for a wider range of c.

The following graph shows how competition favors the use of the BB$_{q_L}$ contract. Competition extends the domain in which objective placement contracts will be used compared to the monopoly setting.

(Graph 8 p. 27)

Numerical example with $r_H = 1$, $\mathrm{r}_L = 2$, $q_H = 3$, $\mathrm{q}_L = 1$, $\lambda = 0.4$,

Proposition 2 *Define* $\delta = \min[\frac{r_H(q_H - Eq) + Eqc}{r_H(q_H - \frac{Eq^2}{q_H}) + \frac{Eq^2}{q_H}c}, \frac{1}{1+2(1-\lambda)\frac{q_L}{q_H}}]$ *An objective placement Bayesian-Nash equilibrium exists for*

$$\delta_L \leq \delta \leq \delta_H \tag{21}$$

and

$$\frac{Eq\overline{v} + (q_H - Eq)\underline{v}}{q_H} \leq R \leq \frac{(1-\varepsilon)q_L\overline{v} + \varepsilon(Eq\overline{v} + (q_H - Eq)\underline{v})}{\varepsilon q_H + (1-\varepsilon)q_L} \tag{22}$$

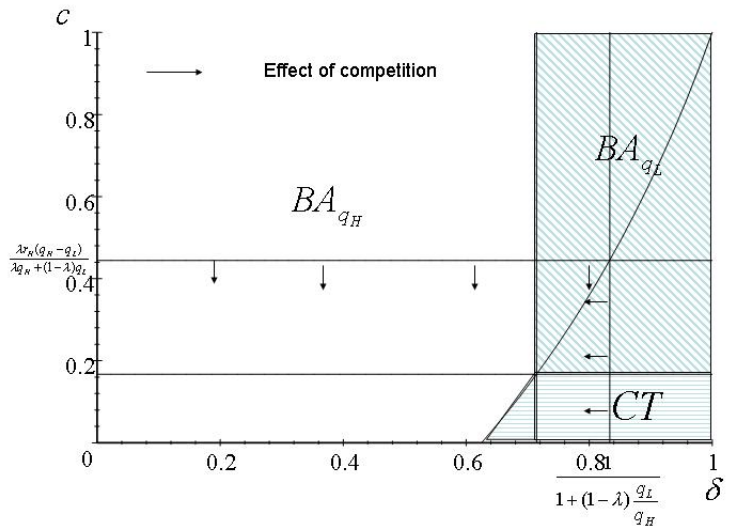

Figure 8: The intermediaries's contract choices in competition, compared with the monopoly setting.

Proof. In appendix E ■

The existence conditions are generally less strict than in the monopoly case, in the sense that δ_H doesn't need to be as high as before for objective placement to occur, and the acceptable range for R is wider.

Now, it is quite obvious that consumer welfare is always enhanced by competition, because the range (δ, c, R) where objective placement occurs is widened, and consumers now have more choice. It is of no importance that there is less use of the CT pricing system: Even though an individual intermediary may use a less efficient, but objective, placement system, that loss of efficiency doesn't matter for the consumer who can go to other intermediaries if he is not directed at one stage of a period.

3 A simple extension

It is not realistic that one type of supplier, type H, could satisfy the need of all customers, although this made for clarity of exposition. Let us therefore look at a more plausible case where $q_C \hookrightarrow U[0, Q]$ with $Q > q_H$. How is this going to change the results? In the monopoly case, the value of retaining a customer is lowered, so that the (δ, c, R) range where a Bayesian-Nash equilibrium ("BNE") with objective placement exists is restricted.

The proposition for the monopoly case is modified as follows:

Proposition 3 *Define* $\delta = \min[\frac{r_H(q_H-Eq)+Eqc}{r_H(q_H-Eq)(\frac{Q+Eq}{Q})+\frac{Eq}{Q}(Eq+Q-q_H)c}, \frac{1}{1+(1-\lambda)\frac{q_L}{Q}}]$ *An objective placement Bayesian-Nash equilibrium exists for*

$$\delta_L \leq \delta \leq \delta_H \tag{23}$$

and

$$\frac{Eq\overline{v}+(Q-Eq)\underline{v}}{Q} \leq R \leq \frac{(1-\varepsilon)q_L\overline{v}+\varepsilon(Eq\overline{v}+(q_H-Eq)\underline{v})}{Q} \tag{24}$$

Proof. This is a simple modification of the proof in the case where $Q = q_H$. ■

The higher is Q, the lower is the average expected value of retaining a customer since the probability he will be interested by the product offered is lowered. The effect that is widely discussed in the literature, i.e. the unraveling of the service offered by intermediaries and the race to the bottom finally emerges in the setting of this model. Therefore, there will be some cases where a BNE with objective listing existed in the monopoly case, and is not anymore sustained in competition.

