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ACQUISITION AND DISCLOSURE OF INFORMATION PRIOR TO ECONOMIC EXCHANGE

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Abstract

The motive to acquire information about something that will be the subject of a transaction is influenced by whether a party who possesses information may keep it private or must disclose it. Suppose that a person contemplates having a painting appraised before selling it and would be free to keep an unfavorable finding to himself. Because he would thus be able to avoid having to accept a low price, he would be expected to be more willing to pay for an appraisal than if he were obligated to disclose its results. Or suppose, as in the well known case of *Texas Gulf Sulfur*, that a firm considers secretly undertaking an aerial survey of farmers' land to determine its mineral-bearing potential and would not have to divulge a positive result and pay a high price. The firm would be more willing to invest in the survey than if it were required to report the conclusions from the survey.

Is the stimulus to acquisition of information when disclosure is voluntary socially desirable? Drawing on examples like *Texas Gulf Sulfur*, Kronman (1978) suggested that voluntary disclosure may sometimes be desirable; were disclosure required, he surmised that Texas Gulf Sulfur would not have made the aerial survey and socially valuable information about the mineral deposits would not have been generated. But fostering acquisition of information arguably is undesirable if the information does not have social value. As was originally emphasized by Hirshleifer (1971), information may sometimes lack social value because it cannot be acted upon to advantage: it may amount to mere foreknowledge. For example, information about the volume of oil contained in an underground reservoir of known location will have no social value if it will not affect total production of oil or extraction costs. Thus, a reduced incentive to acquire information about the volume of oil would not be bad, it would be good because any resources devoted toward ascertaining the volume of oil would be a social waste.

Of course, an evaluation of voluntary versus required disclosure of information must take into account not only incentives to acquire information. It must also incorporate the possible social value of exchange of information itself.

These are the ideas that I investigate in this article. An important aspect of the article is the distinction between the case where a seller decides about acquiring information (as where the seller may have his painting appraised) and where a buyer decides about that (as in *Texas Gulf Sulfur*).

The principal conclusions (in the world of the model) are that *sellers should be required to disclose their information*: their incentives to acquire information will be socially correct in this case; otherwise they would be excessive. *Buyers, however, should sometimes be allowed to conceal their information.*

Acquisition and Disclosure of Information Prior to Economic Exchange

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1. Introduction and Summary

The motive to acquire information about something that will be the subject of a transaction is influenced by whether a party who possesses information may keep it private or must disclose it. Suppose that a person contemplates having a painting appraised before selling it and would be free to keep an unfavorable finding to himself. Because he would thus be able to avoid having to accept a low price, he would be expected to be more willing to pay for an appraisal than if he were obligated to disclose its results. Or suppose, as in the well known case of *Texas Gulf Sulfur*, that a firm considers secretly undertaking an aerial survey of farmers' land to determine its mineral-bearing potential and would not have to divulge a positive result and pay a high price.[1] The firm would be more willing to invest in the survey than if it were required to report the conclusions from the survey.

Is the stimulus to acquisition of information when disclosure is voluntary socially desirable? Drawing on examples like *Texas Gulf Sulfur*, Kronman (1978) suggested that voluntary disclosure may sometimes be desirable; were disclosure required, he surmised that Texas Gulf Sulfur would not have made the aerial

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[1]In fact, Texas Gulf Sulfur spotted an anomaly indicating that certain land probably contained massive sulphide deposits. The firm did not reveal its knowledge and, for one parcel of land that turned out to be worth about $1 billion, paid only $18,500 for mineral rights (although the owner of the land retained a 10% share of the value of the mineral rights). See Kronman (1978) at p. 20.

survey[2] and socially valuable information about the mineral deposits would not have been generated. But fostering acquisition of information arguably is undesirable if the information does not have social value. As was originally emphasized by Hirshleifer (1971), information may sometimes lack social value because it cannot be acted upon to advantage: it may amount to mere foreknowledge. For example, information about the volume of oil contained in an underground reservoir of known location will have no social value if it will not affect total production of oil or extraction costs. Thus, a reduced incentive to acquire information about the volume of oil would not be bad, it would be good because any resources devoted toward ascertaining the volume of oil would be a social waste.[3]

Of course, an evaluation of voluntary versus required disclosure of information must take into account not only incentives to acquire information. It must also incorporate the possible social value of exchange of information itself. In particular, if information is socially valuable because it can be used to raise value, then it is desirable that it be transferred, at least if it is the seller who possesses it.

These are the ideas that I investigate in this article. I consider a model of the acquisition of information and its disclosure, generally describe buyers' and sellers' behavior, and compare voluntary and required disclosure. In doing so, I first suppose that sellers alone have the opportunity to acquire information (as where the seller may have his painting appraised),[4] and I consider the case of information which has no

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[2]Texas Gulf Sulfur spent approximately $3 million on extensive aerial surveys in several years preceding its discovery of sulphide deposits. See Kronman (1978) at p. 21.

[3]In their text, Cooter and Ulen (1988) make a similar remark at p. 260 when commenting on Kronman.

[4]However, many times both buyers and sellers have opportunities to obtain information (suppose the buyer can also have the painting appraised); this will be discussed after the analysis, in Section 3f.

social value and then the contrasting case of information which does have social value. I subsequently suppose that buyers are the parties who decide whether to acquire information (as in *Texas Gulf Sulfur)* and again consider the cases where information does not and does have social value.

The distinction between the situation where sellers have the opportunity to acquire information and where buyers do will be seen to be important: I will conclude that, in the world of the model, sellers should be required to disclose their information but buyers sometimes should be allowed to conceal it. Let me summarize now the main points of the model in the four cases that are analyzed.

(a) *Sellers alone decide whether to acquire information; information has no social value.* When information has no social value, it is socially optimal for nothing to be invested in its acquisition. Thus, it is socially undesirable for a seller of a reservoir of oil to make an expenditure to determine how much oil it holds. (For concreteness, I will use the example of a reservoir of oil throughout this summary.)

What will occur if disclosure is voluntary? A seller who obtains information and learns that his reservoir holds a relatively large quantity of oil will reveal this (credibly and costlessly, I assume) to a buyer in order to be able to obtain a higher price. A seller who determines that his reservoir holds a comparatively small amount of oil will keep silent, and thus not have to accept as low a price as truly reflects his quantity of oil.[5] It follows that information will have positive expected value for sellers, and some sellers will therefore spend to acquire it. In consequence, the outcome will not be socially optimal.

