Roles for Electronic Brokers

Paul Resnick
MIT
Room E53-325
50 Memorial Drive
Cambridge, MA 02319
617-253-8694
presnick@mit.edu

Harvard Kennedy School of Government
Cambridge, MA 02138
617-495-1174
richardz@ksg1.harvard.edu
chrisa@ksg1.harvard.edu

Richard Zeckhauser and Chris Avery

Abstract

The information superhighway directly connects millions of people, each both a consumer of information and a potential provider. If their exchanges are to be efficient, yet protected on matters of privacy, sophisticated mediators will be required. Electronic brokers can play this important role by organizing markets that promote the efficient production and consumption of information. One possible role for brokers would be to

Support from the corporate sponsors of the MIT Center for Coordination Science (Resnick) and the Decision, Risk, and Management Science Division of the National Science Foundation (Zeckhauser and Avery) is gratefully acknowledged.

collect and redistribute product evaluations. We discuss issues of privacy, censorship, and incentives for participation that would arise in such a shared evaluation service. We then argue for the separation of the services of information provision and brokerage.

An earlier version of this paper was presented at the Twenty-Second Annual Telecommunications Policy Research Conference, October 1994. A slightly revised version appeared as:

Resnick, Paul, Zeckhauser, Richard and Avery, Chris, “Roles for Electronic Brokers,” in *Toward a Competitive Telecommunication Industry: Selected Papers from the 1994 Telecommunications Policy Research Conference*, G. W. Brock, Ed. Mahwah, NJ: Lawrence Erlbaum Associates, 1995, pp. 289-304.

Introduction

The information superhighway promises to facilitate the exchange of products. Broadly, we can think of all such exchanges as electronic commerce, even though some products, such as messages on computer bulletin boards, may be free, and physical transactions must be consummated elsewhere. (For example, a seller and buyer would exchange the product and payment by mail.) Most predictions about commercial opportunities on the information superhighway focus on the provision of information products, such as video on demand, and on new sales outlets for physical products, as with home shopping. We believe that electronic brokers, as intermediaries between buyers and sellers, can help to create more efficient markets, both for information products and physical products. Most simply, they can reduce buyer search costs and arrange to pay for information that would not be provided without payment.

Such services raise two important policy questions. First, how do we weigh privacy and censorship concerns against the provision of information in a manageable form? Whenever information products are brokered, privacy and censorship issues come to the fore. When the broker is a computer rather than a person, the stakes are raised; a computer can more easily perform potentially troubling operations involving large amounts of data processing. Second, how should the provision of brokering services be organized? Should they be integrated with information provision, or separated? Is brokering a natural monopoly?

We first identify a number of vital activities that electronic brokers could perform. Next, we describe one prototype service, a Better Bit Bureau, in more detail and discuss its policy implications. Finally, we argue that brokering services should be vertically separated from information provision, and we discuss the tensions between the advantages of competition and monopoly in the provision of brokering services.

The Value of Electronic Brokers

Producers and consumers interact directly in a marketplace: producers provide information to customers, who select from among the available products. In general, producers set prices, but sometimes they are negotiated. But direct negotiations are sometimes undesirable or infeasible. Fortunately, intermediaries, whether human or electronic, can redress five important limitations of privately negotiated transactions:

Search costs. It may be expensive for providers and consumers to find each other. In the bazaar of the information superhighway, for example, thousands of products are exchanged among millions of people. Brokers can maintain databases of customer preferences, and reduce search costs by selectively routing information from providers to consumers. Furthermore, producers may have trouble accurately gauging consumer demand for new products; many desirable items may never be produced simply because no one recognizes the demand for them. Brokers with access to customer preference data can predict demand.

Lack of privacy. Either the buyer or seller may wish to remain anonymous, or at least to protect some information relevant to an exchange. Brokers can relay messages without revealing the identity of one or both parties. A broker can also make pricing and allocation decisions based on information provided by two or more parties, without revealing the information of any individual party.

Incomplete information. The buyer may need more information than the seller is able or willing to provide, such as information about product quality or customer satisfaction. A broker can gather product information from sources other than the product provider, including independent evaluators and other customers.

Contracting risk. A consumer may refuse to pay after receiving a product, or a producer may give inadequate post-purchase service. Brokers have a number of tools to reduce risk. First, the broker can disseminate information about the behavior of providers and consumers. The threat of publicizing bad behavior or removing some seal of approval may encourage both producers and consumers to meet the broker's standard for fair dealing. Second, if publicity is insufficient, the broker may accept responsibility for the behavior of parties in transactions it arranges, and act as a policeman on its own. Third, the broker can provide insurance against bad behavior. The credit card industry uses all three tools to reduce providers' and consumers' exposure to risk.