Proposition 4 *Define* $\delta = \min[\frac{1}{1+(1-\lambda)\frac{q_L}{Q}(1+\frac{q_H}{Q})}, \frac{2r_Hq_H-Eq(1+\frac{q_H}{Q})(r_H-c)}{2r_Hq_H+Eq(1+\frac{q_H}{Q})(r_H-c)\frac{q_H-Eq-Q}{Q}}]$. *An objective placement Bayesian-Nash equilibrium exists for*

$$\delta_L \leq \delta \leq \delta_H \tag{25}$$

and

$$\frac{Eq\overline{v}+(q_H-Eq)\underline{v}}{Q} \leq R \leq \frac{(1-\varepsilon)q_L\overline{v}+\varepsilon(Eq\overline{v}+(Q-Eq)\underline{v})}{\varepsilon Q+(1-\varepsilon)q_L} \tag{26}$$

Proof. This is a simple extension of the proofs made when $Q = q_H$ in the preceding part. ■

The effect of setting $Q > q_H$ can be seen in the graph below to reduce the (δ, c) domain where an objective placement BNE exists. The range of R where this BNE exists is also reduced. That effect means that competition can sometime result in a reduction in welfare.

(Graph 9 p. 29)

Numerical example with $r_H = 1$, $\mathrm{r}_L = 2$, $q_H = 3$, $\mathrm{q}_L = 1$, $\lambda = 0.4$, $Q = 4$

4 The effect of competition on welfare

It is important to understand the effect of introducing competition in information intermediation markets. From a public policy point of view, regulators could become concerned about, for example, Google's dominance as a search engine. They may want to impose some regulation in

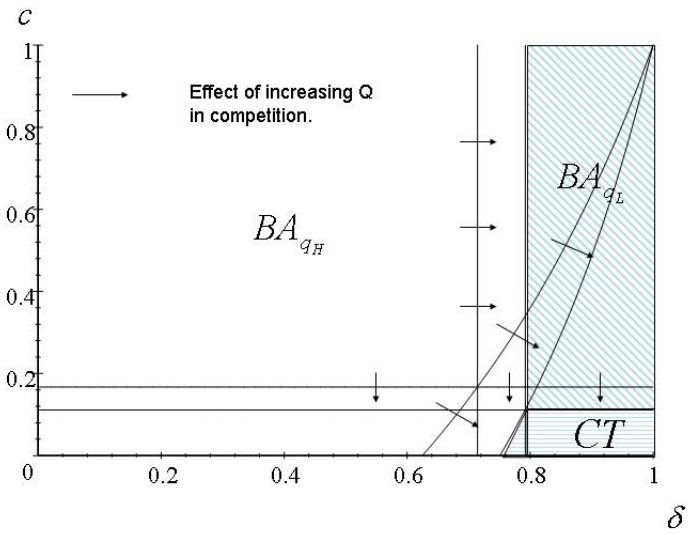

Figure 9: The effect of increasing Q

that market, thus sanctioning but also confirming its monopoly. Or they may encourage entry of competitors. In the context of the present model, competitive pressure on a dominant intermediary is as great as on other intermediaries (they all offer the same contracts). The discussion at the end of the paper indicates that breaking up the market would not improve the situation either.

The following proposition shows how competition influences welfare:

Proposition 5 *Competition almost always improves the overall quality of service in the market as the range of δ for which intermediaries choose to truthfully reveal information is broadened, and the presence of more intermediaries increases the probability with which a customer is directed in one period. Competition may lower the probability with which an individual intermediary directs a customer as the CT pricing system may be replaced by the BB_{q_L} system which is more robust to competition but less efficient. There are cases where competition will result in the breakdown of a BNE with objective placement when going from a monopoly to a competitive setting.*

Proof. In appendix F ■

The following graph illustrates the domains where welfare is increased, and the domain where it is lowered. There is a range for δ_H moderate and c low, where the system of belief of the customers becomes unsustainable. The range of c where the CT system is used is lowered and the range of δ where it is used is not broadened enough to eliminate those instances where the BB_{q_H} system replaces the CT system.

The intuition is that there are two effects at work that affect the range where an objective placement BNE exists in competition. The first one has already been studied in the literature: with competition, intermediaries cannot charge suppliers as much per customer directed, so that

the value of a customer is lowered and therefore, intermediaries are more willing to sell their audience now instead of later. This works to diminish the range (δ, c, R) where an objective placement BNE exists. But there is also another effect at work to expand the range: letting customers trickle down to other intermediaries means those intermediaries put less pressure on the price per customer the intermediary can charge a supplier. This is because the incentive to buy-out an intermediary's information content suppliers so as to get its customers is lowered: why pay to get customers you will get anyway? Overall, the effect of competition on whether an objective placement BNE exists is ambiguous: if c, the cost to check the type of a supplier and administer a CT pricing system, is high, then competition potentially increases welfare. If c is low, then competition may decrease welfare.

(Graph 10 p. 30)

Numerical example with $r_H = 1$, $\mathrm{r}_L = 2$, $q_H = 3$, $\mathrm{q}_L = 1$, $\lambda = 0.4$, $Q = 4$