If, however, disclosure of information is required by law

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[5]It should be noted, though, that when a seller is silent, the buyer will rationally infer that the seller's information may be unfavorable, and the buyer will adjust the price downward as a result.

(and it is assumed that there are no problems of enforcement), nothing will be spent on the acquisition of information. To explain, a seller who does not acquire information will obtain a price equal to the expected value of his good. If a reservoir is equally likely to contain an amount of oil worth 100 or an amount worth 200, a seller who does not have information will obtain a price of 150 for his reservoir. Yet a seller who acquires information and must disclose it will receive the same amount on average; half the time he will receive 100 and half the time, 200. In other words, when disclosure is required, information has no value because, if information is acquired, the expected price equals the expected value, which is the price if a seller does not have information.

To conclude, in the simple case of information without social value, required disclosure of information is socially optimal because it eliminates the wasteful incentive to acquire information that exists if disclosure is voluntary, but not because the transfer of information is itself desirable.

(b) *Sellers alone decide whether to acquire information; information has social value.* Information about a good will be assumed to have social value if the information can be employed to increase the value of the good. Information about the nature of oil deposits (not only about quantity, but also about depth, internal pressure, sulfur content) might raise their value to a buyer because he would know what drilling equipment would be most efficient, could proceed immediately to make the most advantageous contracts for sale of product, and so forth.[6]

When information has social value, it is socially optimal for sellers to invest in its acquisition if the cost of so doing is less than than the social value of the information. And it is

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[6]In the model, socially valuable information is that which allows an action to be taken that raises the value of the good to the party who possesses it. Another way in which information may raise social value is that it could allow a better match between seller and buyer. It will be apparent that the basic points made here would not be affected were this source of the social value of information taken into account.

optimal for any seller who acquires information to disclose it to buyers so that they can use it to raise the value of goods.

Suppose that disclosure of information is required. This will *not* eliminate sellers' incentives to acquire information (unlike in the case of information without social value). If a seller determines the nature of his oil deposits, he can sell his land for a higher price than otherwise; the price the buyer will be willing to pay will reflect the enhancement in value due to the information (due to his being able to employ the most efficient drilling equipment). Suppose that if information about oil deposits is not obtained the two equally probable values of the oil are again 100 and 200, but if information is obtained the two possible values will be 120 and 220. Thus, if the seller acquires information, the expected price he will receive will be 170. If the seller does not acquire information, the price he will receive will be 150, since the expected value of the deposits to the buyer will be that amount. Consequently, the value of information to the seller is 20; information has positive value to the seller.

As may be apparent from this example, the seller who obtains information captures its social value; 20 is the amount by which information about the oil raises the value of the oil deposits. For this reason, sellers' incentives to acquire information are optimal when disclosure is required.[7] Moreover, when disclosure is required, all information that sellers possess is disclosed by definition. Hence, required disclosure results in the socially optimal outcome.

Consider now the situation when disclosure is voluntary. In this case, sellers' incentives to acquire information are socially excessive, for essentially the reasons discussed previously: a seller may decide to acquire information because he

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[7]However, sellers' incentives to acquire information would not be fully optimal if, unlike in the model, they obtain from buyers only a fraction of the value of what they are selling. See Section 3b

can obtain a high price when the information is favorable yet can keep quiet when the information is unfavorable.[8]

To summarize, just as was true in the case of information without social value, it is true here that required disclosure of information is socially optimal and voluntary disclosure is not. This is so for two reasons. First, under voluntary disclosure, the incentive of sellers to obtain information is socially excessive, whereas under required disclosure, their incentive to acquire information is socially optimal. Second, under voluntary disclosure, some information that sellers obtain they fail to disclose, whereas under required disclosure that cannot happen.

(c) *Buyers alone decide whether to acquire information; information has no social value.* In this case, the conclusions are much the same as where sellers may obtain information and it has no social value. Again, it is socially best for nothing to be spent acquiring information; but when disclosure is voluntary buyers will have an incentive to acquire information; and when disclosure is required, buyers will not have a motive to obtain information; thus required disclosure is socially desirable.

The main difference in the present case is that when disclosure is voluntary, buyers will decide to disclose unfavorable information in order to persuade sellers to accept a lower price; buyers will keep silent about favorable information to avoid having to pay a high price. (Before, when sellers chose whether to disclose information, they revealed favorable information and kept silent about unfavorable information.)

(d) *Buyers alone decide whether to acquire information; information has social value.* Here, unlike with sellers, a requirement to disclose information will eliminate the incentive to acquire information -- even though information will raise the value of the good. Suppose that a buyer discloses the nature of

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[8]The proof is not entirely obvious, however, and involves a subtlety: Because a seller will not reveal unfavorable information about his good, he does not capture the social value of such information. Hence, it is not clear, a priori, that the value of information to a seller exceeds its social value.

oil deposits to a seller, enabling a person to obtain a higher value from the deposits. This disclosure will not help the buyer: on average, he will have to pay the seller more on account of the seller's knowledge of the nature of the oil deposits.[9] The difference from the situation where it is sellers who possess valuable information can be explained as follows. Information about the nature of oil deposits has value to a party in bargaining only if he *owns* the land on which the deposits are located *when he is bargaining*; because the buyer does not own the land when he is bargaining, he cannot extract from the seller the value of the information about the oil deposits.[10]

Only if disclosure is voluntary will information have positive value to buyers. If disclosure is voluntary, though, buyers' incentives to acquire information will be socially excessive because part of their gains from acquiring information will be due to their ability to conceal favorable information. (This concealment is not socially undesirable itself, however, because buyers will still use their concealed information after they make purchases.) Hence, voluntary disclosure of information is socially superior to required disclosure if, under voluntary disclosure, the increase in value of goods arising from the information buyers obtain exceeds the total cost of information to buyers.

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[9]Why will the buyer have to pay the seller more if the seller learns that his good is more valuable? In the model, the seller is assumed to have the opportunity to obtain value himself from use of what he is selling -- to be able to develop the oil deposits himself, even though less efficiently than the buyer. In the numerical example, suppose that the seller can obtain from the deposits whatever the buyer can obtain, but less 40. Then if the buyer is required to disclose his information, he will pay either 120 - 40 = 80 or 220 - 40 = 180; in both cases the buyer will gain 40, since he will use the deposits himself. If the buyer does not obtain information, he will pay 150 - 40 = 110, but gain 40. Thus, the buyer gains 40 whether or not he obtains information; information has zero value to him.

