Information intermediaries and optimal information distribution

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Ryan Womack

Kilmer Library, Rutgers, The State University of New Jersey, Piscataway, New Jersey 08854, USA, E-mail address: rwomack@rci.rutgers.edu

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Abstract

Information intermediaries collect, organize, and distribute information to their clients. Three institutional forms of information intermediary--the for-profit firm, the nonprofit organization, and the government agency--are examined. Using results from the economics and information science literature, five tests are proposed that characterize particular information markets. For a given information market, these characteristics determine the institutional form of information intermediary that will maximize the total social and private benefit from information consumption. While many kinds of information can be effectively delivered by for-profit information intermediaries, socially beneficial information often requires subsidized provision from government or nonprofit intermediaries in order to encourage consumption up to socially optimal levels. Applications to current topics in information distribution are discussed.

Introduction

Until the rise of electronic networks, information was distributed to its consumers by a familiar and relatively stable system. Publishers gathered author's individual contributions, edited and marketed them; information consumers purchased discrete bundles of information in the form of periodicals and monographs; libraries amassed large collections of published material for the communities they served; and individuals circulated materials among themselves via informal information sharing networks. The roles and responsibilities of each of the parties were well understood and defined.

Electronic networks such as the Internet are rapidly altering this landscape, causing many

changes, including the following examples. Periodicals are quickly moving to electronic distribution. Commercial firms such as Questia have digitized monographs and offering the promise of large, but homogeneous, repositories of information open to anyone willing to pay the subscription fee. Individuals are posting information on the Internet without the aid of publishers, either on personal sites or at information portals that collect material on a particular topic. Libraries often now rent access to information collections, or sometimes produce their own information, instead of buying materials outright. In the midst of this change, traditional print methods of information distribution continue to function alongside newer methods.

Much debate has ensued on the transition--or conflict, depending on one's point of view--between print and electronic information. The boundaries between authors, publishers, libraries, and information consumers are being blurred as each group stakes out new territory in the electronic information landscape. This article attempts a fresh perspective on this issue. Rather than focusing on the characteristics of print versus electronic information, or examining how the traditional roles of authors, publishers, and libraries extend into the electronic domain, an analysis of the economics of information distribution is used to provide guidance as to the optimal form that entities engaged in information distribution should take. This article refers to these entities as *information intermediaries*. The characteristics of the information being delivered will be seen to determine the socially optimal form of the information intermediary. This approach provides a general foundation for analyzing the information landscape that does not depend on assumptions about existing information institutions. The results of this analysis can be used to predict which forms of information intermediary will best serve which information markets.

The article begins with a review of relevant facts from the literature on the economics of information. The value of information and information's unique characteristics as an economic good are examined. Then the information intermediary is defined and the institutional forms it may take are described. Next, five tests are proposed that can be applied to the information to be delivered by the intermediary. The next sections apply these tests to particular information markets and outline the socially optimal institutional form of information intermediary in each case. Some applications of the theory to particular questions are then outlined, such as whether a commercial firm such as Questia can effectively serve as a substitute for library services. The conclusion reviews the theory presented and suggests directions for future research.

Some economic characteristics of information

The term information has been used in many senses in the scholarly literature. While various authors have proposed different definitions of information (Dertouzos, 1997; Levitan, 1982; Losee, 1997; Marschak, 1968; Rose, 1999), this article treats information pragmatically as a message that has some value to human desires and needs. Information is assumed to be demanded by its final consumers. The question then becomes which mechanisms of information delivery will yield the most nearly optimal results for the final consumer and for society.

Within both the economics and library and information science literature, the paradoxical nature of information as an economic good has long been recognized (Boulding, 1966; Hall, 1981; Hegenbart, 1998; Lamberton, 1998). Unlike physical commodities such as steel or wheat, information's value is hard to measure and analyze, which makes it difficult for information providers to optimize the flow of information (Flowerdew & Whitehead, 1975). Information's

value cannot be known in advance of its consumption: it is an experience good. Information's value can change over time in unpredictable ways; what was once useful as current news becomes useful in a different way when used by a historian. Despite this, Varian (1998) notes that "information, that slippery and strange economic good, is, in fact, handled very well by market institutions" (p. 3). Information is bought and sold constantly in economic markets and exchanged outside of market institutions as well. This article will not attempt to define information's value, but will focus on the information intermediary's role in transforming the value of information.

Moshowitz (1992) identifies five major areas in which value inheres in information commodities. These are (1) the kernel, the information itself, (2) storage, (3) processing, or transformation of the kernel, (4) distribution, and (5) presentation. An information intermediary can affect the value of information in any of the last four aspects through collecting, archiving, organizing, and otherwise enhancing the ease of use of the information.

Information behaves as a public good insofar as it is not "lost or consumed by being used or being transmitted to others; it can be resold or given away with no diminuition of its content". Information behaves as a private good insofar as there is value associated with exclusive or better knowledge than one's competitors, who can be excluded from access to the information (Hayes, 1997, p. 120).

Unlike in a purely competitive market, the information production of a firm and the information consumption of an individual are not independent of the choices made by other firms and individuals. Dertouzos (1997) points out that highly customized information is likely to have little value to those other than its intended recipient. On the other hand, the more abstract and

codified information becomes, the more value it has to a wide audience. While this increases the total value to society of the information, it also makes copying and appropriation easier, and thus it becomes more difficult to secure economic returns for the producer of the information (Boisot, 1998). For these reasons, it is generally accepted that information of general value and applicability has a higher social return than private return. Arrow (1962) demonstrated that a commodity that cannot be made into private property cannot be efficiently provided for through market competition. For example, basic scientific research is a form of highly abstract and codified information that is easily usable by a wide audience and is difficult for a private producer to capture all of the benefits from. Thus, there is general agreement that scientific research should be publicly funded and made publicly available. Grossman and Stiglitz (1980) demonstrated that private knowledge is vulnerable to market failures if the knowledge can be deduced by others from the actions of those that use it. This characteristic of information puts an upper bound on the degree to which valuable information can be privatized. Also, the legal and social infrastructure of a society affects the public/private balance of information through copyright and patent enforcement, and other mechanisms.

The production of information is expandable and self-generating; information is required to generate information (Levitan, 1982). For this reason, existing holders of information may be able to achieve large economies of scale in producing new information. Also, the cost of information is nearly independent of the scale of its application. Information can be replicated at low to zero marginal cost, allowing information producers to easily maintain natural monopolies over their information domain. A second producer of information of a particular type is often superfluous. When producers have monopoly power, the standard economic requirement for efficient markets--that all firms be price takers in a competitive environment--is violated. Partly

for these reasons, "markets for information goods which are costly and infrequently purchased ... will suffer the greatest distortion from asymmetrical information" (Hall, 1981, p. 157). Since information can alter the production process and transform its receiver, power relations also enter into information dynamics (Babe, 1995).