Pricing Inefficiencies. By jockeying to secure a desirable price for a product, providers and consumers may miss opportunities for mutually desirable exchanges (Myerson & Satterthwaite, 1983). This is particularly likely in negotiations over unique or custom products, such as houses, and markets for information products and other public goods, where free-riding is a problem. Brokers can use pricing mechanisms that induce just the appropriate exchanges. One intriguing class of mechanisms requires a broker because the budget balances only on average: the amount the producer receives in any single transaction may be more or less than the amount paid by the customer, and the broker pays or receives the difference.

The information superhighway offers new opportunities for brokering services. First, brokers are especially valuable when the number of participants is enormous, as with the stock market, or when information products are exchanged. Second, many brokering services require information processing; electronic versions of these services can offer more sophisticated features at a lower cost than is possible with human labor. Finally, for delicate negotiations, a computer mediator may be more predictable, and hence more trustworthy, than a human. For example, suppose a mediator's role is to inform a buyer and a seller whether a deal should go through, without revealing either's reservation price to the other, since such a revelation would influence subsequent price negotiations. An independent auditor can verify that a software mediator will reveal only the information it is supposed to; a human mediator's fairness is less easily verified.

Better Bit Bureaus

Information overload plagues computer network users (Malone, Grant, Turbak, Brobst, & Cohen, 1987); there is simply not enough time to sift through all the available information or even a significant fraction of it. In response, several subscription services provide selective filtering: a consumer specifies a profile consisting of a few words or topics; periodically the service sends the consumer news articles that match the profile.

In this analysis, we consider the use of other people's subjective evaluations to help route messages. Subjective evaluations are valuable to consumers who are deciding which products to buy or how to spend their time. For example, we read magazines devoted to product evaluation before purchasing cars and appliances. We ask our friends and read reviews by professional critics when deciding which movies to see or where to eat.

Before committing to a new job or school, we ask current employees what the firm is like and inquire of college students what it would be like to go to their school.

Of course, there are drawbacks to subjective evaluations. Not all evaluations are equally trustworthy; there may be differences in effort or expertise, or conflicts of interest due to the financial stakes of the evaluators. Moreover, consumers' tastes may differ, so that an evaluation that is trustworthy to one person may not be to another. It is costly to gather and distribute evaluations, and it takes time for an individual to process them. The high transaction costs of sharing evaluations reduces their use except when they may influence an expensive purchase, such as a car, or when the evaluations are entertaining, as with movie reviews.

Computers can reduce the cost of gathering, distributing, and processing evaluations, especially evaluations of information products such as computer bulletin board messages. By analogy to the Better Business Bureau, we call a broker that shares evaluations of information products a Better Bit Bureau. A Better Bit Bureau that helps people choose information products is called a collaborative information filtering service. We describe a research prototype, called GroupLens (Resnick, Iacovou, Suchak, Bergstrom, & Riedl, 1994), that implements collaborative information filtering. Other researcher are also exploring related services (Goldberg, Nichols, Oki, & Terry, 1992; Hill, Stead, & Rosenstein, 1995; Maltz, 1994; Shardanand & Maes, 1995). Commercial brokering services based on shared evaluations are just beginning to appear (Nichols, 1994).

GroupLens collects evaluations of computer bulletin board messages. After reading each bulletin board message, a user enters a number from 1 to 5. The user's computer forwards the numeric rating to a Better Bit Bureau, which may distribute it to other Better Bit Bureaus. The GroupLens Better Bit Bureaus implement a rating aggregation scheme that takes account of differences in individual tastes. It employs the heuristic that "people who agreed in the past will likely agree again." Thus, in predicting whether a particular person will enjoy a particular message, it weights more heavily ratings from people who agreed substantially with the person in the past.

Censorship and Groupthink

To what extent is collaborative filtering censorship, and therefore objectionable? Here we define censorship as any activity whereby a third party prevents or inhibits one party from communicating with another. While collaborative filtering fits this definition of censorship, we argue that it is a benign form. Instead, the danger may be a splintering of society, where each individual listens only to others with like views.

One filtering mechanism already built into some software for browsing computer bulletin boards is the ability to create a "kill" file which suppresses all messages containing a certain string of characters. For example, a user might put a subject line in a kill file to avoid all follow-up messages, or a name to avoid all messages from that person. This is not censorship, since no third party is involved: one person's kill files do not affect what anyone else receives.

A second filtering mechanism is the "moderated" newsgroup. A moderator, acting much like the editor of a periodical, receives all messages and decides which to post to the newsgroup. In most cases, computer bulletin board moderators screen messages for conciseness and relevance to a particular topic, rather than the positions they argue for, but some abuses of power are inevitable. A moderated newsgroup often coexists with an unmoderated one that addresses the same topic, so that an author has an alternative place to post a message rejected by the moderator.