Another reason why the seller may demand a higher price is that the seller may be able to sell to another buyer at a higher price and in that way make use of his knowledge of the nature of the oil deposits; see Section 3e.

[10]This conclusion will be qualified when certain assumptions in the model are relaxed; see Section 3b.

This summary of the model indicates how to assess the suggestion that voluntary disclosure of information may be socially desirable because it will foster the acquisition of information: The suggestion is correct in the model as it applies to buyers but incorrect as it applies to sellers. Sellers should be required to disclose information; this will leave them with the socially appropriate incentive to acquire socially valuable information, yet eliminate their incentive to obtain socially useless information. Buyers, however, should sometimes be allowed the freedom to decide whether to disclose information; although they will then have an excessive incentive to acquire information, their incentive to acquire information would be vitiated if they were required to disclose what they know.

The last section of the article, following the analysis, considers variations of assumption in the model, such as altering the identity of the party who makes offers. The section also addresses certain issues going beyond the model, including the credibility of the information that is revealed by a party; the source of the conclusion that sellers but not necessarily buyers should have an obligation to disclose information; the relative capacities of sellers and buyers to obtain information; information obtained prior to sale versus information obtained after sale; and the ability of the law to enforce an obligation to disclose information.

Before proceeding, the conclusions of previous literature on disclosure of information, apart from Kronman's article, should be noted. The focus of this literature is on the question of how much information will be disclosed voluntarily by sellers. Grossman (1981) and Milgrom (1981) assume that sellers possess information and can freely and credibly disclose it. They find that complete voluntary disclosure of information results because a buyer's negative inference from a seller's silence would lead to an unraveling of any situation in which a seller is silent.

This complete unraveling does not occur -- and some sellers keep silent in equilibrium -- under a variety of alternative assumptions: in Jovanovic (1982), information is costly for sellers to disclose; in Farrell and Sobel (1983) and Farrell (1986), information is costly for sellers to acquire; in Shavell (1989a), some sellers are unable to credibly convey information. Okuno-Fujiwara, Postlewaite, and Suzumara (1990) provide a fairly general analysis of conditions under which voluntary disclosure leads to complete disclosure of information. Also, Matthews and Postlewaite (1985) study a model with free acquisition of information and disclosure and find that sellers will acquire information and voluntarily disclose it (if they cannot prove that they are ignorant).[11]

The model that I examine builds most closely on Farrell's and Sobel's, who first investigated costly acquisition of information prior to disclosure (and who emphasized the result that complete disclosure does not occur if disclosure is voluntary). The additions that I make are that I allow for information that can be used to increase the value of goods, and that I consider the possibility that buyers may be the parties who acquire information.

2. The Model

There are two types of parties, risk neutral sellers of a good and risk neutral buyers of the good. Each seller has one unit of the good to sell, and each buyer wants to buy at most one unit. Units of the good differ in value, and initially no one knows the value of particular units (of particular parcels of

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[11]Disclosure of information has been studied in contexts other than the sale of something. For example, a number of articles examine whether oligopolists will benefit from exchanging private information with each other; see, for instance, Novshek and Sonnenschein (1982) and Shapiro (1986). Also, several recent articles ask about the sharing of information between litigants before they decide whether to settle or go to trial; see Shavell (1989b) and Sobel (1989).

In addition, one recent article, Craswell (1988), studies acquisition of information before the making of contracts, but does not deal with disclosure.

land). However, information about the value of a (unit of the) good can be determined by an expenditure. In the first version of the model, sellers decide whether to make expenditures to acquire information before they meet with buyers; buyers can obtain information only from sellers. In the second version of the model, it is buyers alone who have the opportunity to acquire information.

In each version of the model, two cases are considered: where information about the good has no social value, because it does not increase the value of the good; and where information has social value, because it allows actions to be taken that increase the value of the good.

The analysis identifies, in each case, socially optimal behavior, behavior if disclosure of information is voluntary, and behavior if disclosure is required. The measure of social welfare is the net value obtained from use of goods minus the costs of acquisition of information.

2.1. Sellers May Acquire Information

The sequence of actions and certain basic assumptions are as follows. First, each seller decides whether to spend an amount to acquire information about his good. Buyers cannot observe whether sellers have acquired information. Second, each seller meets with a buyer and may reveal his information -- he chooses to do so if disclosure is voluntary; he must reveal it if disclosure is required. Information revealed by sellers is assumed to be believed by buyers. Third, the seller makes a single demand of the buyer, who either accepts or rejects the demand.[12] Fourth, in the case where information has social value, the buyer may use the good in a way that depends on the information he receives.

2.1.1. Information has no social value. Define the

[12]The conclusions reached would be essentially the same if it were assumed instead that buyers make single offers to sellers; see Section 3a.

following notation (which will be employed throughout the article).

v = value of the good to a buyer; $v \geq 0$;

$f(v)$ = probability density of v over the population of buyers; $f(v) > 0$ for all $v \geq 0$; $F(y)$ is the cumulative distribution function (cdf) of f;

c = cost of acquiring information -- of learning v;[13] $c \geq 0$;

$g(c)$ = probability density of c over the population of sellers; $g(c) > 0$ for all $c \geq 0$; $G(y)$ is the cdf of g.[14]

It is assumed that each buyer values a particular good in the same way (so that if the seller learns v, he knows exactly what it will be worth to any buyer); that each seller knows his cost c of acquiring information but buyers do not know c; and that v and c are independent random variables.

Social optimality. Because acquisition of information about the good does not raise its value but is costly, the following is clear.

Proposition 1. Suppose that information about the good has no social value. Then it is socially optimal for sellers not to acquire information about their goods.◂

Voluntary disclosure of information. If disclosure is voluntary, behavior is assumed to be determined by a sequential equilibrium, a situation in which two things are true: first, at each stage, parties act optimally given their information and the strategies of other parties; and second, buyers' probabilistic beliefs about silent sellers' types are correct.[15]

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[13]The assumption that information about the value of a good is perfect is inessential.

[14]The importance of the assumption that c differs among sellers is discussed after Proposition 2.

[15]For the general definition of sequential equilibrium, see Kreps and Wilson (1982). The general definition reduces in the present model to the one under consideration.