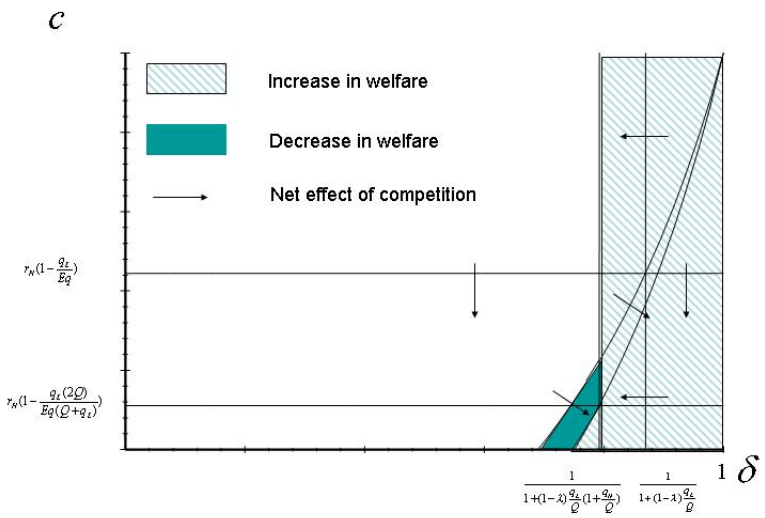

Figure 10: A comparison of welfare in competition and in a monopoly setting.

5 Conclusion

The paper shows how competition affects the contract offering of information intermediaries (and thus the probability with which they deliver good service). An intermediary will not want to use a contract that is too efficient, because doing so would prevent the trickling down of customers from the dominant intermediary to the alternative ones. In an objective placement BNE, all customers

go to the dominant intermediary in each period, and in each period, some of those customers visit alternative intermediaries if the dominant intermediary did not offer the good they need. However, they will come back next period to the dominant intermediary.

Those results settle some controversy over which pricing system will be used in competition, and whether competition improves the quality of service in the market. There is a domino effect that leads to a degradation of service quality as customers become less valuable and intermediaries want to exploit customers now instead of trying to retain them. This domino effect is countered by another effect as lowering quality simply results in a more than proportional reduction in the price that can be charged to suppliers. Indeed, an intermediary who reduces quality and directs more customers gives other intermediaries more incentive to distract customers from it. Competition thus generally encourages honesty in placement, but it also discourages the intermediary from making their own research on the suppliers (use of the CT system), and leads them to increasingly rely instead on an inflexible system that doesn't take into account information about the supplier's type.

6 Discussion

6.1 Suppliers' incentives

Suppliers were assumed to belong to two types, "spammers", who have a message of low interest to most consumers but may derive high benefits from transmitting it, and others, who incurred high costs to express a message that is useful to most consumers. In that view, a message (or a product) is composed of bits of information (or features). Each information (or feature) comes on top of the other to progressively build a message (or product) that will include all information (or features) that a consumer may require. Adding one information (or feature) is costly, but gains consumers. In the model, though, those suppliers who have the most attractive information make less profit than those who did less effort; the intermediary extracts most of their surplus. There is therefore little incentive to produce high quality information in this partial model. It could be extended to take into account information suppliers' incentives to produce.

However, the assumption that high quality information producers made lower profits than low quality ones was made mainly for ease of analysis; it led to an unique BB contract being proposed. The revenues that an information supplier may get from a visit by a consumer were implicitly defined from the production cost perspective. The possibility that a consumer may be ready to pay more for an information of higher quality was not considered: this is because it is very difficult for a short-lived information supplier to convey the value of its information before selling it. Moreover, the intermediary's message is restricted to saying whether the supplier's

product is good or isn't. Suppliers cannot differentiate based on the intermediary's message and their product is therefore sold at the same price irrespective of their type.

Changing the assumption on costs would potentially lead to the intermediary proposing a menu of BB contracts instead of only one, and this will improve the efficiency of BB based contracts. However, the CT-based contract always will be more efficient, so that the analysis of the basic trade-off outlined in this model remains valid.

6.2 Communication between customers

Customers could observe the accounts by previous customers about one intermediary's quality of service, as customers can choose to warn others about the quality of the service they experienced. Indeed, it is often said in the marketing literature that one happy customer will seldom tell others about it, while one unhappy one will be very vocal. Customers also frequently organize themselves in groups to defend their rights as consumers and propagate information about the quality of service they were provided. Information intermediary's website are frequently built so as to allow customers to give feedback and communicate with others. This is a way for the intermediary to put some limits to its own opportunistic behavior. The problem is that it is difficult to trust the intermediary to not erase bad feedback about its service, so that there must be a modicum of independent control on the monitoring system.

In the extreme, information intermediaries such as Slashdot (`http://slashdot.com`) not only allow their customers to rate its service, but the service is provided by those same customers; they provide the information that is diffused by the site. Every Slashdot member has a karma number. When that member does something that benefit the site (submitting a story that is accepted, posting a comment that gets moderated up, moderating others' comments), the user's karma level increases. When that user does something that the site administrators want to discourage (posting something that gets moderated down, making moderations that are deemed unfair), the user's karma level decreases.

The ways in which information about the intermediary's service are spread can be introduced in the model by considering successive generation of customers, and a probability that a customer who got dissatisfied will tell so to the new generation of customers. This 'vocality' parameter can be easily integrated in the model, and would make the intermediaries more wary in their recommendations.