Collaborative filtering fits somewhere between kill files and moderated newsgroups. It fits the broad definition of censorship above -- some people's evaluations can cause other people not to read a particular message. This form of censorship seems benign, however, for two reasons. First, the power to censor is distributed among many evaluators, so the damage from any one person's abuse of power is limited. Second, each person relies on ratings from a different set of evaluators. In GroupLens, the computer identifies which evaluators' opinions to weight most heavily. Alternatively, users might specify that only evaluations from particular friends or celebrities be used. In either case, no one is forced to take suggestions from an incompatible evaluator.

Collaborative filtering may be a viable alternative to the "free speech vs. censorship" debate about television programming (Brynjolfsson & Resnick, 1993). It may provide a way to supersede regulations concerning the broadcast of nudity and to quiet agitation for restrictions on the broadcast of violent material. One proposed technology, nicknamed the V-chip (Andrews, 1993), would allow individuals to automatically block out all violent material from appearing on their own TV sets. Broadcasters would send a "V" signal along with any violent shows they broadcast and new TVs equipped with the chip would detect the signal. Thus, a parent could program the TV not to show anything accompanied by a "V" signal between 3PM and 6PM, the unsupervised after school hours. The drawback is that technology can not obviate the old question of who decides what is violent enough to receive the "V" rating; proposals range from industry self-labeling to a government-appointed independent board.

With collaborative filtering, it would not be necessary to designate any official rating board. Anyone could publish a set of evaluations (on many dimensions, not just violence). If a wide range of evaluations were available, a parent could program a TV to pay attention to any censor, from Action for Children's Television to Howard Stern, or a group of neighbors. Today, people practice collaborative filtering on an informal basis, but there are too many programs and too many evaluators to keep track of. Technological support, in the form of broadcasting many independent evaluations, could make collaborative filtering an effective alternative to government regulation.

Yet there may be a danger more subtle than censorship in giving people greater control over what television programs they watch or what messages they read. No individual rights are abridged if Rush Limbaugh's evaluations were to screen out politically liberal messages; liberals could still reach people (including open-minded conservatives) who want to hear what they have to say. It may be dangerous for society as a whole, however, to fragment into like-minded groups. Today's inadequate technology for filtering information may force people to be exposed to contrary viewpoints. This may have a positive value for society despite its negative value for individuals. On the other hand, ineffective information filtering is hardly an efficient way to ensure cross-fertilization.

With collaborative filtering, boundary-crossing individuals may naturally introduce interesting new ideas into self-selected interest groups.[1]

Some people may mistrust collaborative filtering, either out of misunderstanding or fear that the system will be manipulated to perform a more pernicious form of censorship. One difficulty is that in a very large network, it may become infeasible for a user to decide how to weight each evaluator. Each user must either lose some control, by not understanding whose opinions the filter is relying on, or bypass the potential benefits of strangers' evaluations. In GroupLens, users must trust the computer's mechanism for picking compatible evaluators.[2]

Privacy

Protecting the privacy of evaluators and their information is another important policy concern. Contemporary standards of fairness require that many documents, ranging from letters to the editor to personnel evaluations, be signed, and that one's accuser be identified in court. Signed evaluations are less likely to be unfair and, over time, people can identify trustworthy evaluators. Perhaps requiring signed evaluations could help

---

[1]More sophisticated possibilities might also be created. Though each individual might prefer to be insular, he might agree to receive contrary views if others would do so as well, leading to a general agreement on a system that provides some contrary exposure to all.

[2]A mistrustful user might subscribe to several Better Bit Bureaus that follow different filtering rules, much as medical patients often ask for a second opinion from another doctor.

people develop friendships; matching people based on their tastes in movies might be useful as part of a dating service. On the other hand, evaluators may prefer not to sign their evaluations. For example, most professional journals employ blind reviews so that reviewers will not fear retribution from authors. Evaluators on computer networks may not even want anyone to know what bulletin boards they read, much less their opinions of particular messages.

GroupLens offers a compromise between signed and anonymous evaluations; each user signs all evaluations with one pseudonym. There is no simple way to identify the person behind the pseudonym, but the Better Bit Bureau can still match evaluators with similar tastes.

The use of pseudonyms does not completely resolve the privacy issue. First, by preserving privacy we sacrifice some information. With signed evaluations, it is possible to draw on external information when choosing which evaluators to pay attention to. Knowing that evaluator A is C. Everett Koop is a much faster way to learn of his expertise than to examine all his past evaluations. One solution to this problem may be to provide some descriptive attributes of each evaluator.

Second, some information about the evaluator is leaked even without the name and a knowledgeable observer may be able to guess an evaluator's identity from past evaluations. Publishing descriptive attributes along with pseudonyms, such as the fact that evaluator B is an economist, would exacerbate this problem. Even without guessing the evaluator's identity, an observer may be able to infer information that the evaluator would prefer to hide. For example, suppose the evaluator wishes to hide the very wellkept secret that most mainstream economists have socialist leanings. An analysis of many evaluations could support this claim even if it could not pinpoint the identity of any individual socialist.