It is convenient to describe sequential equilibrium by describing the last stage, then the middle and the first stages.

At the final stage, a seller who has acquired information and reveals v will make an offer to sell of v, for v is the maximum that the buyer will be willing to pay; this offer will just be accepted. A seller who is silent (either because he chooses not to reveal v or because he does not know it) will make an offer to sell of v^*, where v^* is the maximum that buyers will pay to silent individuals. Thus we must have

(1) v^* = mean of v conditional on sellers being silent.

We will return to (1) after we identify the sellers who are silent.

At the preceding stage, a seller who knows v decides whether to reveal it. It is evident from what has been said that for a seller who knows v,

(2) $v \leq v^*$ implies seller will be silent and receive v^*;[16]

$v > v^*$ implies seller will reveal v and receive v.

With regard to the initial stage, when the seller decides whether to obtain information, let

I = expected value of information to a seller.

From (2), it is apparent that

$$(3) \quad I = \int_{v^*}^{\infty} (v - v^*) f(v) dv.$$

Notice that the right-hand side of (3) shows that I inheres in the chance that information will be "favorable" -- above v^* -- in which case the seller will reveal it and obtain a higher price than v^*; and the expression also reflects the seller's ability to keep quiet when v is below v^* (otherwise, the integration would be over the interval $[0, v^*)$ as well, where the integrand $v - v^*$ would be negative). The initial decision of a seller whether to obtain information is therefore

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[16] If $v = v^*$, the seller will be indifferent whether to reveal v, but I adopt the convention that he does not; and I make similar assumptions below without further comment.

(4) $c \leq I$ implies seller will spend c and obtain information;
$c > I$ implies seller will not obtain information.

Observe that the total expenditures on acquisition of information are

$$(5) \qquad \int_0^I cg(c)dc;$$

these expenditures represent a social waste.

The behavior of sellers and buyers in equilibrium has now been described, presuming that (1), which was not fully specified, has a solution. To be specific, because silent sellers are comprised of sellers with $c > I$ -- those who do not obtain information -- together with sellers with $c \leq I$ and $v \leq v^*$ -- those who obtain information but who do not reveal it -- we can rewrite (1) as follows:

$$(6) \quad v^* = (1 - p(I))E(v) + p(I)E(v|v \leq v^*),$$

where

$$(7) \quad p(I) = F(v^*)G(I)/[1 - G(I) + F(v^*)G(I)],$$

$E(v)$ is the mean of v, and $E(v|v \leq v^*)$ is the mean of v conditional on v being less than or equal to v^*. Notice that $p(I)$ is the proportion of the silent sellers who have information and that the mean of v among those sellers who do not obtain information -- those for whom $c > I$ -- is $E(v)$ because of the assumption that v and c are independent.

Now (6) is an equation involving v^* on both sides (on the right, v^* appears not only in $E(v|v \leq v^*)$, but also in $p(I)$ and I, for, from (3), I depends on v^*). Eq. (6) can be shown to have a solution;[17] the solution may not be unique,[18] but for

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[17]Eq. (6) has a solution if and only if the function $h(v^*) = [(1 - p(I(v^*)))E(v) + p(I(v^*))E(v|v \leq v^*)] - v^*$ equals 0 for some v^* (where $I(v^*)$ is given by (3)). Now $h(0) = E(v) > 0$. And for any positive v^*, it is clear that the term in brackets is less than $E(v)$, so that $h(v^*) < E(v) - v^*$. Hence, for all $v^* \geq E(v)$, $h(v^*) < 0$. Because $h(0) > 0$, $h(v^*) < 0$ for $v^* \geq E(v)$, and $h(v^*)$ is a continuous function of v^*, $h(v^*)$ must equal 0 for some v^* in the interval $(0, E(v))$.

expositional ease I will speak as if it is.[19] It is clear from (6) that $E(v|v \leq v^*) < v^* < E(v)$, reflecting the fact that silent sellers include both high value sellers who do not know their v and whose value is E(v) on average, and low value sellers who know their v and whose value is $E(v|v \leq v^*)$ on average.

We have established the following result.[20]

Proposition 2. Suppose that information about the good has no social value and that disclosure of information is voluntary. Then

(a) sellers with costs of acquiring information below a threshold I (given by (3)) obtain information and others do not.

(b) The resources spent on acquiring information (given by (5)) are a social waste.

(c) Sellers who acquire information and learn that their goods have value less than a threshold v^* (determined by (6)) keep silent and receive v^*; other sellers reveal their information v and receive v, which is greater than v^*.◂

Several remarks about equilibrium with voluntary disclosure may be of interest. First, the reason for the assumption that the cost c of acquiring information varies among sellers is that if instead c has a single value, so that sellers are identical, ex ante, there cannot be a uniform equilibrium in which they obtain information. For then, as all sellers obtain information, G(I) = 1, so p(I) = 1, and thus the right-hand side of (6) equals $E(v|v \leq v^*)$; therefore (6) has no solution.[21]

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[18]The solution may not be unique because the function h of the previous note may not be monotonic. In particular, the term in brackets can rise or fall as v^* rises because, as the reader can verify, the derivative of p can be positive or negative.

[19]I will do the same below. Nothing rests on this, however; the comparisons I make between equilibrium when disclosure of information is voluntary and when it is not are not affected by the possibility of multiple equilibria.

[20]This result is essentially that of Farrell and Sobel (1983).

[21]Lack of existence of such an equilibrium implicitly reflects the unraveling phenomenon stressed in Grossman (1981) and Milgrom (1981): Were there an equilibrium with silent sellers, each silent seller would receive the conditional mean for silent sellers. But any silent seller whose value exceeded the

Second, the assumption that sellers who do not acquire information are unable to demonstrate that that is their situation is necessary. Without this assumption, the outcome described in the proposition would not be an equilibrium; for sellers who did not acquire information would want to prove this to buyers in order to obtain a price of E(v) rather than the lower amount v*. Thus, an equilibrium in which sellers acquire information and remain silent could not exist; that in turn would make information valueless, so that no sellers would acquire it.[22]

Third, it was implicitly assumed that all sellers would be willing to sell their goods, and in particular, that those without information would be willing to sell their goods at the equilibrium price v* even though v* is less than E(v). This assumption can be justified by a further assumption that the value of a good to a seller for his own use is v - k, where k is large enough that E(v) - k < v*. In the absence of such an assumption, the complicating issue would arise that sellers without information might not sell, a problem similar to the "lemons" problem in Akerlof (1970).