Halliday (1991, p. 330) argues that "the analysis of information as economic commodity suggests there are two types of information which will be vulnerable in a free market system: that which is highly valuable to only a small and therefore economically powerless group; and that which is valuable to those who are least able to pay." For costly and infrequently purchased information goods, non-market solutions for information production and distribution may be appropriate. According to Keppler (1998), public goods can be viewed as goods for which information complexity is too high for firms and individuals to establish normal competitive markets. Non-market institutions in this case may play a role in ``making markets" for information.

For these reasons, information whose production generates a social return that is greater than its private return has some of the characteristics of a public good and should be publicly financed (Spar, 1999; Stiglitz, 1999). Baumol and Ordover (1976) make the interesting observation that a public good can be any commodity of whose costs a high proportion are fixed. They view information transfer as a special case of financing of goods whose production involves scale economies. These arguments will be extended to the case of information intermediaries.

Within the library community, the debate over charging to cover the costs of library services, the "fee-or-free" controversy, generated a number of studies and reviews that discuss the economics of libraries and whether the information services provided by libraries can be considered public

goods (Abend & McClure, 1999; Braman, 1995; Kingma, 1996; Koenig; 1995; Ordover & Willig, 1978; Repo, 1989; Van House, 1984; Young, 1994). McCain (1988) emphasizes the importance of transactions costs and property rights in information, arguing that public libraries, even if they are not pure public goods, may be justified due to the high transactions costs of registering and billing all potential users of the service. In this sense, libraries behave as a club that chooses not to restrict entrance to its services by charging fees.

The peculiar properties of information will be seen to have an impact on the optimal forms of information distribution. It is important, however, to clearly separate the analysis of information production and information distribution, which operate under very different cost and incentive structures (Demsetz, 1969). Chodorow and Lyman (1998) point out the division between information production and distribution in the academic environment. Production operates as a gift economy among scholars, while publishing operates as a market economy. Most notably, in scholarly publishing, commercial publishers have exploited the gap between these two economies to deliver extraordinary profits and price increases.This article will focus closely on the issues involved in information distribution. However, many of the arguments described above will apply, in modified form, to the case of information intermediaries.

Information intermediaries

While Rose (1999,) focuses on profit-making information intermediaries, his definition is useful:

> An information intermediary is an independent, profit maximizing economic information processing system performing its activities (information acquisition, processing, and dissemination) on behalf of other agents' information needs. (p. 79)

This article adopts the definition proposed by Rose, without requiring that information intermediaries be profit maximizing. Thus an *information intermediary* can be viewed as any system that mediates between the producers and consumers of information. The information in question could be formally published by a publisher, distributed by a governmental or non-governmental agency, generated by an automated computer system, created as a single item by a single author, or generated using any other method of production. The information intermediary's function is to collect the information and disseminate it to its defined audience. The audience could be the employees of a corporation, the faculty and students of a university, everyone with an interest in a particular topic, all primary school children, residents of a particular community, or any other defined group. The audience that a particular information intermediary serves will be referred to as the *client group* . Individual members of that group will be referred to as *clients.* The intermediary will select and organize information according to the needs of its client group, and distribute information and set access fees in a manner that is determined by the client group, subject to the intermediary's organizational form. Levitan (1982) cites many examples of information resources that meet the proposed definition of an information intermediary, including libraries, professional societies, corporations, archives, government agencies, computer networks, publishers, individuals, organizations, and advertising companies.

Intermediaries and information distribution

The client always has the option of collecting information from primary producers, whether via an Internet search, a request to the author for a copy of a paper, a telephone call to a government agency, purchase from the publisher, or other means. Therefore, the intermediary must provide some added value in order for the client to choose the intermediary's services. This value can be

in the form of higher quality information, more complete information, more easily accessible information, better organized information, cheaper information, or a number of other factors (Glazer, 1998).

Evaluations, collaborative filtering, and selection by experts are other mechanisms for organizing information according to its quality and appropriateness to the client (Avery, Resnick & Zeckhauser, 1999; Heckart, 1999; Rudner, 2000). In the context of scholarly communication, Meyer (1997) notes that scholars receive value for four things from their journal contributions: (1) communication to peers, (2) archiving, (3) filtering into levels of quality, and (4) segmenting into discipline groupings. Journal publishers, in this example, are the information intermediary providing added value.

Once information has been collected and organized by the information intermediary, it costs very little to redistribute. The marginal cost of the information itself is zero, and the costs of physical distribution are very small, and tend to decrease as electronic networks and new modes of communication become available. However, the time and attention of clients remain fixed and scarce. The cost of information distribution can be viewed as the opportunity cost of time for the client group plus the cost of distribution. Most of the information intermediary's costs will be fixed: the costs of gathering the information and organizing the information are usually independent of the number of clients. Of course, the intermediary will select the quantity, quality, and the level of organization of information as a function of the client group's needs.

The intermediary also has the opportunity to exploit economies of scale in information gathering and organization. Just as one producer of a particular kind of information can meet the demand of the entire market, it is also possible for a single intermediary to meet the information needs of

an entire client group. This can lead to a winner-take-all situation where the intermediary that provides the highest value to its clients ends up serving the entire market. Industries with large fixed costs have monopolistic tendencies that must often be counteracted by non-market interventions.

Intermediaries may also achieve economies of scale by bundling information goods together. A single journal or a single newspaper article is of highly unpredictable interest to a single client. Either the client is interested, or not interested at all, and it is difficult to know in advance how much value the client would assign to the information. However a collection of journals or an entire newspaper is of more predictable value. The client has a more stable expectation of the value of a collection of information on a particular topic. Bakos and Brynjolfson (1999) demonstrate that bundling is profitable for publishers, but the same arguments apply to an information intermediary developing a menu of information offerings from a variety of information producers. It becomes easier to assess the average consumer's valuation and price services appropriately when there are a large number of goods. Newspapers and journal aggregators such as ProQuest or EBSCO use this strategy to generate their information products. Chuang and Sirbu (1999) develop a model in which mixed bundling is an optimal strategy for publishers. The publishers can attract the occasional interested user with individual articles, but sell an entire journal to customers with sufficient interest in the bundle of articles. The intermediary's ability to offer different groupings of information to different clients is another way to add value to the intermediary's collection of information.

Just as information producers develop a reputation for producing a particular type and quality of information, so too can information intermediaries develop a ``brand'' that summarizes the kinds

and quality of information services they offer. Since information is an experience good, such reputation effects are an important time-saving and risk-reducing signal to information consumers that the ``brand'' of information service they plan to use will deliver the results they expect. Information intermediaries have many opportunities to add value to the ``raw'' information products of information producers.

The clients' use of information will depend a great deal on the information environment created for them by producers and intermediaries. Clients will seek the most easily available and least costly information they can find. Gazzale and MacKie-Mason (2000) and Bonn et. al. (1999) show that additional marginal costs of information greatly reduce the likelihood of consumption. Higher monetary and non-pecuniary costs (including the time spent in getting a password and registering for access) greatly suppressed usage of electronic journals in a scholarly context in the PEAK experiment. Information intermediaries must design their services with the knowledge that their structure will have a large impact on their clients' patterns of information consumption.