A potential compromise is to pay people for the loss of privacy. A broker could pay one amount for signed evaluations, somewhat less for pseudonymous evaluations, and very little for anonymous evaluations. An interesting policy question is whether people should be allowed to sell their privacy in this way, since it is nearly impossible to anticipate all the potential uses of large databases of personal information. Moreover, selling one's privacy may create externalities; revealing one's identity might reveal information about similar people.[3]

Paying for Evaluations

Even if we can effectively and appropriately aggregate all evaluations, a second major problem will arise: too few evaluations will be produced. In GroupLens, all evaluations are generated as a result of self-interested activities. When someone evaluates a document, possibly helping vast numbers of others, he is not compensated. What can we do to assure a sufficient supply of evaluations? Elsewhere we present a series of mechanisms that can be helpful (Avery, Resnick, & Zeckhauser, 1994a); here we review

---

[3]Vote selling offers an interesting analogy. I am hurt when others who are like me sell their votes, but whether they do or not, it is still worthwhile for me to sell my own. Similarly, my privacy is lost if others like me sell theirs, yet I might sell mine. In either case, a like-minded group might agree to preserve their votes or their privacy, even though each would sell without an agreement.

the issues and our findings, using very simple examples. We analyze three types of social inefficiencies that are likely to occur if evaluators are not compensated, and then consider the difficulties of creating a compensation scheme that is fair and can induce the socially optimal set of evaluations.

Suppose that two people are deciding whether to read a message. Initially, they both think it is equally like that the message is "good" or "bad." The two players' evaluations of messages are perfectly informative; when a message is "good" to one player it is "good" to the other as well. There are two critical parameters for each potential reader; the values of reading and evaluating a good message and a bad message. Call them r_i and s_i respectively. Either or both can be greater or less than zero, but typically we would expect $r_i > 0 > s_i$. A player who does not read the message receives a payoff of 0, regardless of its content. We assume that each player knows the other's payoffs.

If evaluators receive no compensation, three types of inefficiency are likely to arise. We illustrate these with three scenarios that differ only in the payoffs to each player. First, too few evaluations may be produced. It will sometimes be socially beneficial for individuals to read messages and evaluate them even if they expect a negative value on average. In scenario a, player 1 benefits by ten units ($r_1 = +10$) if she reads the message and likes it, but loses twelve units ($s_1 = -12$) if she reads and dislikes it, reflecting the value of the time she spent reading the message. Second, people may evaluate voluntarily, but in the wrong order. In scenario b, player 1 gains more from a good message, but has less time to spare, so it is better for player 2 to read first, even though her expected value is negative and player 1's is positive. Third, as shown in scenario c, people who expect a positive utility from reading may wait anyway, in the hope that others' evaluations will enable a better informed decision.

Figure 1: Payoffs from Reading in Three Scenarios

	Good	Bad
Player 1	+10	-12
Player 2	+10	-12

(a) underprovision

	Good	Bad
Player 1	+40	-20
Player 2	+10	-12

(b) improper ordering

Player 1	+12	-10
Player 2	+12	-10

(c) wasteful value claiming

Good Bad

There are two initial strategies for each player: read immediately (R) and wait (W). A player who waits can make a fully informed decision if the other player reads immediately. If both players wait, they decide simultaneously whether or not to read in the second round, without the benefit of any additional information, and then the game ends.

We assume that reading a good message provides the same benefit in the first and second periods, which in most practical circumstances will only be separated briefly. Without any discounting, however, waiting will be a weakly dominant strategy. We therefore assume a sliver of discounting when required for tie-breaking: given a choice between the same expected payoff now or at some future time, a player will choose the earlier payoff.

We assume the players care only about maximizing their own payoffs, without regard to the payoffs of the other players. The initial probability that the message is good is assumed to be $p = \frac{1}{2}$. Figure 2 shows the games in the 2x2 normal form after converting individual outcomes to expected payoffs.

Figure 2: Normal Forms of the Games

Player 2

(a) underprovision

Player 1		Read	Wait
	Read	-1,-1	-1,5
	Wait	5,-1	0,0

(b) improper ordering

Player 1		Read	Wait
	Read	10,-1	10,5
	Wait	20,-1	10,0

(c) wasteful value claiming

Player 1		Read	Wait
	Read	1,1	1,6
	Wait	6,1	1,1

In (a), the social optimum is for either person to read immediately and the other to wait. The reader has an expected loss of 1; $r_i p + s_i(1-p) = \frac{10}{2} - \frac{12}{2} = -1$. The expected value for the player who waits is $r_j * 1 + s_j * 0 = \frac{10}{2} = 5$. Unfortunately, waiting is a strictly dominant strategy for both players: no matter what player i does, player j gains by not reading the message initially. The only Nash Equilibrium, the outcome that results if each player takes the other's action as fixed, is (W,W), giving each a payoff of 0. Thus, case (a) demonstrates the natural tendency to underprovide information in equilibrium, since neither player takes account of the value that her first-round evaluation provides to the second-round decision of the other player.