Required disclosure of information. When disclosure of

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conditional mean among silent sellers would then have a motive to reveal his value -- causing an unraveling of equilibrium. This argument does not apply in the model studied here: the mean among silent sellers is v* and this *exceeds* the mean among silent sellers who are able to disclose their v, due to the presence of silent sellers who are not able to disclose their v (because they did not learn it).

There may, however, be nonuniform equilibria, in which sellers are indifferent between obtaining information and not doing so, and a fraction obtain information and the remaining fraction do not. The proof is as follows. Find the v* such that the single c equals I(v*). From (3), such a v* exists if c < E(v). If this v* is less than E(v), there exists a unique fraction p of sellers who are silent and have information, such that (6) is satisfied for v*, since E(v) > v* and E(v|v < v*) < v*. Using this p and F(v*), one can find the G that satisfies (7): by manipulation of (7), G = p/[p + F(v*) - pF(v*)]. Thus, if this fraction G of sellers acquires information, there is an equilibrium.

[22]The same result would occur if sellers were able to make contracts for sale at a contingent price, equal to the value v that the good turns out to have. For then a seller who did not acquire information would want to make such a contract -- he would obtain E(v) on average, which exceeds v* -- and a buyer would be willing to make such a contract. Contracts contingent on v may be difficult to make if courts are not able easily to verify v.

information is required, assume that behavior is determined by sequential equilibrium, as generally described above, but where a seller who acquires information must disclose it.

As before, in the last stage, a seller who reveals v will ask for and obtain v from the buyer. Also, as before, v* is what is received by silent sellers and is given by (1). However, as silent sellers are exclusively sellers who do not have information, (1) becomes

(8) $v^* = E(v)$.

And because in the middle stage any seller who has information must reveal it, the value of information to sellers is

$$(9) \quad I = \int_0^\infty (v - v^*) f(v) dv = E(v) - v^* = E(v) - E(v) = 0.$$

Hence, no sellers obtain information. (Eq. (9) reflects what was noted in the Introduction, that the expected price received when information is obtained equals the mean, which is the price if no information is obtained.) We have established

Proposition 3. Suppose that information about the good has no social value and that disclosure of information is required. Then

(a) no sellers spend to acquire information, so the outcome is socially optimal.

(b) Sellers offer and receive E(v) from buyers.◂

2.1.2. Information has social value. Now assume that information v about the good has social value because it allows an action to be taken that increases the value of the good. Specifically, let the action be an investment (or effort),

x = buyer's investment in the good;

vr(x) = value of the good given v and x; $r(x) > 0$; $r'(x) > 0$; $r''(x) < 0$.

Thus, v is now a parameter determining the value of the good rather than being the value itself; the value of the good net of

investment is[23]

(10) $w(v, x) = vr(x) - x.$

The socially optimal x maximizes (10) and is determined by

(11) $vr'(x) = 1$

where it is positive. Denote by $x(v)$ the optimal x, and note that when $x(v)$ is positive, it is increasing in v.

Social optimality. If a seller acquires information and reveals v to the buyer, the buyer can maximize (10) and choose $x(v)$; if the buyer is not told v, he cannot choose $x(v)$. Thus, if a seller has information, it is optimal for him to reveal it.

If a seller does not have information, the buyer selects x to maximize the expected net return,

$$(12)\quad \int_0^\infty (vr(x) - x)f(v)dv = E(v)r(x) - x,$$

so that the x chosen is $x(E(v))$. Hence, the social value of information is

$$(13)\quad I^* = \int_0^\infty [w(v, x(v)) - w(v, x(E(v)))]f(v)dv$$

$$= \int_0^\infty w(v, x(v))f(v)dv - w(E(v), x(E(v))).$$

$$= \int_0^\infty [w(v, x(v)) - w(E(v), x(E(v)))]f(v)dv.$$

The first integrand is positive for all v other than $E(v)$ itself, where it is zero. Hence, $I^* > 0$, and sellers for whom $c < I^*$ ought to obtain information, and then disclose it whatever it is. To summarize, we have

Proposition 4. Suppose that information v about the good has social value because it affects the optimal level of investment x in the good. Then socially optimal behavior is as follows.

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[23]This particular formulation of $w(v, x)$ is convenient but not of significance; the analysis would be essentially the same for any function $w(v, x)$ that is increasing in v and decreasing in x.

(a) Sellers whose cost of information is less than its social value (given by (13)) obtain information;

(b) sellers who obtain information disclose it to buyers;

(c) a buyer who has information v invests x(v), and a buyer who does not have information invests x(E(v)).◂

Voluntary disclosure of information. The sequential equilibrium is found much as before. In the final stage, if a seller reveals v, he will ask for and obtain w(v, x(v)) = vr(x(v)) - x(v). If a seller is silent, the buyer's willingness to pay w* is determined by the expected value of the good, conditional on sellers' silence, where the buyer chooses the best x given his information. Thus

$$(14)\quad w^* = \max_x E(w(v, x)|\text{silence}) = \max_x E(v|\text{silence})r(x) - x$$

$$= w(E(v|\text{silence}), x(E(v|\text{silence}))).$$

(Eq. (14) is the analogue of (1).) Denote E(v|silence) by v* and x(E(v|silence)) by x*, so that

$$(15)\quad w^* = w(v^*, x(v^*)) = w(v^*, x^*).$$

A seller who acquires information will reveal v if and only if w(v, x(v)) exceeds w*, which is to say, if and only if v exceeds v*. Hence, the value of information to a seller is

$$(16)\quad I = \int_{v^*}^{\infty}(w(v, x(v)) - w^*)f(v)dv.$$

Sellers will acquire information if and only if $c \leq I$. Since silent sellers are those for whom $c > I$ together with those for whom $c \leq I$ and $v \leq v^*$, we have that (6) still applies, but where I in (6) is now determined by (16) rather than by (3). Eq. (6) can again be demonstrated to have a solution.[24]

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[24]We can proceed essentially as in footnote 17 above. In (16), write w* as w(v*, x(v*)), and let

$$I(v^*) = \int_{v^*}^{\infty}(w(v, x(v)) - w(v^*, x(v^*)))f(v)dv.$$

Thus, if there exists a v* such that the function $h(v^*) = [(1 - p(I(v^*)))E(v) + p(I(v^*))E(v|v \leq v^*)] - v^*$ equals 0, (6) has a solution, and that there exists a v* such that h(v*) = 0 follows from the argument given in footnote 17.