The institutional form of information intermediaries

Until now information intermediaries have been treated as a homogeneous category. However, intermediaries can take a number of forms. There are many aspects of the intermediary that might be interesting to examine, such as the size of the intermediary, its degree of specialization, its level of centralization, the degree of control it exercises over the information it provides, its pricing and distribution structure (Varian, 1998), and many others (Shapiro & Varian, 1998). However, this article focuses on one aspect that greatly affects the intermediary's incentives: its institutional form. Following Weisbrod (1988), this article will study three major institutional

forms: the for-profit firm, the nonprofit organization, and the governmental agency. Due to their differing incentives, each of these forms will tend to produce information intermediaries best suited to different kinds of client groups and information markets.

The for-profit firm attempts to maximize its revenues less its costs so that it can distribute any surplus to its shareholders. It has a powerful incentive to operate efficiently and minimize its costs. It also has a powerful incentive to maximize its revenue by charging as much as the market will bear for its services. It will tend not to serve clients with little to no ability to pay for its services. Competition ensures that the for-profit will react quickly to change or face extinction. In a fully competitive market for a normal economic good without public good characteristics, the prices the firm is able to charge will be restrained by competition with other firms, and the cost reduction and innovation of the for-profit firm will normally produce more benefit for the consumer than alternative institutional forms (Easley & O'Hara, 1986, p. 88). Some examples of for-profit information intermediaries include electronic document collections such as Questia or ProQuest, information services such as Bloomberg, consultants offering customized information to clients, video rental stores, and publishers to the extent that they deliver information directly to client groups.

The nonprofit organization has a self-defined institutional goal, which in the information intermediary's case would include a definition of its client group, along with possibly restrictive criteria on the means appropriate to reach the goal. A nonprofit is prohibited from distributing excess monetary gains to its managers, directors, and funders. Excess revenues must be returned or plowed back into the nonprofit's operations. The nonprofit therefore tends to maximize the services it provides, subject only to the constraint that its revenues meet the costs of operation in

the long run (James & Rose-Ackerman, 1986, pp. 91-92). If the nonprofit has a secure source of funding, it has more freedom to focus exclusively on meeting its goal while losing some of its incentive to minimize cost and adapt to changing environments. One danger is that the nonprofit/public institution may be insufficiently responsive to its clientele, since it does not face bankruptcy from a loss of customers (Halliday, 1991). However, competition among several nonprofits for clients and donors will increase the responsiveness of the nonprofit organization. If the nonprofit does not have a secure source of funding, it must adapt its goal to attract paying clients and donors. While the nonprofit in this case faces pressures to be efficient and change more rapidly, it may adapt to serve the needs of its donors rather than the needs of its clients. The nonprofit can also face competition from for-profit and governmental service providers.

The nonprofit is a more trustworthy provider of service when information asymmetries are large (Weisbrod, 1989). Divorcing rewards from performance ensures that managers of the organization do not reduce service in order to enhance profits, which is especially important in the case of information whose quality is not easily observable (Hansmann, 1980). With information goods, adulteration of this type may be difficult to detect in the short term. The constraints on nonprofit activites also attract donors, who have a greater certainty that their money will be spent to further the goals of the organization. Some examples of nonprofit information intermediaries include academic libraries, scholarly and professional societies, most museums, and issue-oriented nonprofit organizations to the extent that they serve as centers of information dissemination for their cause. For a general review of the literature on nonprofits, see Rose-Ackerman (1996).

Governments--whether local, regional, or national--can also act as information intermediaries,

usually through the creation of agencies and organizations to disseminate information. The governmental agency is likely to face little direct competition from other intermediaries. In many cases, competition may be legally barred. The agency faces primarly political constraints on its survival; the agency's services must be viewed as desirable by a majority of the government's constituency. When preferences are homogeneous and economies of scale are large, governments may serve as an effective single provider of information services. If preferences are heterogeneous, government services are likely to be supplemented by the services of nonprofit and for-profits serving different segments of the information market (Weisbrod, 1975). The political constituency that ultimately determines the governmental agency's services is likely to differ from the paying clientele that determines a for-profit's services, or the client/donor group that guides the nonprofit's services. As approval of the service rises, pressures for cost reduction and innovation will diminish. Services that would benefit only a minority of the constituency are likely to be underprovided. While governments are uniquely positioned to deliver information with large economies of scale that would benefit broadly based client groups, governments may also lack sufficient information about their clients to effectively provide services, since normal market choice mechanisms for feedback may be lacking. Costly monitoring and regulation may be necessary to ensure a given quality and quantity of service.

Governments also have the ability to tax, subsidize, and regulate in order to achieve goals. At times, regulation or subsidy of for-profit and nonprofit intermediaries may be preferable to having the government operate an information intermediary (Krashinsky, 1986). Governments may mandate information disclosure and set reporting standards without serving directly as an intermediary. Some examples of governmental information intermediaries include the Bureau of the Census, the National Weather Service, public libraries, national libraries, and any

government agency to the extent that it distributes information on its activities and the information it gathers. Government regulation plays a major role in the dissemination of financial information. By offering tax credits for educational and professional learning expenses, or discounted mailing rates for printed matter, government also subsidizes information consumption.

The three institutional forms should be used in different information markets to create the most nearly optimal mechanisms for information distribution. Appropriate institutional forms for information intermediaries are one such mechanism to ensure the efficient use of information.

Five tests

The institutional form that maximizes social welfare will be the most beneficial form to use in each situation. Social welfare is normally defined as the sum of all individuals' benefits in the society, less costs. By consuming information, the individual consumer benefits by the amount their personal valuation of the information, or willingness to pay, exceeds the cost of the information in money and time. The for-profit information intermediary's profits are also a benefit since these are ultimately passed back to the shareholders of the firm. If the information consumed by an individual is used to generate socially useful results, the societal gain from these results is not normally accounted for financially, but should be included in the social welfare calculation.

There are five key questions that must be asked about the information delivered by the information intermediary that will determine which institutional form is optimal:

- *Is the information of primarily private or of primarily social benefit?* If others in society benefit from a client's use of the information, the cost, in time and money, of accessing the information must be subsidized in order to align the client's incentives to consume the information with the total social benefit from its consumption. As shown earlier, information use is extremely sensitive to the information's cost and convenience. Low private valuations may greatly suppress the amount of socially beneficial information that is consumed. Also, if the intermediary packages information in a way that has value only to one client, transferring the information to others has little value. This is likely to be associated with information of primarily private benefit, such as a financial adviser's customized report on a client's stock portfolio. If the intermediary packages information in a way that is easily appropriable by other consumers, the intermediary creates social benefit, but may have difficulty in recouping its costs from all potential users of the information. This is likely to be associated with information of high social benefit. Examples could include an academic researcher accessing an organized and coherent body of scholarly literature, leading to future research of high social benefit. Another example would be publicly accessible information on current government legislation that results in a more informed citizenry and electoral choices that better reflect the public's preferences.