In (b), player 1's stakes are higher: she can gain more if the message is good, but the cost of her potential mistake is also higher. The social optimum is for player 2 to read the message first and then recommend it to player 1 if it is good (W,R, in the lower left of table b.) In effect, player 2 should act as the king's taster: if the taster does not get sick, it is safe for the king to eat. Left to himself, however, player 2 will refuse the role of human guinea pig (a -1 payoff), preferring to wait (at least a 0 payoff). Player 1 realizes that player 2 will not provide an evaluation. Either a bit of altruism or a sliver of discounting is sufficient to make player 1 prefer to read in the first round rather than the second, for an expected payoff of 10. Thus, (R,W) is the unique Nash Equilibrium, producing a payoff of (10,5) compared to the larger social payoff of (20, 1) when player 2 reads first. Case (b) demonstrates the failure of the Nash Equilibrium to generate the optimal order of message reading.

In (c), both players are willing to read immediately, and their payoffs are symmetric. The social optimum is for one to read and the other to wait. If the players could coordinate their actions, they might flip a coin to decide which should read, thereby giving the other the benefits of waiting. Without any coordinating mechanism, however, they are likely to engage in a costly game of waiting, not unlike a game of chicken, hoping to be the last to decide in order to gain information provided by the other's action. The inclusion of a discount factor δ illustrates these incentive problems.

The unique symmetric equilibrium calls for each player to read immediately with probability $\frac{1-\delta}{5\delta}$. As δ approaches 1, the probability that either player will immediately read the message vanishes. For both players, it is worse to wait a period, yet that is the most likely outcome. The costs of the waiting game are represented by equilibrium payoffs of 1 for each, the same payoff as derived from reading immediately. In equilibrium, attempts to claim the surplus dissipate it.

Trade-offs in Compensation Schemes

Evaluations as a potential public good: distribution is essentially costless and the use of an evaluation by one person does not reduce its value to anyone else. Provisioning of public goods is problematic for several reasons, most notably because of the free rider problem: people don't pay their "fair share" because they hope that others will purchase the good and share it. An ideal compensation system would generate the socially optimal number of evaluations and satisfy these three criteria: same action same price (SASP), budget balance, and voluntary participation. Budget balance and voluntary participation are widely accepted goals in the design of allocation mechanisms. Budget balance means that the amount collected from some players equals the amount paid out. Voluntary participation requires that no individual would rather drop out of the game than participate.

The remaining condition, we believe, is new to theory, though it is widely invoked in practice and is a natural consequence of market-allocation processes. We label it "same action same price," or SASP. It requires that individuals engaging in the same action receive the same compensation, and that any offer made to one individual be offered to all. Normal markets, where pricing does not depend on the identity of the customer, follow the SASP constraint. A wealthy person who would willingly pay $10 for a gallon of fresh milk if prices rose that high, still pays only $2 at the store, the same price as an impoverished mother of four. In fact, we often feel vaguely cheated when a producer manages to price discriminate. For example, air travelers who pay the full fare for seats equivalent to those occupied by super-saver passengers may be resentful. In essence, SASP is a no-envy condition far removed from its usual fair division context (Crawford & Sobel, 1982; Glazer&Ma, 1989; Varian, 1974). SASP is highly relevant to traditional public goods financed through taxation; similarly-situated citizens are taxed the same amount, independent of their preferences.

Unfortunately, it is not possible to achieve all three conditions as well as efficient allocation, even if everyone's value of waiting for evaluations is public knowledge (Avery, Resnick, & Zeckhauser, 1994b). The proof is by counterexample. Two individuals, A and B, value a public good by the amounts 3 and 5 respectively. The cost of provision is 7. It is efficient to buy the good, since the total payoff, 8, is more than the cost. To secure voluntary participation, A can be charged no more than 3. SASP requires B to pay the same amount as A. Thus the most that can be raised is 6. To purchase the good at a cost of 7, the budget must be unbalanced.

Our difficulty is neither the free-rider problem nor asymmetric information; the problem arises because beneficiaries have different valuations. Even if all agents were willing to contribute their true values, thereby obviating the free-rider problem, the combination of SASP and voluntary participation limits them to paying the minimum value of any participant. Some degree of price discrimination among them is required to raise sufficient funds to pay for the public good.