6.3 Patterns in competition

There could be more complicated patterns of customer frequentation, with new customers each period, and some random probability governing changes in customer traffic at each intermedi-

ary. This would probably more accurately reflect reality, where the probability to use the service of one intermediary is dependent on its current popularity among existing customers. It would then make sense to ask suppliers of a given type to give selective exclusivity, asking them not to register at some intermediaries, and letting them register at some others. The simple pattern of customer frequentation adopted in this model reflects what happens when there is a dominant actor in the market, and intermediaries are ranked vis-à-vis this actor and serve only as alternatives. In that more complicated setting, the basic conclusions from the simple model would readily translate: the constraint on the price that can be practiced at one intermediary would depend on the incentive of the intermediary that stands to gain the most from a degradation of its service. The constraint would be less severe than in the simple model, since no intermediary would stand to gain all the customers of another intermediary, but the system would still favor inflexible but objective contracts compared to the monopoly case.

In this model, intermediaries can divert advertisers from another intermediary and thus degrade its quality of service. That mechanism was chosen because it provides some easy to find limit on the prices that can be practiced at each intermediary, and conveys the basic point that some contracts are more sensitive than others to 'sabotage' by other intermediaries. Other technologies than bribing could be introduced to represent the various ways in which competitors can try to degrade the quality of service at one intermediary in order to gain customers.

6.4 Cost structure of the intermediary

An information intermediary must incur high upfront capital costs for hardware, software development, and for advertising and marketing expenses to attract traffic. The main reason a simple variable cost structure was adopted was because if some fixed cost was introduced into the equation, then there would be no incentive for intermediaries too far down into the chain of intermediaries to be active, as they would not receive enough customers to justify being in business. Also, an intermediary who would lose customers each period would reach a point where it would choose to stop its activity. Introducing fixed costs thus poses some modeling problems while not changing the basic structure and conclusions of the model.

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Notes

[1]In the Interactive Advertising Bureau ("IAB") terminology, which we will alternatively use, billboard pricing is referred to as CPM pricing (cost per thousand impressions), as opposed to performance deals, which we refer here to as click-through based pricing. The IAB (www.iab.net) is an association for online, interactive broadcasting, email, wireless and interactive television media companies.

[2]This corresponds to a situation where a consumer needs a specific information that is part of a bundle of information (the supplier's product. The information's value is V and the supplier sells his bundle at p, so that if the information is provided, the value of the bundle is $V - p = \overline{v}$ while if it is not, the value of the bundle is $-p = \underline{v}$.

The supplier cannot charge different price depending on whether it has the information the consumer wants or not, as any information he may give about his product is either not credible or gives away the product.

In that view, an uninformative bundle generates revenue $r_L = p$ while an informative one, which costs c to produce, will generate revenue $r_H = p - c$.

Note also that we consider only marginal costs of production in this model, as they are the only ones that enter into the decision of the actors since fixed costs of production already are incurred.

[3]Note that there is no need to study updating of belief about the type of the intermediary over time, as under the customer's strategy, as soon as its service is of bad quality, the intermediary is dropped, while the condition under which the intermediary is used in the first place ensures it will be used in subsequent periods if its service keeps on being of high quality.

[4]Blogs are regularly updated personal websites. Some of them are reliable sources of specialized information.

[5]This doesn't mean the proper comparison would have to be the one between a monopoly who holds all products and can satisfy each customers each period, and many intermediaries each holding one product, with customers visiting intermediaries until they find their desired product. Indeed, there are limitations on the number of products an intermediary may hold at one location—think of the limits on the amount of information than can be held on a computer screen when you visit a web site. That limit is taken into account in this model, where one intermediary may give only one advice each period. The conclusions of this model hold even if an intermediary is allowed to give two or more advices to a customer each period. This only means an intermediary has a higher chances to satisfy a customer each period.

[6]This reflects limitations both in the capacity of an intermediary to list suppliers, and in the capacity of suppliers to get listed at all intermediaries

A Proof of claim 1

The intermediary offers a menu of contract $\overline{C} = (\overline{p}, \overline{q})$ and $\underline{C} = (\underline{p}, \underline{q})$ which will be chosen by suppliers of type H and L respectively. The intermediary guarantees $q = \overline{q}$ or $\underline{q}$ customers to the supplier depending on the contract he chose.

The contract variables must verify the following incentive and rationality constraints:

$$(r_H - \overline{p})\overline{q} \geq (r_H - \underline{p})\underline{q} \tag{27}$$

$$(r_L - \underline{p})\underline{q} \geq (r_L - \overline{p})\overline{q} \tag{28}$$

$$(r_H - \overline{p})\overline{q} \geq 0 \tag{29}$$

$$(r_L - \underline{p})\underline{q} \geq 0 \tag{30}$$

which leads to

$$r_L(\overline{q} - \underline{q}) \leq \overline{pq} - \underline{pq} \leq r_H(\overline{q} - \underline{q}) \tag{31}$$

which is possible only if

$$\overline{q} - \underline{q} \leq 0 \tag{32}$$

because $r_H \leq r_L$.

Since

$$(r_L - \underline{p})\underline{q} \geq (r_L - \overline{p})\overline{q} \geq (r_H - \overline{p})\overline{q} \geq (r_H - \underline{p})\underline{q} \tag{33}$$

we will have $(r_H - \overline{p})\overline{q} = 0$.