Another way to view this test is whether or not the client can fully realize all of the gains from the information consumed. The gains from accurate financial information on a company's worthiness as an investment are likely to be fully appropriable by an informed trader who consumes the information, while information used to produce scientific research of value to future generations is likely to net the researcher only a small percentage of the total value created by her use of the information.

- *Is the information transparent or opaque?* As stated earlier, it is difficult to predict the value of information before it is consumed. However, if the intermediary offers information that is easily sampled, repeatedly used, and whose value is easily tested once acquired, it can be said to offer relatively *transparent* information. If the intermediary offers information whose value cannot be determined in the short-term, or offers information that is infrequently used or difficult to sample, it becomes much more difficult to accurately predict the value of future information offered by the intermediary. Information of this type will be referred to as *opaque*. Examples of transparent information include the daily news, short-term weather forecasts, or reviews of easily consumed products. Their value and accuracy is known soon after the consumption of the information. Repeat usage ensures that intermediaries who do not serve their client's needs will soon lack for clients. Examples of opaque information include educational information or information requiring specialized knowledge to comprehend, such as legal information. In the case of general education, the consumer often does not know the value of the information imparted for many years after its delivery and has little ability to accurately sample the information for its quality. If the client does not have the specialized knowledge to evaluate the intermediary's offerings, the client must rely on the intermediary's guarantee of its quality. In this case, there is a greater need for external reputation and certification mechanisms to ensure that the information delivered is accurate and appropriate.

- *Is the information provided by many intermediaries or few?* A choice of information intermediaries leads to competition among the intermediaries for clients. The client is then more likely to find an intermediary that suits its particular needs. Intermediaries have a natural tendency towards monopoly due to high fixed costs of entry. If there are few

intermediaries, some of the client's needs may not be served, and the intermediary may fail to innovate to meet new demands. The intermediary may also raise costs and reduce quality in order to earn monopoly profits. The nature of the information provided will play a major role in determining the number of intermediaries that are viable providers. If the information is difficult to collect and organize, there will be a natural tendency towards fewer intermediaries due to economies of scale and barriers to entry in the information market. Regulation is one method of counteracting monopoly power; encouragement of alternate institutional forms is another. An example of oligopolistic information intermediaries with high barriers to entry are legal information services like Westlaw and LEXIS-NEXIS. An example of a market with many information intermediaries is the market for information on stocks, where free web portals coexist with specialized and customized services offered by brokerage houses.

- *Is the information in demand by many or few?* If information is demanded only by a limited number of clients, intermediaries are likely to offer customized services to clients. Government agencies are unlikely to serve those clients who do not form a significant part of their political base. When the information is widely demanded, there is a greater potential for large economies of scale to be realized. Weather forecasts are demanded by many, and are provided by governments, which can maintain a large number of weather stations and process large volumes of information, alongside other providers who customize information according to local needs. Information on rare books is demanded by a limited and geographically scattered client group, and is provided by many specialized organizations.

- *Is the information useful to paying clients or clients who have little ability to pay?* Without

> the promise of some financial return, for-profit intermediaries will not serve a client's needs. Rose demonstrates that the for-profit information intermediary will serve those clients with medium to high abilities to pay. Stock market information intermediaries exist in large numbers partly because of the high willingness to pay for information that can lead to immediate financial return. By contrast, low income individuals may have a need for information on how to budget and save, but few intermediaries provide detailed information in this area due to the lack of paying demand. Nonprofits and government agencies are necessary to provide information services to those who do not have the ability to pay that attracts the attention of for-profit firms. Information useful to clients with little ability to pay may still have large social returns, and may require subsidies for consumption.

These tests can now be applied to determine some likely outcomes for optimal information distribution. In reality, the qualities of information defined by these tests will not be binary. Information is typically not fully transparent or fully opaque, but will have qualities that make it more or less transparent or more or less opaque. While these spectra of information qualities exist for each of the five tests, to simplify the exposition of the model, this article will limit discussion to the binary categories defined above.

For organizational purposes, the results will be discussed under the following four categories: (1) transparent information of private benefit; (2) opaque information of private benefit (3) transparent information of social benefit; and (4) opaque information of social benefit. A particular combination of the conditions outlined in the four tests above will be called an *information market*.

Transparent information of private benefit

First, consider the information intermediary that delivers information of primarily private benefit to its clients. This information is also transparent, so the client group can easily assess its quality, quantity, and value. Applying the remaining three information tests to this case leads to the following results, summarized in Table 1.

[Table 1 here]

When information is transparent and of private benefit, it behaves like an ordinary economic good. In this case, for-profit firms will be able to supply the market efficiently without introducing significant distortions, while providing significant advantages in cost reduction and rapid innovation. Governments would presumably have little interest in subsidizing intermediaries that provide only private benefits, especially when for-profits can provide the same services less expensively. Any redistributive or egalitarian goals that governments may have in ensuring access to the information would be better met through cash transfers directly to low-income clients. The same arguments apply equally to nonprofits. Even if the goal of a nonprofit is to deliver information in this category, it is likely to find that for-profit firms will deliver better results when they choose to enter the market.

If conditions allow for many for-profit firms to act as information intermediaries, competition minimizes the risk of monopoly power. When combined with many clients having the ability to pay for information, the situation comes as close to a fully competitive, free market in information as is possible. Clients will have their choice among firms striving to meet their information needs, and firms will develop a wide spectrum of information offerings to serve the

large number of clients.

When there are many clients with little ability to pay, the expenses of the intermediaries must be met through other means. Often, advertising can subsidize the intermediary. If the client group may develop the ability to pay in the future, such as students or novice users, the intermediary may subsidize access itself from other revenue streams. Without a source of funding, there will be little information provision. Nonprofits may choose to provide information services if their institutional goals include serving these clients, but no net social benefit will accrue from doing so.

With many intermediaries and few clients, the likely outcome depends on the clients' ability to pay. If the clients can pay, they will be able to demand highly customized services from the intermediaries competing for their business. An example would be customized financial advice or market research that synthesizes and extracts information from diverse sources according to the needs of the client. If the clients cannot pay, there is little likelihood of an external subsidy since there are very few clients. Unless a nonprofit serves this market with little prospect of financial return, the services provided by for-profits will be very minimal.

If few intermediaries serve the market due to high costs of entry, economies of scale, or other barriers, the situation is slightly different. When there are many paying clients, the market will be well served by for-profits provided there is sufficient antitrust regulation to prevent the firms from exercising monopoly power. Government regulation is likely to be less costly than government provision of information services. If there are many clients with little ability to pay, the same arguments about advertising subsidies made above apply, with the additional caveat that antitrust regulation must be enforced to ensure adequate competition.

However, governments are not likely to aggressively enforce antitrust regulation when there are few clients affected by the monopolistic conditions among information intermediaries. In this case, those clients with the ability to pay will have to rely on their own bargaining power with respect to the intermediaries to gain a favorable outcome. If the for-profits have too much market power, the clients may form nonprofit intermediaries to serve their own needs. The intermediaries serving the market, whether for-profit or nonprofit, will form very close relationships with their clients and may tend to evolve over time through collaboration rather than competition.