Observe that the private value of information (16) is different from the social value (13): the integration in (16) is only over v exceeding v*, because the seller will reveal only these v, whereas in (13) the integration is over all v; also, the integrands in (16) and (13) are different. It can be demonstrated that the private value exceeds the social value.[25] This result is not surprising, for when the seller reveals v he obtains w(v, x(v)), and he obtains more than this when he keeps silent (but this reasoning is only suggestive, for it does not refer to the difference between the private and social payoffs when information is not obtained).

We may summarize as follows.

Proposition 5. Suppose that information about the good has social value and that disclosure is voluntary. Then

(a) The value of information to sellers I (given by (16)) exceeds the social value of information I*.

(b) Sellers with costs of acquiring information below I obtain information and others do not.

(c) The amount spent by sellers acquiring information is socially excessive.

(d) Sellers who acquire information and learn that their information v is less than a threshold level v* keep silent and receive w*; other sellers reveal their information v and receive w(v, x(v)), which is greater than w*.

(e) Failure to disclose information by sellers who have information is socially undesirable because buyers do not choose optimal levels of investment even though information is

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[25] Because $E(v|\text{silence}) < E(v)$, $w^* < w(E(v), x(E(v))$. Hence, $\int_0^\infty [w(v, x(v)) - w^*]f(v)dv > \int_0^\infty [w(v, x(v)) - w(E(v), x(E(v)))]f(v)dv = I^*$. But $\int_{v^*}^\infty [w(v, x(v)) - w^*]f(v)dv > \int_0^\infty [w(v, x(v)) - w^*]f(v)dv$ since $w(v, x(v)) < w^*$ for all $v < v^*$. Thus, $\int_{v^*}^\infty [w(v), x(v)) - w^*]f(v)dv > I^*$.

available.◂

Required disclosure of information. In the last stage, if a seller obtains information and therefore reveals v, he will ask for and receive w(v, x(v)). If he does not obtain information and is silent, he will obtain w* given again by (14), but the mean of v among silent sellers will now be E(v), so that

(17) $w^* = w(E(v), x(E(v)))$.

Consequently, the value of information to a seller is

(18) $\int_0^\infty [w(v, x(v)) - w(E(v), x(E(v)))]f(v)dv = I^*$.

Accordingly, we have

Proposition 6. Suppose that information about the good has social value and that disclosure is required. Then

(a) the private value of information equals the social value and behavior is socially optimal.

(b) Sellers acquire information if and only if their costs are below the social value of information I*.

(c) Sellers who acquire information then disclose it.

(d) Buyers choose optimal amounts of investment given the information sellers supply them.◂

2.1.3. Conclusion. It has been seen that the obligation to disclose information is socially beneficial in both the cases where information does and does not have social value. Allowing sellers to choose whether to disclose information is socially undesirable for two reasons. First, it gives them a socially excessive motive to obtain information because they can conceal unfavorable information. Second, their failure to disclose socially valuable information is itself undesirable.

2.2 Buyers May Acquire Information

Let us reconsider the model, using the same notation, but assuming that it is buyers who alone can acquire information and that their sequence of actions is like that of sellers above. In particular, buyers initially choose whether to acquire

information and whether or not to disclose it, if disclosure is voluntary. Then buyers make offers to sellers and, in the case where information has social value, the good is used in a way reflecting available information.

Because the buyer makes an offer to the seller, we now have to specify the value of a good to the seller (before we did not, as we assumed that the seller made a demand to the buyer, except as discussed in the remarks following Proposition 2). We will assume that the value of a good to the seller is less than the value to a buyer by a constant amount. This captures the idea that sellers are in the market as sellers -- for they value the goods systematically less than do buyers.

2.2.1. Information has no social value. Let

k = difference between a seller's and a buyer's value of the good; $k > 0$;

so that

(19) $v - k$ = seller's value of the good.

Social optimality. As in the last case, the following is clear.

Proposition 7. Suppose that information about the good has no social value. Then it is socially optimal for buyers not to acquire information about their goods.◂

Voluntary disclosure of information. At the final stage, a buyer who has acquired information and reveals v will make an offer to purchase of $v - k$, the value to the seller, which the seller will just accept. A buyer who is silent will make an offer to purchase of $v^* - k$, where $v^* - k$ is the least that sellers will accept from silent buyers. Hence,

(20) v^* = mean of v conditional on buyers being silent.

At the preceding stage, the following describes whether a buyer who knows v will reveal it.

(21) $v \leq v^*$ implies buyer will reveal v and pay $v - k$.
$v > v^*$ implies buyer will keep silent and pay $v^* - k$.

That is, buyers reveal bad news, not good news. The value of information to a buyer is

$$(22)\quad I = \int_0^{v^*} (v^* - v)f(v)dv;$$

and (4) and (5) describe when buyers will acquire information and the total amount spent on information. Also, (20) can be rewritten in a way analogous to (6),

$$(23)\quad v^* = (1 - p(I))E(v) + p(I)E(v|v > v^*)$$

where

$$(24)\quad p(I) = (1 - F(v^*))G(I)/[1 - G(I) + (1 - F(v^*))G(I)].$$

It will be assumed that (23) has a solution;[26] and because $E(v|v > v^*) > v^*$, it is apparent that any solution obeys $v^* > E(v)$, reflecting the presence among silent buyers of those who are voluntarily silent because their true v exceeds v^*. In summary, we have

Proposition 8. Suppose that information about the good has no social value and that disclosure of information is voluntary. Then

(a) buyers with costs of acquiring information below a threshold I (given by (22)) obtain information and others do not.

(b) The resources spent on acquiring information are a social waste.