So that either

$$r_H - \overline{p} = 0 \tag{34}$$

or

$$\overline{q} = 0 \tag{35}$$

The participation constraint for type H supplier is saturated and the incentive constraint for type L suppliers will be saturated:

$$(r_L - \underline{p})\underline{q} = (r_L - \overline{p})\overline{q} \tag{36}$$

If $\overline{p} = r_H$: Since both suppliers can participate, the intermediary's expected profit function is

$$\pi_i = \frac{\lambda\overline{pq} + (1-\lambda)\underline{pq}}{1 - [\lambda(1 - \frac{\max(\overline{q} - q_H, 0)}{q_H}) + (1-\lambda)(1 - \frac{\max(\underline{q} - q_L, 0)}{q_H})]\delta_i} \tag{37}$$

indeed, with probability λ, it is a supplier of type H that comes, and he pays $\overline{pq}$, or with probability $(1-\lambda)$ it is a supplier of type L which pays $\underline{pq}$. If $\overline{C}$ was chosen, which means the

supplier is of type H, and $\overline{q} \geq q_H$, then a portion $\frac{\overline{q}-q_H}{q_H}$ of customers will not come back next period because they were directed to the supplier of type H even though he could not satisfy their taste. The same kind of thing happens if it was a supplier of type L that came and $\underline{q} \geq q_L$. This explains the discount factor.

Now, suppose $\overline{q} < \underline{q} = q_L$ which is an objective placement system. Then, because $q_H \geq q_L$, we have $\overline{q} - q_H < \underline{q} - q_L$. Therefore, when the intermediary wants to increase either $\underline{q}$ or $\overline{q}$, he will want to increase $\overline{q}$ first because it increases the numerator and the impact on the denominator is nil. Therefore, the intermediary will set $\overline{q}$ at its maximum, subject to $\underline{q} \geq \overline{q}$, so that $\overline{q}$ will be set equal to $\underline{q}$. Then $p(\underline{q}) = p(\overline{q})$ because else, each supplier would simply choose the lowest priced contract.

If $\overline{q} = 0$: The intermediary sets $\underline{p} = r_L$ and the contract is equivalent to excluding one type of supplier.

This means the intermediary will offer an unique contract, $C = (p, q) = (r_H, q_L)$ which guarantees objective placement and will make profit of $\frac{r_H q_L}{1-\delta_i}$.

Suppose now the intermediary decides to mislead some customers from that situation of objective placement. He can increase either $\overline{q}$ or $\underline{q}$. If he increases $\overline{q}$ then he must increase $\underline{q}$ because we must have $\overline{q} < \underline{q}$. And if he increases $\underline{q}$, he can as well increase $\overline{q}$ because that increase in $\overline{q}$ only results in increasing the numerator with no change in the denominator. Therefore, the objective placement system under BB must be compared to a system where an unique contract $C = (r_H, q_H)$ is offered. That system results in profit of $\frac{r_H q_H}{1-(1-(1-\lambda)\frac{q_H-q_L}{q_H})\delta_i}$ and that profit is lower than $\frac{r_H q_L}{1-\delta_i}$ for $\delta_i \geq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$. The optimal contract is invariant over time; if it is profitable to deviate in one period, it is profitable to deviate each period. This means that if $\delta \geq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$, then $C = (r_H, q_L)$ is offered, and if $\delta \leq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$, then $C = (r_H, q_H)$ is offered.

B Proof of claim 2

The intermediary's program is the following:

$$\underset{\overline{p},\overline{q},\underline{p},\underline{q}}{Max} \frac{\lambda(p-c)\widetilde{q}_H + (1-\lambda)(p-c)\widetilde{q}_L}{1-[\lambda(1-\frac{\max(\widetilde{q}_H-q_H,0)}{q_H}) + (1-\lambda)(1-\frac{\max(\widetilde{q}_L-q_L,0)}{q_H})]\delta} \tag{38}$$

subject to

$$r_H - p > 0 \tag{39}$$

with $\widetilde{q}_S$ denoting the number of customers directed by the intermediary when he find out the supplier is of type $S = H$ or L.

The best way the intermediary can better the BB_{q_L} system and still remain objective is to set $\widetilde{q}_S = q_S$ with q_S being the type of the supplier. Indeed, the intermediary will not want to replicate the outcome of the BB contract—for example here, the second best is to set $\widetilde{q}_S = q_H, \forall S$ exactly as it was the second best in the BB case, but this second best brings less profits than the BA's second best since it still requires to pay c. The only original outcome that can be achieved under the CT system is the one where he directs the maximum number of customers that can be satisfied by a supplier after having determined the match between each customer and the supplier at cost c per customer. The profit function will then be $\frac{Eq(r_H - c)}{1-\delta}$: the intermediary directs an average of Eq customers per period, and does not lose any each period.

For $\delta \geq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$ this must be compared to $\frac{r_H q_L}{1-\delta}$ which is the profit under BB, and CT is chosen for $c < \frac{\lambda r_H (q_H - q_L)}{\lambda q_H + (1-\lambda) q_L}$.

For $\delta \leq \frac{1}{1+(1-\lambda)\frac{q_L}{q_H}}$ this must be compared to $\frac{r_H q_H}{1-(1-(1-\lambda)\frac{q_H - q_L}{q_H})\delta}$ which is the profit under BB and CT is chosen for $\delta \geq \frac{r_H(q_H - Eq) + Eqc}{r_H(q_H - \frac{Eq^2}{q_H}) + \frac{Eq^2}{q_H}c}$.