If, on the other hand, clients have little ability to pay, the market for information intermediaries may tend to disappear altogether. Information may circulate informally among clients with little organization or distribution by an intermediary.

In all of these cases, the total benefit of information consumption is maximized when markets for information operate efficiently and consumers are able to consume information up to the point their their private marginal benefit equals the marginal cost of information. Governments should intervene in the market only to ensure fair competition among information intermediaries. Since information does not have added social value, the lack of information intermediaries serving certain markets does not present a problem. Only if governments or nonprofits seek redistribution, rather than efficiency, will they intervene to provide information services to unserved clients.

Opaque information of private benefit

The next case to consider is that of opaque information of private benefit. Here, the information

delivered by the intermediary is of private benefit to its recipient, and the information is opaque in that in cannot be easily assessed by the client upon consumption. Table 2 summarizes the optimal institutional forms in this situation.

[Table 2 here]

To service its clients effectively under opaque information conditions, the information intermediary must offer strong guarantees of quality. The general guarantee that the information intermediary will offer information of sufficient quality, quantity, organization, and ease of use to meet the client's information needs is referred to as *quality assurance*. Building a reputation or brand is one mechanism that can overcome some of the consumer's uncertainty about the quality of information. Such a reputation can only be developed over time at some expense to the intermediary. There are therefore higher costs of entry in opaque information markets. The same conditions allow an established intermediary to dilute quality for some time before its reputation is affected.

If the consequences of misrepresentation of information are severe, or may lead to market failure, governments may intervene to regulate the market and ensure that certain standards are upheld. Although the information benefits only the client, some government intervention may be necessary to ensure that the market for information functions optimally, otherwise clients will underconsume information. Only governments have the capacity to uniformly regulate and require disclosure of indicators of the information's quality.

However, if the information in question is highly customized and difficult to evaluate, it may also be difficult to regulate. Professional codes of ethics and licensing provide another form of

non-governmental quality assurance that may be more appropriate for hard-to-regulate situations. Since buying a house is an uncertain process and has great repercussions for the involved parties, a mixture of regulation, licensing, and professional ethics has evolved to address the potentially severe informational imbalances between seller and buyer.

In opaque information markets, nonprofits will play a greater role as information intermediaries. Their organizational structure provides some assurance that the nonprofit will provide better service, rather than maximizing profits by substituting inferior information or otherwise cutting corners. Governments will be unlikely to assume a role as information intermediaries, since the information is of private benefit. Except in limited cases, governments should restrict their activities to regulating information markets. Governments are unlikely, however, to regulate markets with few clients. Opaque information markets are likely to lag in innovation and cost reduction when compared to transparent information markets due to increased regulation and the presence of fewer for-profit firms.

When there are many intermediaries, competition will tend to reduce the problem of assymmetric information between intermediaries and clients. When there are many clients with the ability to pay for services, for-profit firms with strong reputations will provide information services alongside nonprofits whose missions include service to these information markets. Some degree of government regulation against extreme misreprentations may be beneficial as well. When only a few clients have the ability to pay for services, they will attempt to use their bargaining power to extract guarantees of quality from the intermediaries. If they are successful, the result will be highly customized information services. If it is difficult for for-profit firms to offer sufficient quality assurance, clients may combine to sponsor nonprofit organizations that serve their

information needs. For example, the Conference Board allows businesses to share and develop information of benefit to all businesses while removing company-specific bias through its nonprofit organization.

When there are many intermediaries but clients have little ability to pay, the situation is similar to the transparent-private case. A subsidy of some sort will be necessary to ensure provision, along with more regulation than the transparent-private situation requires. If no subsidy is available and no nonprofit can serve the market, governments may choose to provide information services as an alternative to extensive regulation and subsidy of clients, if there are many clients who will benefit. If there are few, non-paying clients, for-profit firms will be unable to serve the market and governments will be uninterested in serving the market. Only if nonprofits have identified service to this select client group as their goal will information services be provided. The social benefit gained from service to this market is small. For example, several small associations of enthusiasts of a rarefied hobby, funded by a wealthy donor, might put up web pages with links to information on the hobby that would otherwise be unavailable.

With few intermediaries providing information, the arguments are similar, but with a further bias towards nonprofit provision and government regulation to counteract the effects of monopoly power among the intermediaries. With many paying clients, regulation will ordinarily suffice, but it is possible that government provision would be the preferred solution if regulation proves too complex to enforce. If there are many, non-paying clients and large economies of scale, there may be a stronger argument for direct government provision of information. Although the information is only of private benefit, government provision can prevent market failure and increase the total benefits of information consumption by ensuring that the information continues

to flow to clients.

With few clients and few intermediaries, the information market is likely to be weak. With few clients, governments will not be interested in regulating the markets. The opacity of information will cause reluctance on the part of the clients to seek the intermediaries' services. Only if there are close and long-lasting bonds of trust between the intermediary and the client will service be provided. This is of course much more likely when clients have a high ability to pay. Clients with the means may again sponsor nonprofit organizations to provide information according to their needs. If clients have little ability to pay, information intermediaries are unlikely to exist. The costs of servicing the market exceed the small private benefits that would accrue to the clients in this case.

Transparent information of social benefit

The next case is that of information whose social benefit is a significant portion of its total value. When such information is transparent, clients will be able to effectively evaluate the quality and quantity of information delivered. The peculiar nature of information as an economic good does not strongly distort the outcomes in this case.

However, the socially useful nature of the information is an important consideration. Here the distinction between information production and information distribution becomes most clear. It has been shown earlier that the production of socially useful information should be subsidized. But since information is a necessary input into the production of socially beneficial information, information consumption should also be subsidized. If the consumption of information is to be subsidized so that consumers consume up to the point that the total (social plus private) marginal

return is equal to marginal cost, consumers must face lower prices for information in the marketplace. This can be achieved through direct subsidy of information consumers or by the funding of government and nonprofit information intermediaries who provide information ``below cost'', or below the market price that a for-profit firm would set. The conditions of the particular information market in question will determine which method is most nearly optimal. According to Bates (1988), only governments and organizations concerned with issues of social welfare are likely to pay attention to the provision of information that has significant ancillary social value.

When dealing with information of social benefit, who decides how the information is to be distributed is also a factor in determing the social benefit realized (Sy, 1999). Society has a strong interest in ensuring that intermediaries distribute socially beneficial information in a socially beneficial manner. Intermediaries that distribute information in an easily appropriable and transferable form are more likely to increase social benefits. Table 3 summarizes the socially optimal institutional forms in the case of transparent information of social benefit.