(c) Buyers who acquire information and learn that their information exceeds a threshold level v^* (determined by (23)) keep silent and pay $v^* - k$; other buyers reveal their information v and pay $v - k$, which is less than $v^* - k$.◂

Required disclosure of information. In this case, proceeding in a way analogous to that in 2.1.1, we obtain

Proposition 9. Suppose that information about the good has

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[26]If (23) has a solution, it must be that $b(v^*) = (1 - p(I(v^*)))E(v) + p(I(v^*))E(v|v > v^*)$ equals v^* for some v^*, where $I(v^*)$ is given by (22). Now since $b(v^*)$ is at least $E(v)$, we can restrict attention to $v^* \geq E(v)$. At $v^* = E(v)$, $b(E(v)) > E(v)$. As v^* increases, there seems to be no reason why $b(v^*)$ cannot remain above v^*. In particular, as $v^* \to \infty$, $E(v|v > v^*) \to \infty$, so that $pE(v|v > v^*) \to \infty$ and $b(v^*) > v^*$ for all v^* seems possible, in which case (23) has no solution.

no social value and that disclosure of information is required. Then

(a) no buyers spend to acquire information, so the outcome is socially optimal.

(b) All buyers offer and pay $E(v) - k$ to sellers.◂

2.2.2. Information has social value. Assume that the situation is the same as in 2.1.2 except that, if the buyer does not purchase the good, the seller's value is $vr(x) - x - k$ because the seller can invest x and obtain a gross return of $vr(x) - k$; that is, continue to assume the seller's value is lower than the buyer's by the constant k.

Social optimality. In this case, (12) again gives the expected value of the good to a buyer if he does not have information and chooses x, and (13) still gives the social value of information I^*. Hence, a buyer should obtain information if its cost is less than I^*, in which case he should choose $x(v)$. However, it is not socially necessary for the buyer to disclose his information to the seller, for it is only the buyer who needs this information (the buyer ought to receive the good, since he values it more). Thus, we have

Proposition 10. Suppose that information v about the good has social value because it affects the optimal level of investment x in the good. Then socially optimal behavior is as follows.

(a) Buyers whose cost of information is less than its social value obtain information.

(b) It is irrelevant whether buyers who have information disclose it to sellers;

(c) A buyer who has information v invests $x(v)$, and a buyer who does not have information invests $x(E(v))$.◂

Voluntary disclosure of information. In the last stage, if a buyer reveals v, he will offer and pay $w(v, x(v)) - k$, which the seller will just accept. If a buyer is silent, he will pay $w^* - k$, where w^* is of the form (14). A buyer will reveal information if and only if $w(v, x(v))$ is less than w^*, that is,

if and only if v is less than $v^* = E(v|\text{silence})$. The value of information to a buyer involves two elements: saving $w^* - w(v, x(E(v)))$ when v is less than v^* and he reveals v;[27] and gaining $w(v, x(v)) - w(v, x(E(v)))$ when v is at least v^* and he remains silent.[28] The value of information to a buyer is thus

$$(25) \quad I = \int_0^{v^*} (w^* - w(v, x(E(v)))f(v)dv + \int_{v^*}^{\infty} (w(v, x(v)) - w(v, x(E(v)))f(v)dv.$$

This can be demonstrated to exceed the social value I^*.[29] Buyers will acquire information if and only if $c \leq I$, and (23) will determine v^*, but where I in (23) is determined by (25). In summary, we have

Proposition 11. Suppose that information about the good has social value and that disclosure is voluntary. Then

(a) the value of information to buyers I (given by (25)) exceeds the social value of information I^*.

(b) Buyers with costs of acquiring information below I obtain information and others do not.

(c) The amount spent by buyers on information is socially

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[27]To demonstrate this, observe that with information, his net return is $w(v, x(v)) - (w(v, x(v)) - k) = k$; without information his net return is $w(v, x(E(v))) - (w^* - k)$; subtracting, we obtain $w^* - w(v, x(E(v)))$.

[28]If he has information, his net value is $w(v, x(v)) - (w^* - k)$; if he does not have information, his net value is $w(v, x(E(v)) - (w^* - k)$; the difference is $w(v, x(v)) - w(v, x(E(v)))$.

[29]Since $w^* > w(v, x(v))$ for $v < v^*$, we have

$$\int_0^{v^*} (w^* - w(v, x(E(v)))f(v)dv > \int_0^{v^*} (w(v, x(v)) - w(v, x(E(v)))f(v)dv.$$

Hence, from (25),

$$I > \int_0^{v^*} (w(v, x(v)) - w(v, x(E(v)))f(v)dv + \int_{v^*}^{\infty} (w(v, x(v)) - w(v, x(E(v)))f(v)dv$$

$$= \int_0^{\infty} (w(v, x(v)) - w(v, x(E(v)))f(v)dv = I^*.$$

excessive.

(d) Buyers who acquire information and learn that their information is less than a threshold level v^* reveal v and pay $w(v, x(v)) - k$; other sellers keep silent and pay $w^* - k$, which is less than $w(v, x(v)) - k$.

(e) Failure to disclose information by buyers who have information is not itself socially undesirable, since they purchase the good and use their information.◂

Required disclosure of information. In the last stage, if a buyer acquires information and thus must reveal v, he will pay $w(v, x(v)) - k$ and will obtain $w(v, x(v))$, so he will gain k. If he does not obtain information, he will pay $w(E(v), x(E(v))) - k$ and obtain $w(v, x(E(v)))$, so gain $w(v, x(E(v))) - w(E(v), x(E(v))) + k$. Accordingly, the value of information to a buyer is

$$(26) \quad I = \int_0^\infty [w(E(v), x(E(v))) - w(v, x(E(v)))]f(v)dv = 0.$$

Hence, no buyers will acquire information, and we have

Proposition 12. Suppose that information has social value and that disclosure is required. Then

(a) No buyers will acquire information (so that none will disclose it).

(b) Buyers purchase goods at the price $w(E(v), x(E(v))) - k$.◂

We can compare the desirability of required disclosure and voluntary disclosure. The outcome, and thus social welfare, is the same under required disclosure and under voluntary disclosure with regard to all buyers for whom $c > I$, for under voluntary disclosure, they will not obtain information. Under voluntary but not required disclosure, buyers for whom $c \leq I$ will acquire information and use it (whether or not they reveal it). Hence, the effect of voluntary disclosure is that for each buyer for whom $c \leq I$, there is an expected social gain equal to I^* achieved at a cost c. It follows that voluntary disclosure of information is superior to required disclosure if and only if

$$(27)\quad \int_0^I (I^* - c)g(c)dc > 0 \quad \text{or} \quad F(I)I^* > \int_0^I cg(c)dc.$$

The second condition is that the increase in value of goods due to information exceeds the costs of its acquisition among buyers for whom $c \leq I$. Condition (27) is also equivalent to

$$(28)\quad \int_0^{I^*} (I^* - c)g(c)dc > \int_{I^*}^I (c - I^*)g(c)dc,$$

The term on the left in (28) is the net social gain due to socially desirable acquisition of information, and the term on the right is the net social loss due to socially undesirable acquisition of information (the loss is positive because $I^* < I$). We therefore have

Proposition 13. Suppose that information has social value. Then voluntary disclosure of information is socially preferable to required disclosure if and only if, under voluntary disclosure, the social gain from those who desirably acquire information exceeds the social loss from those who acquire information even though its cost exceeds its value (see (28)).