C Proof of claim 3

Suppose the BB placement system is used and a Bayesian-Nash equilibrium with objective placement is sustainable. The optimal strategy for the intermediary will be shown to still be to propose only one contract $C = (p, q)$, but this time, the price p must be set such that the next intermediary is not tempted to buy exclusivity from suppliers. This will deter deviation where competing intermediaries ask for exclusivity from one type of supplier only. As before, suppose p is such that both suppliers can afford it, or $p \leq r_H$.

Let's look at a menu of $C = (p, q)$ contracts and suppose that among the contracts offered, there is one that is acceptable to suppliers of type H (i.e. $\overline{p} \leq r_H$).

The program of the intermediary is the following:

$$\underset{\overline{p},\overline{q},\underline{p},\underline{q}}{Max} \frac{\lambda \overline{pq} + (1-\lambda)\underline{pq}}{1 - [\lambda(1 - \frac{\max(\overline{q} - q_H, 0)}{q_H} + (1-\lambda)(1 - \frac{\max(\underline{q} - q_L, 0)}{q_H}]\delta} \tag{40}$$

subject to

$$(r_H - \overline{p})\overline{q} \geq 0 \tag{41}$$

$$(r_L - \underline{p})\underline{q} \geq 0 \tag{42}$$

$$(r_H - \overline{p})\overline{q} \geq (r_H - \underline{p})\underline{q} \tag{43}$$

$$(r_L - \underline{p})\underline{q} \geq (r_L - \overline{p})\overline{q} \tag{44}$$

$$(r_H - \overline{p})\overline{q} \geq \frac{(\overline{q} - \delta \max[\overline{q} - q_H, 0])}{q_H} \times (\lambda \overline{pq} + (1-\lambda)\underline{pq}) \tag{45}$$

$$(r_L - \underline{p})\underline{q} \geq \frac{[\lambda(\overline{q} - \delta \max[\overline{q} - q_H, 0]) + (1-\lambda)(\underline{q} - \delta \max[\underline{q} - q_L, 0])]}{q_H} \times (\lambda \overline{pq} + (1-\lambda)\underline{pq}) \tag{46}$$

The additional constraints (compared to the monopoly case) are that the intermediary does not find it profitable to buy exclusivity from one or both type of suppliers, and they are defined below: The expected profit of S_L (suppliers of type low) is $\pi_L = \underline{q}(r_L - \underline{p})$, while the expected profit of S_H is $\pi_H = \overline{q}(r_H - \overline{p})$. Due to the incentive constraints, π_L is more than π_H so that the intermediary $n+1$ can choose to get exclusivity from both type of suppliers by paying $\max(\pi_L, \pi_H)$ to all suppliers, or choose to get exclusivity from only one type of suppliers by paying $\min(\pi_L, \pi_H) = \pi_H$ to suppliers of type H. Since intermediary $n+1$ is in the same situation as intermediary n, he will choose the same strategy as intermediary n, which means his profit per customer will be the same as that of intermediary n. There will therefore be no subsidization where only one type is encouraged to deviate (type H), if

$$\lambda \overline{q}(r_H - \overline{p}) \geq \lambda(\overline{q} - \delta \max[\overline{q} - q_H, 0]) \times \frac{\lambda \overline{pq} + (1-\lambda)\underline{pq}}{q_H} \tag{47}$$

The term on the left hand side of those expressions is the cost of subsidizing type H suppliers, and the right hand side term is the additional number of disappointed consumers as only type L suppliers will stay at I_n, compared to the number of consumers I_{n+1} would have received if it had not bought the exclusivity from suppliers of type H. Indeed, if a supplier of type H sells its exclusive contract with I_n to the intermediary I_{n+1} in this period, the total number of consumers I_{n+1} gets is $\lambda(q_H) + (1-\lambda)(q_H - \underline{q} + \delta \max[\underline{q} - q_L, 0])$. Indeed, with probability λ, there is no supplier left at I_n, so that he must relinquish all his customers who go directly to I_{n+1} in this period, and with probability $(1-\lambda)$ the supplier at I_n was of type L, and then, I_n directs $\underline{q}$ of them to that supplier, and if $\underline{q}$ is more than q_L, those who got dissatisfied go to I_{n+1} next period. If I_{n+1} had not asked for exclusivity from suppliers of type H, then the expected number of clients it would have had would have been $\lambda(q_H - \overline{q} + \delta \max[\overline{q} - q_H, 0]) + (1-\lambda)(q_H - \underline{q} + \delta \max[\underline{q} - q_L, 0])$. The additional consumers gained from exclusivity is therefore $\lambda(\overline{q} - \delta \max[\overline{q} - q_H, 0])$. The profit that I_{n+1} gets from those consumers is the same as the per consumer profit that I_n makes, because all intermediaries adopt the same strategy, since they are facing the same competitive situation[7].

In the same manner, both types will not be encouraged to deviate if

$$\underline{q}(r_L - p(\underline{q})) \geq [\lambda(\overline{q} - \delta \max[\overline{q} - q_H, 0]) + (1-\lambda)(\underline{q} - \delta \max[\underline{q} - q_L, 0])] \times \frac{\lambda \overline{pq} + (1-\lambda)\underline{pq}}{q_H} \quad (48)$$

Like in the monopoly case, the intermediary who wants to do objective placement will propose only one contract C, but now p will be constrained by the no-deviation conditions instead of being constrained by the individual rationality constraints. As for the level of q, the two choices, as usual, are either maximizing long-term profit and setting $q = q_L$, or maximizing short-term profits and setting $q = q_H$.