If everyone's preferences are public knowledge, it is possible to achieve efficient allocation along with any two of the three desired properties. Which of the three conditions can be most readily sacrificed?

Consider, first, relaxing the voluntary participation constraint. Suppose an allocation scheme could force some people to read and provide evaluations for less compensation than their actual cost of doing the work. If everyone who uses the evaluations pays an equal share of the total compensation payments, budget balance and SASP would be maintained. Even if forced participation were palatable from a policy perspective, it would not work without a mechanism to ensure that the people assigned to evaluate give their best effort. As a form of resistance to such coercion, people might provide random or even deliberately misleading evaluations.

Next consider relaxing the budget balance constraint. If a central broker can charge less than it pays, it can charge each person who consumes evaluations the minimum value that the evaluations provide to any one of them, yet pay each evaluator the actual cost of providing the evaluation. The amount disbursed is likely to exceed the amount collected, creating a deficit.

One way to finance the broker's deficits is through dues that pay for one's participation in the evaluation of a large number of messages. Thus, a membership organization could collect dues and spend them by running a budget deficit on individual evaluation purchases.[4] Unfortunately, someone who expects to benefit by less than the dues would refuse to join such an organization, and would be denied access to the evaluations that the organization finances. Any system that does not share every evaluation with everyone who can benefit from it -- and no break-even system with SASP and voluntary participation can assure this -- is inefficient.

Another deficit financing strategy is government subsidy, an option that finances public goods such as roads and the military. However, government funding of evaluation provision would violate the voluntary participation provision, since it would compel all taxpayers to pay for the service, even though many are unlikely to benefit from it. In any case, the government is not likely to finance evaluations of bulletin board messages, though it does subsidize other informational efforts intended to improve the functioning of markets, such as the Securities and Exchange Commission.

Third, consider relaxing the SASP constraint. In this case, the central broker can charge each user of evaluations his or her full value for consumption, which would raise more than enough money to pay the evaluators. In order to balance the budget, the broker can evenly disburse the surplus among all the participants. Note that this scheme involves price discrimination among people who consume the same number of evaluations: the people who gain more utility from the evaluations pay more for them.

---

[4]Economists would label this two-part pricing, with the dues being a fixed cost that enables individual items to be priced closer to marginal cost.

The allocation problem becomes much more difficult when individuals' preferences are not public knowledge at the outset, and may be reported strategically. Strategic reporting can take many forms; one person might report too high a cost of evaluating in order to get paid more when it is efficient for him to evaluate early, and a second person might report too low a benefit from evaluations in order to free-ride on the willingness of others to pay the early evaluators.

Several mechanisms could determine the correct set of evaluators, even when preferences are unknown and people can report them strategically (Avery et al., 1994b). The difficulty is that two of our desirable properties must be sacrificed. For example, Groves-Clarke levies (Clarke, 1971; Groves, 1973), which in essence charge each individual the cost his participation imposes on the rest of the players, can achieve voluntary participation and induce honest reporting, at the cost of sacrificing both budget balance and SASP.

If there is some initial stage when people agree about the probability distributions of each others' preferences, and can contract before finding out their own preferences, then they can use an expected-externality mechanism (Pratt & Zeckhauser, 1987), which charges each individual the cost his participation will on average (though not in any particular instance) impose on the rest of the participants. Honest reporting and budget balance can be met, but only a weaker (ex ante) form of voluntary participation is secured and SASP is lost.[5]

When preferences are not public, which we expect to be the norm, any efficient system must give up SASP and either budget balance or voluntary participation. Given the theoretical limitations on even the most sophisticated possible system, even when there are no practical problems such as transmitting information or computing prices, achieving a reasonably effective exchange of material on the information superhighway will take all the help we can get. Objective, impartial electronic brokers have an important role to play.

Integration, Competition, and Fees

The degree to which brokerage services should be vertically integrated with information provision is a policy concern. Telecommunications policy generally distinguishes between and often separates information provision and carriage. For example, after the AT&T breakup, the Baby Bells (information carriers) were not initially permitted to

---

[5] A weaker relative of SASP, in which bids are considered actions, is met by both Groves-Clarke and expected externalities approaches. Individuals who report the same preferences and take the same actions face the same price.

provide information services such as pay-per-call stock quotes.[6] The separation of provision and carriage allows competition and innovation in one realm to proceed independent of developments in the other realm.

Vertical integration of two services may be desirable for either of two reasons: 1) To reduce productions costs when there are technological economies returning to integration, and 2) To reduce deadweight losses when each of the two services operating in isolation would be monopolized or cartelized. (Two separate stages of monopolistic pricing -- producing what is called double marginalization -- generate higher deadweight losses than a single overall stage.[7])

The principal argument against integration is that market power at one stage will be transmitted to the other. Years ago, for example, DeBeers exploited its control over

---

[6]By the same reasoning, AT&T, as a long-distance carrier was prohibited from providing local telephone service. The vertical integration argument is also at the center of current cable debates. Should cable services operate merely as a common carrier, or should they also create and buy programs?