[Table 3 here]

When there are many intermediaries and many clients, the transparency of the information combined with a richly competitive marketplace ensures that information intermediaries will be able to efficiently serve their clients with little intervention. However, in a totally free market, clients will underconsume the socially beneficial information; subsidies must be granted to reduce prices and increase information consumption. Note that for-profit information intermediaries cannot be subsidized directly, since they may have little incentive to pass these savings on to their clients. Subsidies could be offered directly to clients as discounts, vouchers,

tax credits, or targeted grants. For example, Getz (1999) argues that subsidized personal information accounts should be granted to researchers. Also, although governments are an obvious source for these subsidies, nonprofits who have social goals aligned with the social benefits produced by the information may also choose to offer subsidies through credits or grants to clients.

When clients have little ability to pay, subsidies will have to be higher than if clients can pay. Direct subsidies to clients can be combined with subsidies from advertising or other sources. Assuming that a sufficient subsidy is granted, for-profit firms will be most efficient at delivering low-cost and innovative information services. The resulting information services will reflect a mixture of the clients' private preferences and the effect induced by the subsidy.

With many intermediaries and few clients, the situation is similar. The intermediaries will be able to deliver services that are highly customized to their clients' needs. Government will again offer grants or subsidies to encourage the consumption of socially beneficial information. However, the information services could still be developed most efficiently by for-profit firms, acting to meet the clients' preferences that have been altered by the subsidies. If the few clients have little ability to pay, subsidies should still be offered if the social benefit of the clients' information consumption is large. In this case, the intermediaries will produce information services almost entirely based on governments' preferences, as reflected in the subsidy.

When there are few intermediaries and many clients, antitrust regulation may be necessary to ensure that for-profit firms do not exercise monopoly power. Subsidies to clients will still be necessary to boost information consumption. Alternatively, if regulation and subsidy are too burdensome or difficult to enact, governments may provide information services directly or

subsidize nonprofit information intermediaries to replace for-profits that are not meeting social needs. When clients have little ability to pay, government or nonprofit provision is more likely to be preferred to for-profit provision, unless regulation is unusually inexpensive.

With few intermediaries and few clients, the market for information is quite thin. If there is a social benefit to information consumption, it is likely that direct government or nonprofit provision will be necessary to provide information services that reflect the social benefit of the information consumed. Since there are few clients, nonprofits may be in a better position to serve the market than governments. Nonprofits can adapt to a small group's preferences without the constraints that governments face in pleasing the majority of their constituency. If the social benefit is small, governments will have little interest in subsidizing information intermediaries. In this case, information intermediaries may provide limited services, depending on the willingness of nonprofits to serve the market.

Opaque information of social benefit

Opaque information of social benefit presents the greatest challenges for optimal information provision. In the absence of intervention, clients will consume suboptimal levels of information, and they will have little ability to appropriately evaluate and choose information that meets either their own needs or those of society. For-profit firms cannot effectively serve as information intermediaries when the information in question is highly opaque and has a high ratio of social-to-private benefit. They will not be able to serve as trusted intermediaries due to their incentive to cut corners in ways that are invisible to clients. When clients receive little private benefit from the services provided, complex reputational arrangements between clients and for-profits will no

longer be possible, since the client has a low private interest in the information. In this situation, nonprofits and governments will be able to deliver information services more efficiently in almost all cases. Nonprofits and governments are also more likely to deliver information that is easily appropriable and transferable for socially beneficial uses. Table 4 summarizes the optimal institutional forms for opaque information of social benefit.

[Table 4 here]

With many intermediaries and many clients, governments will have a strong interest in subsidizing information consumption. The range of clients, however, will mean that a single, government-sponsored solution will not be able to serve the diversity of clients' interests. When clients have the ability to pay for services, multiple nonprofits will be able to offer a range of information services to different clients and will be encouraged through competition to meet clients' needs in a responsive manner. Government subsidies to clients or the nonprofits themselves will ensure that information is consumed up to socially optimal levels. If clients have little ability to pay, governments may choose to serve as an information intermediary to meet common information needs, while continuing to subsidize nonprofits to serve niche markets. Having different versions of information will increase the social surplus, as demonstrated in Varian (2000).

With many intermediaries and few clients, nonprofits will serve as small-scale information intermediaries providing customized information solutions. As in the case of opaque information of private benefit, clients may form their own nonprofits to act in their own interests. Governments should not provide an information service that meets the needs of only a few clients, but should instead use subsidies to boost information consumption to optimal levels. Government subsidies directly to clients, combined with client choices, will encourage competition among the intermediaries to provide services. This should lead to a relatively high level of innovation and cost reduction among nonprofit information intermediaries. When clients have little ability to pay, the same nonprofit-based information structure will be present, but the nature of services will depend almost entirely on the direction given by the government subsidy.

With few intermediaries and many clients, severe problems of asymmetric information will arise

without intervention. Governments will have a strong interest in providing information services to serve the many clients, and in designing these services to maximize social benefit. For-profit firms can only supply the market if there strong regulation to curb monopoly power and reduce the opacity of information, combined with subsidies to clients. This approach is likely to be more costly than direct government provision.

When clients have the ability to pay, they may also form their own nonprofit information intermediaries to represent their interests. The result will be a mixed information market with both nonprofits and governments providing information services. If clients have little ability to pay, nonprofit provision is not likely to arise unless particular nonprofits have made it their mission to serve these markets. This case offers the best argument for governments acting as a sole information intermediary to clients. If there are strong economies of scale, large social benefits, and many clients, governments should provide information directly to clients in this market. For-profits will have little interest in serving non-paying clients, nonprofits will be unlikely to form, and government regulation is likely to be more cumbersome and costly than direct provision.

With few intermediaries and few clients, nonprofits representing client interests may form when clients have the ability to pay, although the market will be thin. Governments may choose to provide some subsidy to boost information consumption to socially optimal levels, but will not be interested in direct provision that only serves a minority constituency. If clients have little ability to pay, there is again a very weak market for information. Well-developed information intermediaries are unlikely to form, but governments may subsidize the individual consumption of information of high social benefit. In this case, a decentralized form of information sharing is

likely to develop among clients.

Even when governments provide information services directly to clients, they should not necessarily provide free service. Government can charge up to the point that the cost to the consumer equals the consumer's marginal private benefit of information consumption and still maximize social welfare. Also, the government, or other intermediaries, may practice price discrimination. Varian (1996) demonstrates that if price discrimination allows producers with increasing returns to scale to expand the overall size of the market, social welfare is improved by the price discrimination.

Applications

The theory outlined above can be applied to many situations involving real world information intermediaries. This section looks at some of these cases using the principles developed above.

First, can a for-profit digital library such as Questia substitute for some of the services provided by college and university libraries? Questia and other companies are currently digitizing books in an effort to provide fee-based access to a basic library of texts serving the undergraduate curriculum. Using the five tests, the information provided by academic monographs can be classified as opaque information of social benefit. Academic monographs are presumably written with specialized knowledge whose value to the user cannot be known until after intensive study of the work. Texts written for an educational purpose are designed to impart knowledge and skills whose value to the consumer will not be fully realized until long after their education is complete. Educational texts also have social value in terms of training students to be functional and productive members of society with a capacity for lifelong learning and improvement.