In the case where $q = q_L$, then the profit of the intermediary must be such that it discourages competitors (who make the same profit per customer) from trying to make both types of suppliers deviate and trying to make suppliers of type H only deviate:

$$\Pi_I = \min[\frac{r_H q_L}{(1 + \frac{q_L}{q_H})(1-\delta)}, \frac{r_L q_L}{(1 + \frac{q_L}{q_H})(1-\delta)}] = \frac{r_H q_L}{(1 + \frac{q_L}{q_H})(1-\delta)} \quad (49)$$

When $q = q_H$ then

$$\Pi_I = \min[\frac{r_H q_H}{(1 + \frac{q_H}{q_H})(1 - \delta + (1-\lambda)\frac{q_H - q_L}{q_H}\delta)}, \frac{r_L q_H}{(1 + \frac{q_H}{q_H} - (1-\lambda)\frac{q_H - q_L}{q_H}\delta)(1 - \delta + (1-\lambda)\frac{q_H - q_L}{q_H}\delta)}] \quad (50)$$

$$= \frac{r_H q_H}{(1 + \frac{q_H}{q_H})(1 - \delta + (1-\lambda)\frac{q_H - q_L}{q_H}\delta)} \quad (51)$$

The intermediary will choose q so as to obtain maximum profit, and BB_{q_L} is preferred to BB_{q_H} for $\delta \geq \frac{B}{1+B} = \delta_1$ with $B = \frac{\frac{q_H(q_H+q_L)}{q_L(q_H+q_H)} - 1}{\frac{q_H - Eq}{q_H}}$, or $\delta_1 = \frac{1}{1+2(1-\lambda)\frac{q_L}{q_H}}$

D Proof of claim 4

Profits under CT contracting is first defined, and there only remains then to compare it to profits under the BB system to determine the above ranges.

The competition game goes as follows: Intermediary $n+1$ cares mostly about intermediary n, since disappointed or undirected consumers of that intermediary will most directly go to him. He will therefore be the one who offers the supplier at intermediary n the highest payment to break its contract with its intermediary. Suppose intermediary n uses the click-through based system, and $f_n \leq r_H$. $\widetilde{q}_S$ is the number of consumers the intermediary directs to the supplier of type S. The expected profit of S_L (suppliers of type low) is $\pi_L = (\widetilde{q}_L)(r_L - f_n)$, while the expected

profit of S_H is $\pi_H = (\widetilde{q_H})(r_H - f_n)$. π_L will be more than π_H if $f_n \geq \frac{r_H \widetilde{q}_H - r_L \widetilde{q}_L}{\widetilde{q}_H - \widetilde{q}_L}$. Assume this is the case in equilibrium[8] The intermediary $n+1$ can choose to make sure the supplier deviates by offering him $\max(\pi_L, \pi_H) = \pi_L$, or choose to get its payment accepted only if the supplier is of a given type, by offering only $\min(\pi_L, \pi_H) = \pi_H$. Since intermediary $n+1$ is in the same situation as intermediary n, he will choose the same strategy as intermediary n, which means his profit per customer will be the same as that of intermediary n. The choice of the intermediary is between directing customers truthfully, and maximizing long-term profit, or telling all customers to go to the supplier at hand, thus favoring short-term advantage. There will be no subsidization where only one type is encouraged to deviate (type H), if

$$\alpha_n \lambda q_H (r_H - f_n) \geq \alpha_n \lambda q_H \times (f_{n+1} - c) \tag{52}$$

The left hand term of those expressions is the cost of subsidizing type H suppliers, with α_n being the number of customers of n, and the right hand side is the additional number of disappointed consumers when I_{n+1} got the exclusivity on suppliers of type H as only type L suppliers will stay at I_n, multiplied by the profit per customer intermediary $n+1$ makes. Indeed, if suppliers of type H accept the payment of the intermediary $I_{n+1,}$ in this period, the total number of consumers I_{n+1} gets is $\lambda(q_H) + (1-\lambda)(q_H - q_L)$ - all customers of I_n if the supplier at I_n was of type H, and only $q_H - q_L$ of them if it was of type L, and thus did not accept its payment - while if I_{n+1} had not asked for exclusivity from suppliers of type H, then the expected number of clients it would have had would have been $\lambda(q_H - q_H) + (1-\lambda)(q_H - q_L)$. The additional consumers gained from exclusivity is therefore λq_H. The customer who did not get directed at intermediary n because the supplier who contracted with n deviated will come back next period to intermediary n, and not to intermediary $n+1$, even if $n+1$ directed him correctly. Indeed, his a-priori on n was not lowered—not being directed is interpreted as a good signal because only intermediaries that do objective placement do not direct customers. Therefore, the customer gained is gained only for one period. The profit per customer intermediary $n+1$ makes is the same as the profit per customer of the intermediary n because all intermediaries follow the same strategy since they are all subject to the same type of constraints. Indeed, for intermediary $n+1$, the condition translates in