[7] Consider one monopolist who sells to another, who then sells to a market. If the first raises its price, this reduces the profits of the second, and vice versa. But since the separate monopolists do not take into account these reductions, the ultimate price is greater than it would be if they integrated vertically. The additional deadweight loss due to double marginalization may occur in the form of lower quality, not just lower quantity and higher cost (Economides, 1994).

diamond production to exert control of the distribution network, leading to greater total efficiency loss than if it merely controlled production.[8]

Given the miracles of electronic exchange, there do not appear to be substantial economies of vertical integration between information provision and brokering. Therefore, the argument for and against permitting integration must involve a tradeoff between double marginalization concerns and the undesirable extension of market power from one stage to the other. How market power will evolve in information provision and brokering is difficult to predict. Nevertheless, we consider it unlikely that substantial market power will develop at both stages, hence our concern with double marginalization is not great. The possibility of market power at just one stage is considerably greater, with the unfortunate possibility of additional efficiency loss when it is transferred to the other. Moreover, if separation is required initially, and there turns out to be significant market concentration both for brokerage and for information provision, a policy move

[8] This set of issues has also arisen in an array of other arenas. For example, Microsoft has been accused of selling its operating systems at lower prices to computer manufacturers that agreed not to offer any other operating system. Government policy towards competition will be sound, we suspect, if appropriate analogies are drawn, say from the telephone or airline industries, about the success of existing methods. The market may also play a helpful role: in the computer industry in recent years, "open systems" strategies, in which downstream firms are encouraged to make complementary products, have fared better than proprietary strategies. By contrast, efforts to gain or maintain predominant control over upstream software resources have fared poorly. The disasters SONY and Matsushita have suffered in the Hollywood movie business are perhaps the best examples.

toward integration should not be difficult to achieve. The need for a policy shift in the other direction, from integration toward separation, would be harder to recognize, and implementing such a shift would be more disruptive.

Based on this analysis, we recommend that the provision of information should initially be separated from the value-added services that a broker might provide, such as matching providers and consumers, or conducting auctions to determine prices. For example, in a future where consumers can watch videos on demand, a brokering service might keep track of a consumer's preferences in order to suggest a video to watch. A second company would actually send movies to the consumer's home, with transmission provided by yet a third company. The services would appear integrated to consumers, just as today one is not necessarily aware of all the telephone companies that participate in each phone call. The underlying separation, however, would encourage innovation in all services and prevent biases from creeping into the suggestion service, as might well happen if the suggestion service were owned by, say, Disney[9].

---

[9] Similarly, information carriage could be broken into two pieces, actual carriage and value-added brokering services. For example, if accounting and bill collection were separate from carriage, consumers would likely have the choice of telephone bills with calls itemized at a somewhat higher charge than un-itemized bills, and an even wider array of pricing packages than is currently available. Other brokerage services might identify the cheapest carrier for a particular phone call or even for a single data packet. Brokering of information carriage, however, is beyond the scope of this paper.

There are technical barriers to the separation of brokering and information provision. The software run by brokers and information providers must work together. For example, the broker needs to know what information is available from each provider, and on what terms. If many independent vendors write software for brokers and information providers, the software must conform to compatibility specifications.[10]

A simple but important corollary of the argument for separation is that brokers should be permitted to charge fees, even if the information providers may not or do not. Much of the information now exchanged on the Internet is provided free of charge and a spirit of altruism pervades the Internet community. At first blush, it seems unfair that a broker should make a profit by identifying information that is available for free, and some Internet user groups would likely agitate for policies to prevent for-profit brokering. But so long as the use of the brokering service is voluntary, it helps some information seekers without hurting any others. Anyone who does not wish to pay can still find the same information through other means, at no charge.

With brokerage services, there is a tension between the advantages of competition and those of monopoly provision. First, a competitive market with many brokers will permit the easy introduction of new innovations and the rapid spread of useful ones. Because of

---

[10] Technical standards must be set with great care. Once a system is in place with even a moderate number of users, there can be considerable technological inertia. An outmoded interface in current use may win out over a much better one just being introduced since it will be very costly for users to switch to the new interface without the guarantee that others will be switching as well.

the rapid spread, however, the original innovator may gain little market advantage and so may have little reason to innovate in the first place. Patents or other methods of ensuring a period of exclusive use for innovations may be necessary. Second, some brokering services may be a natural monopoly. For example, Better Bit Bureaus work best if all evaluations are shared freely, so competing brokering services with private collections of evaluations would be inefficient. Similarly, auction and other pricing services may be most effective if all buyers and sellers participate in the same market.[11] One solution might be for all evaluations to be collected in one place, with brokers competing to sell different ways to aggregate them. More generally, some aspects of brokering may be best organized as monopolies; others should be competitive.