Many intermediaries, including the entire network of academic libraries and an increasing number of for-profit firms, serve this information market. There are many clients, but most, being students, have a limited ability to pay for information services beyond what their normal financial aid packages cover. The analysis above would predict that government and nonprofit information intermediaries should be the preferred institutional forms of information intermediaries in this information market. Why is this so? A for-profit firm faces strong pressure to minimize its costs, and given that the information is opaque, has the capacity to conceal reductions in quality in the short term. The for-profit could offer the appearance of a well-rounded collection, while restricting its information offerings to information of suboptimal quality. For example, the for-profit could offer superseded editions of textbooks, since these would most likely be less expensive to acquire. The for-profit may skimp on information from hard-to-find but significant sources. The for-profit could offer minimal organization of the information, through substandard cataloging and information design. Or the for-profit could reduce labor-intensive services that aid in the selection and interpretation of information, such as those offered by reference librarians. Students selecting the for-profit information intermediary will not be in a position to fully evaluate the quality of its services and detect such potential adulterations.

The for-profit must also recoup its costs of operation from the fees it charges to students. Consuming only up to the point that the cost of information equals their private benefit, students will consume less information than is socially optimal. Students must face very low costs of information acquisition, in time and money, in order to be able to freely consume information that may improve their education and generate social benefits. In contrast to for-profit firms, nonprofits or governments are able to subsidize students' information access from donations and

tax revenues, making library services freely available.

Note that the analysis does not predict the optimal scale of the information intermediary. If the package offered by a for-profit firm such as Questia seems attractive, it is because the for-profit is using innovative technology to increase its economies of scale. Young (1994) points out that most libraries are not organized to exploit substantial economies of scale. However, if a core set of texts can be identified that would appeal to most undergraduate institutions, a nonprofit or governmental institution could be created to offer a nationwide or global digital library of core texts. Such an institution would be able to offer greater quality assurance, higher levels of service, and appropriate information subsidies to ensure optimal consumption of the information. A direct subsidy that allowed students to purchase services from the for-profit firm would not overcome the quality assurance and service problems described above. While there is no reason to prevent for-profits from entering this market, as long as there is some oversight to ensure that no gross misrepresentation of services takes place, the presence of for-profits in a market best served by nonprofits and governments is a signal that a greater nonprofit and governmental presence would be likely to improve the social benefits of information consumption.

Second, should libraries charge for service to businesses? The ``fee-or-free'' debate is now treated in the context of the analysis. The information sought by businesses--market research, product design, and the like--is of private benefit. The business expects to realize a financial return from its acquisition of information in the form of improved sales or reduced costs. Often the information is opaque: a five-year demographic forecast's accuracy cannot be judged in the short term. Many intermediaries exist to serve this market, from small consultancies to large public libraries. The reputation of the intermediary for accurate information provision is an

important guarantee of quality. As discussed above, nonprofits have an advantage insofar as their institutional form offers assurance to the client that services will not be shortchanged in order to cut costs. For-profits, on the hand, are likely to be more innovative in terms of the services offered. The analysis predicts that both for-profit and nonprofit organizations will be able to provide effective information to an information market that is characterized by opaque information of private benefit with many paying clients and many intermediaries. Libraries can therefore provide effective information services to this market alongside other nonprofit and for-profit organizations.

The information provided, however, has little social benefit beyond what the business expects to privately capture in the form of its profits. Unless there is some unusual reason to suspect market failure in the business world, such as excessive regulation stifling new business formation and change, there is no reason to subsidize the information acquisition of businesses. Libraries should therefore recoup the costs of serving business clients by charging appropriate fees. Free or low cost service to business clients is in fact suboptimal, since it diverts subsidies away from more socially beneficial uses.

Third, when can personal information accounts eliminate the need for direct provision of subsidized information services? Getz (1999) argues that information accounts, paid for by educational institutions, can often take the place of traditional library services for academic researchers. Instead of relying on the services of large library collections, researchers could be granted funds that could be used to pay for articles on demand or database searches. One benefit of this system would be to encourage researchers to make appropriate tradeoffs between cost and convenience when retrieving information.

Certainly a subsidy for information consumption is necessary. As discussed earlier, information consumption is very sensitive to cost. Also, according to Atkinson (1996, p. 257), "if the publication of scholarly information depended on real demand - on direct purchase by individuals - much truly scholarly publication (that is, refereed) would probably be too expensive to appear at all." Libraries have played an important role in generating ``artificial" demand for scholarly information. Personal information accounts could have the same function. Kaser (2000) points out that end users have traditionally not had to pay for the value added services of indexing and organization in scholarly information markets. Subsidies can also encourage the extension of such organization to new forms of information delivery.

The analysis predicts that subsidies for the consumption of information of social benefit will be preferred when information is transparent and there are many, paying clients and many intermediaries. Some kinds of information which should meet this criteria when used by a researcher are basic news and data sources, which can be assessed for the quantity and quality of the information delivered in a relatively straightforward, if not costless, manner. In this case, personal information accounts could spur for-profit information intermediaries to offer better service to the academic market by creating a paying market for customized information delivery.

Journal articles may also be good candidates for a client-side subsidy, if the articles are easily evaluated by researchers for quality and there is no monopoly power among the information intermediaries. However, if researchers rely on the journal to certify quality (Meyer, 1997) before taking the time to make their own evaluation, the information becomes less transparent, and nonprofits will be able to offer superior quality assurance. Also, if conditions strongly favor monopoly power among for-profit journal publishers, appropriate antitrust regulation may be

difficult to enforce. If regulation is too costly, direct nonprofit or government provision will be the preferred institutional form to generate socially optimal information provision. It is still possible to envision a mixed market in which nonprofits collect and distribute information, but recoup some of their costs from charges to clients' information accounts. This would both encourage innovation and competition among nonprofits and ensure incentives to maximize quality. Projects such as SPARC and JSTOR are examples of nonprofit information intermediaries that act to lower costs and provide quality assurance for journal articles.

In markets with few intermediaries and few clients, such as highly specialized areas of research, the market will be too thin to support a complex infrastructure of subsidies to multiple intermediaries. In these cases, direct nonprofit or government provision is likely to be less costly than a system of personal information accounts.

The analysis suggests that personal information accounts can improve information distribution in some cases, but that the information markets in question need to be carefully studied in order to determine whether personal information accounts are appropriate.

Fourth, can scholarly electronic portals replace libraries and commercial journal publishers? Odylzko (1995) and Harnad (1998) argue that the journal as it is currently know will wither away and that future scholarship will reside in centralized electronic repositories such as the Los Alamos National Laboratories e-print archives, accessible to all researchers with an internet connection. This could deliver cost savings, but is it an optimal solution in terms of information distribution? If so, what institutional forms should such repositories take?