$$\alpha_{n+1} \lambda q_H (r_H - f_{n+1}) \geq \alpha_{n+1} \lambda q_H \times (f_{n+2} - c) \tag{53}$$

and by successive replacement, we find the same expression that limits f_n for any n :

$$f_n \leq \frac{r_H + c}{2} \tag{54}$$

The profit that I_{n+1} gets from those consumers is therefore the same as the per consumer

profit that I_n makes, because all intermediaries adopt the same strategy, since they are facing the same competitive situation.[9] In the same manner, both types will not be encouraged to deviate if

$$q_L(r_L - f_n) \geq (\lambda q_H + (1-\lambda)q_L) \times (f_n - c) \tag{55}$$

Profits of the intermediary can be obtained from this: To deter a deviation by a supplier of type H, f must be such that:

$$\frac{r_H + c}{2} > f_n \tag{56}$$

and this is less than $r(q_H)$ as $c < r(q_H)$. Profit of the first intermediary is then

$$\Pi_1 = Eq\frac{r_H - c}{2(1-\delta)} \tag{57}$$

when the deviation from both type of suppliers must be deterred, f must be such that

$$\frac{q_L r_L + Eqc}{q_L + Eq} \geq f_n \tag{58}$$

and profit is

$$\Pi_1 = Eq\frac{q_L(r_L - c)}{(q_L + Eq)(1-\delta)} \tag{59}$$

Therefore, profit of the intermediary under an objective CT system is

$$\Pi_1 = \min[Eq\frac{r_H - c}{2(1-\delta)}, Eq\frac{r_L - c}{(1 + \frac{Eq}{q_L})(1-\delta)}] \tag{60}$$

or $Eq\frac{r_H - c}{2(1-\delta)}$ because $c \geq r_H - \frac{2(r_L - r_H)}{\frac{Eq}{q_L} - 1}$ as it was assumed that $\frac{r_L}{r_H} - 1 \geq \frac{\lambda}{2}(\frac{q_H}{q_L} - 1)$.

As mentioned in the analysis of the model in the monopoly part, the intermediary will never choose the CT contract and set $\widetilde{q}$ other than q_t, with t being the type of the supplier because the BB contract is more efficient in those cases.[10]

E Proof of proposition 2

The value of δ comes from the preceding claims. The right hand side for the acceptable range for R is the value of using the service of an intermediary with unknown type when the BB_{q_L} system

is used. Let us denote it V.

$$V = (1-\varepsilon)[\frac{q_L}{q_H}\overline{v} + (1-\frac{q_L}{q_H})V] + \varepsilon[\frac{Eq\overline{v} + (q_H - Eq)\underline{v}}{q_H}] \tag{61}$$

Indeed, with probability $1-\varepsilon$ the intermediary is of a high type, uses the BB_{q_L} system, and therefore directs the customer to a supplier with probability $\frac{q_L}{q_H}$, and the value of the product is $\overline{v}$. Else, the customer goes to another intermediary, whose service's expected value is V too. With probability ε, the intermediary is of a low type who directs the customer with probability one to any customer at hand.

F Proof of proposition 5

When comparing the CT system and the BB system, the BB_{q_L} system is used for δ lower, but c higher than in the monopoly case. Either the BB_{q_L} or the CT system is used for $\delta \geq \frac{1}{1+(1-\lambda)\frac{q_L}{Q}(1+\frac{q_H}{Q})} = \delta_1$ and δ_1 is less than $\delta_0 = \frac{1}{1+(1-\lambda)\frac{q_L}{Q}}$ which was the limit over which the BB_{q_L} system was used in the monopoly setting. But in that δ domain, the CT system is preferred to the BB_{q_L} system for $c \leq r_H(1-\frac{q_L(2Q)}{Eq(Q+q_L)}) = c_2$ which is less than $c_0 = r_H(1-\frac{q_L}{Eq})$, the limit over which the BB system was preferred in the monopoly case.

Define $\delta(c)$ as $\frac{2r_Hq_H - Eq(1+\frac{q_H}{Q})(r_H-c)}{2r_Hq_H + Eq(1+\frac{q_H}{Q})(r_H-c)\frac{q_H-Eq-Q}{Q}}$. The range of δ_H where the BB_{q_H} system will replace the CT system is

$$\delta_H \in [\frac{r_Hq_H - Eq(r_H-c)}{r_Hq_H + Eq(r_H-c)\frac{q_H-Eq-Q}{Q}}, \max(\frac{1}{1+(1-\lambda)\frac{q_L}{Q}(1+\frac{q_H}{Q})}, \delta(c))] \tag{62}$$

In that range, the competition will result in a lowering of welfare as the customers' belief system is not sustainable. Even high δ intermediaries may present misleading placement: customers cannot anymore conclude from a bad service that the intermediary is of a low type so that there is no sustainable punishment system. This means the system will unravel and no customers will participate because there are no sustainable uncoordinated disciplining mechanisms.

Welfare is increased compared to the monopoly case for any

$$\delta_H \geq \min[\frac{1}{1+(1-\lambda)\frac{q_L}{Q}(1+\frac{q_H}{Q})}, \delta(c)] \tag{63}$$

because then a customer is ultimately directed adequately. The range of c for which the more efficient CT contract is used will however be reduced compared to the monopoly case, meaning that the probability to get directed at an intermediary may be decreased.