Conclusion

[11] Experience with stock exchanges is instructive, although the data are unclear about the advantages and disadvantages of centralization. The New York Stock Exchange long argued for its monopoly on the theory that gathering all bids and asks in one place provided for the most liquid market. Parallel markets, however, are now well established, and are often quite innovative.

In the pure information exchange realm, there are now services that enable employers to compare medical costs against those of other employers on the system, standardized by such factors as age and occupation. The more employers on a single system, the richer and more informative will be the comparison data. The virtue of aggregating information provides one argument for a natural monopoly, assuming data would not be readily exchanged between services.

The information superhighway brings together millions of individuals who could exchange information with one another. Any conception of a traditional market for making beneficial exchanges, such as an agricultural market or trading pit, or any system where individuals respond to posted prices on a computer screen is woefully inadequate for the extremely large number of often complex trades that will be required.

Electronic brokers will be required to permit even reasonably efficient levels and patterns of exchanges. Their ability to handle complex, albeit mechanical, transactions, to process millions of bits of information per second, and to act in a demonstrably even-handed fashion will be critical as this information market develops. Electronic brokers can also run pricing systems, charging and crediting slight amounts to individual accounts as bits careen along the superhighway.

Such power does not come without dangers. Might privacy be hijacked by tomorrow's equivalent of the computer hacker, or sacrificed merely by providing anonymous but extensive statistical data? Can we be confident that we can avoid groupthink or censorship concerns? We must find electronic brokerage mechanisms that address these questions satisfactorily, for without brokers we will be stymied in our ability to use the information superhighway effectively.

References

Andrews, E. L. (1993, July 18). A Chip That Allows Parents to Censor TV Sex and Violence. New York Times, p. 14.

Avery, C., Resnick, P., & Zeckhauser, R. (1994a). The Market for Evaluations. In preparation.

Avery, C., Resnick, P., & Zeckhauser, R. (1994b). Price Discrimination and the Provision of Public Goods. In preparation.

Brynjolfsson, E., & Resnick, P. (1993, December 2). Electronic Solution, Letter to the Editor. New York Times, p. A14.

Clarke, E. (1971). Multipart Pricing of Public Goods. Public Choice, 11, 17-33.

Crawford, V., & Sobel, J. (1982). Strategic Information Transmission. Econometrica, 50, 1431-1452.

Economides, N. (1994). Quality Choice and Vertical Integration. Report EC-94-22. Stern School of Business, NYU.

Glazer, J., & Ma, C. (1989). Efficient Allocation of a Prize-- King Solomon's Dilemma. Games and Economic Behavior, 1, 222-233.

Goldberg, D., Nichols, D., Oki, B. M., & Terry, D. (1992). Using Collaborative Filtering to Weave an Information Tapestry. Communications of the ACM, 35(12), 61-70.

Groves, T. (1973). Incentives in Teams. Econometrica, 41, 617-631.

Hill, W., Stead, L., & Rosenstein, M. (1995). Recommending and Evaluating Choices in a Virtual Community of Use. In CHI 95: Conference on Human Factors in Computing Systems, (To appear). Denver: ACM.

Malone, T. W., Grant, K. R., Turbak, F. A., Brobst, S. A., & Cohen, M. D. (1987). Intelligent Information Sharing Systems. Communications of the ACM, 30(5), 390-402.

Maltz, D. A. (1994). Distributing Information for Collaborative Filtering on Usenet Net News. Report TR-603. MIT Laboratory for Computer Science.

Myerson, R., & Satterthwaite, M. (1983). Efficient Mechanisms for Bilateral Trade. Journal of Economic Theory, 28, 265-281.

Nichols, P. M. (1994, August 26). Home Video: What to Rent? Ask a Jury of Your Peers. New York Times, p. D15.

Pratt, J., & Zeckhauser, R. (1987). Incentive-based Decentralization: Expected-Externality Payment Induced Efficient Behavior in Groups. In G. R. Feiwel (Eds.), Arrow and the Ascent of Modern Economic Theory (pp. 439-483). New York: New York University Press.

Resnick, P., Iacovou, N., Suchak, M., Bergstrom, P., & Riedl, J. (1994). GroupLens: An Open Architecture for Collaborative Filtering of Netnews. In CSCW 94: Conference on Computer Supported Cooperative Work, (pp. 175-186). ACM.

Shardanand, U., & Maes, P. (1995). Social Information Filtering: Algorithms for Automating "Word of Mouth". In CHI 95: Conference of Human Factors in Computing Systems, (To appear). Denver: ACM.

Varian, H. (1974). Equity, Envy, and Efficiency. Journal of Economic Theory, 9, 63-91.