While individual journal articles in an area known to a researcher may be considered transparent

insofar as the researcher has the expertise to evaluate the article, scholarly information begins to be opaque when viewed through the larger lens of an entire discipline or multiple disciplines. Information must be organized and classified so that nonspecialists can identify and use the most important parts of the literature. Publishers add value by sorting information (Morris, 1999), and libraries organize information by selecting quality material and foregrounding it for the researcher's attention, creating a ``control zone'' of authenticated material, to use Atkinson's phrase. If a scholarly portal is well-designed with appropriate quality control and organization, it can also meet the needs of researchers for a well-ordered information archive.

Since the information is opaque, nonprofit or government scholarly portals provide stronger guarantees that sufficient effort will be made to ensure quality and organization of their information than for-profit intermediaries can. To quote Atkinson (1996, p. 252) once again, ``we would have to be blind indeed to what has occurred in commercial scholarly publishing over the past twenty years to imagine that technology will be used by commercial information proprietors for any purpose other than to increase revenue as rapidly as possible.''

Who should operate these portals? Scholarly societies would seem to be the natural choice to maintain the literature of their discipline. Libraries, on the other hand, have expertise in handling multidisciplinary and interdisciplinary research needs. Libraries therefore may develop interdisciplinary portals or develop standards for interoperability among portals. Scholarly societies will safeguard the interests of members of their discipline, but may not offer sufficiently open access to information for researchers from outside the discipline. Some form of subsidy may be necessary to cover the costs of access for outside researchers, and also to ensure that members of the discipline consume information up to the optimal social level. Libraries may

play a role here as a neutral agent in ensuring the equitable distribution of subsidized access. When there are common interests among many users, governments may develop appropriately subsidized portals. The vision of a single server holding all of the information on a topic is attractive from a cost perspective, but is not likely to serve the diverse needs of scholars in the long term. Competition among many forms of information intermediaries, including scholarly societies, government agences, and libraries, will ensure that the portals are open to change and diverse information needs.

Once again the analysis does not indicate the appropriate scale of such scholarly portals. The economies of scale of scholarly information distribution, determined by technological and cultural factors, must be balanced against the diversity of researchers' interests to determine an appropriate balance between centralization and localization of information resources.

Conclusion

The theory developed in this article provides a methodology for analyzing optimal information distribution in particular information markets. The examples above demonstrate how the five tests proposed in the paper can be used to predict the appropriate institutional forms that information intermediaries should take for the delivery of different kinds of information. In particular, the institutional form of the information intermediary has been shown to have a crucial role in the social benefits generated from information distribution.

Information markets reflect a tension between economies of scale and centralized control and the alternative of competitive, innovative markets. In the absence of other distortions, a decentralized, competitive market for information should be better able to deal effectively with

the myriad complexities that the universe of information presents (Hayek, 1945).

In an information environment that approximates a fully competitive market, where clients can easily ascertain the quality and quantity of the information they purchase and have many suppliers to choose from, competition among many for-profit information intermediaries should provide the lowest costs and most innovation to clients in the long term. Also, when the social benefits to information consumption are low, there is little justification for nonprofit or governmental information intermediaries to enter the market.

When the information environment does not resemble a competitive market, nonprofit and government intermediaries are more likely to provide optimal information distribution. This can occur when (1) intermediaries or clients are highly concentrated, creating monopolistic or monopsonistic conditions; (2) information is opaque, implying that clients lack sufficient knowledge about the information they are seeking to consume; or (3) the social benefit to information consumption is high, necessitating mechanisms that will align clients private incentives to consume information with the social benefits their consumption produces. Competition among nonprofit organizations and governments, if possible in the given market, can encourage innovation similar to that which occurs in fully competitive markets.

The analysis presented here has the advantage of abstracting from many real world conditions, providing insights that do not depend on existing technologies or institutions. However, there are many lines of research that could enhance the theory and its applications. Research on particular information markets would generate more explicit information policy recommendations. The study of the interaction between information and its users could determine more precisely when information is relatively opaque and when it is transparent. A more formal model of how

information consumption interacts with the institutional form to produce social benefit would yield more precise predictions of socially optimal outcomes in empirical cases. Such a model would address the continuum of information qualities that exist along the dimensions defined by the five tests. Studies of information technology could determine when the introduction of new technology alters information markets in a manner that generates a change in the optimal form of information distribution. Studies of the long-term performance of information intermediaries could determine how the institutional form affects innovation. The approach to the study of optimal information distribution outlined in this article can provide insight into these questions and provide a new perspective on familiar information institutions.

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Table 1: Transparent information of private benefit: optimal institutional forms

	INTERMEDIARIES	
CLIENTS	**Many**	**Few**
Many, Paying	Competitive optimum; for-profits can supply information needs with little or no adverse effects	For-profits operate subject to antitrust regulation
Many, Non-paying	For-profits are efficient; low information provision without subsidy, e.g. advertising	For-profits operate subject to antitrust regulation; low provision without subsidy
Few, Paying	For-profits supply customized services to wealthy clients	For-profits operate without regulation due to small number of clients; possibility of client-oriented nonprofit
Few, Non-paying	Minimal services provided by for-profits	Very little organized activity by intermediaries; information likely to circulate informally

Table 2: Opaque information of private benefit: optimal institutional forms

	INTERMEDIARIES	
CLIENTS	**Many**	**Few**
Many, Paying	For-profit and nonprofit firms operate with strong reputation effects; regulation can provide quality assurance	Stringent regulation; enhanced role for nonprofits; possible government provision
Many, Non-paying	Low information provision without subsidy; regulation, nonprofits, and government all play a role in assuring quality	Weak market with strong argument for nonprofit or government provision
Few, Paying	Clients may be able to exercise bargaining power over for-profit firms, or sponsor client-oriented nonprofits; some risk of market failure	Nonprofits representing clients may be only counterweight to intermediary's monopoly power
Few, Non-paying	Market served only by nonprofits	Market unlikely to be served by intermediaries

Table 3: Transparent information of social benefit: optimal institutional forms

	INTERMEDIARIES	
CLIENTS	**Many**	**Few**
Many, Paying	For-profits are efficient suppliers; best case for client-side subsidy	Antitrust regulation + subsidy to client; or nonprofit/government provision
Many, Non-paying	For-profits are efficient; client-side subsidy in addition to other subsidies are necessary to increase information consumption	Antitrust + subsidy or nonprofit/government provision depending on costs
Few, Paying	For-profits supply customized services to wealthy clients; targeted subsidies (e.g., research grants) support social interests	Nonprofit or government provision substitutes for for-profits
Few, Non-paying	For-profits develop information services primarily dictated by the subsidies offered	Limited government and/or nonprofit provision unless social benefit is large

Table 4: Opaque information of social benefit: optimal institutional forms

	INTERMEDIARIES	
CLIENTS	**Many**	**Few**
Many, Paying	Nonprofit provision, underwritten by government funding	Government and/or nonprofit provision
Many, Non-paying	Government and nonprofits both provide information services	Best case for government provision
Few, Paying	Nonprofit provision, underwritten by clients and government subsidy	Nonprofit provision, with possible govt. subsidy
Few, Non-paying	Nonprofits develop information services primarily dictated by the subsidies offered	Possibility for decentralized information sharing, subsidized by govt.