2.2.3. Conclusion. We have seen that when buyers are the ones who may acquire information, the situation when information has no social value is analogous to the case when sellers acquire information: allowing voluntary disclosure of information is socially undesirable because it encourages expenditure on information acquisition.

However, when information is socially valuable, the results here are different from before. When disclosure is required, the incentive of buyers to acquire information is eliminated, rather than being reduced to the socially optimal level. Hence, for buyers to be induced to acquire information, they must be allowed to decide whether to disclose it.

It follows that, when information has social value, either required or voluntary disclosure of information could be socially better (depending on (27) or (28)).

3. Discussion

I now consider several issues going outside the model and how the conclusions would be affected by various changes in assumption.

(a) *The identity of the parties making offers.* In the model, the parties who may acquire information make offers, but this assumption is not crucial. Consider the situation where sellers may acquire information that does not have social value and suppose, unlike in the model, that buyers make offers. If a seller reveals his value v, he then will be offered v - k by the buyer and sell for that amount; otherwise, if a seller is silent, he will receive v* - k, for some appropriate v*. Hence, sellers will voluntarily reveal v if and only if v > v*. Thus, just as was true in the model, the value of information for sellers will be positive and the outcome will not be socially optimal.[30] Moreover, if disclosure of information is required, sellers will not acquire information,[31] and the outcome will be optimal. Thus, the conclusions will be the same as in the model. Consider next the situation where information has social value and assume that disclosure by sellers is required.[32] Then, again as was true in the model, sellers will have the socially correct incentive to acquire information, for a seller who obtains information and reveals v will obtain $w(v, x(v)) - k$.[33]

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[30]Eq. (3) will still determine the value of information and (4) and (5) will continue to apply. The determination of v*, however, will be different. On one hand, v* must be such that sellers who do not acquire information are willing to sell; hence we must have $v^* - k \geq E(v) - k$, or $v^* \geq E(v)$. On the other hand, buyers must be willing to pay v* - k; thus, $v^* - k \leq E(v|\text{silence}) = (1 - p(I))E(v) + p(I)E(v|v \leq v^*)$, where p(I) is defined by (7). That is, v* must satisfy $E(v) \leq v^* \leq E(v|\text{silence}) + k$. This condition can be satisfied for a range of v*, so the equilibrium, defined in this way, is not unique.

[31]A seller who acquires information and discloses it will receive v - k, so that his expected revenue is E(v) - k, which is what he will receive if he does not acquire information. The value of information to him is therefore zero.

[32]For brevity, I omit the case where disclosure is voluntary.

[33]If the seller does not obtain information, he will be paid w(E(v), x(E(v))) - k, so that the expected value of information is $\int_{\infty}[w(v, x(v)) - w(E(v), x(E(v)))]f(v)dv$, which equals I*.

Now consider the situation where buyers may acquire information that has no social value and suppose that sellers make offers. Then if a buyer reveals v, the seller will demand v. Thus, a buyer will voluntarily reveal v if and only if v is less than the equilibrium v*, and it is again apparent that the situation will be essentially the same as in the model. Also, in the case where information has social value, information will have no value to buyers if its disclosure is required: for then the seller will charge the buyer who acquires and reveals v the amount $w(v, x(v))$.[34] In sum, the qualitative nature of the conclusions is not sensitive to the assumption in the model about which party makes offers.

(b) *The possibility that bargaining results in division of surplus between buyer and seller.* In the model, because one party made a single, take-it-or-leave-it offer, the surplus was appropriated entirely by one or the other party (as was just seen, in (a), it does not matter by which party).[35] What if different assumptions about bargaining are made such that a positive fraction α of surplus from a transaction is enjoyed by the buyer and a positive fraction $1 - \alpha$ is enjoyed by the seller? In this case, it will still be true that parties will have a positive incentive to acquire information when its disclosure is voluntary (although the private value of information will be lower), so that required disclosure will still be best when information has no social value. When information has social value, however, the amount that sellers can obtain for it will not be its full social value, but only α of the social value. Hence, it is possible that allowing voluntary disclosure by sellers will be preferable to requiring disclosure. Also,

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[34]Hence, the buyer's expected return is zero if he discloses information. If he does not acquire information, he will be charged $w(E(v), x(E(v)))$, so his expected return will also be zero. Thus, information will have no value to him.

[35]Of course, the assumption that one side captures the entire surplus is sometimes appropriate: notably, in a setting with many buyers competing for sellers' goods, sellers would be expected to capture the entire surplus from their transactions.

requiring disclosure by buyers will be preferable to allowing voluntary disclosure more often than was true in the model (for buyers will place a positive value on information under the presently considered assumption).

(c) *Fundamental nature of asymmetry of position between buyers and sellers.* One of the main conclusions from the model was that disclosure of information discourages buyers, but not sellers, from acquiring socially valuable information. The reason for this conclusion, recall, was that because a buyer is someone who, by definition, is seeking to acquire property rights in a good but does not possess them, his revealing information that can raise the value of the good will not improve his bargaining position. By telling the seller what he knows, the buyer gives the seller more bargaining power, allows the seller to charge more for the good, because the good is now worth more to the seller. By contrast, when the seller discloses information that can raise the value of his good, the seller is able to collect more for the good because he does enjoy property rights in the good when he is bargaining. This appears to be a fundamental difference between the positions of buyers and sellers. Thus, I would expect that in many models different from the one I studied -- such as a model in which a seller cannot use the good himself but can sell to another buyer (see (e) below) -- the conclusion would still hold that requiring disclosure would more strongly reduce buyers' incentives to acquire socially valuable information than it would reduce sellers' incentives.

(d) *Credibility of revealed information.* It was assumed in the model that if a party revealed information, he would be believed. This assumption is appropriate if false statements are punished or if the validity of the information can be directly verified, guaranteed by a third party (such as a firm specializing in geological surveys), or warranted in some way.

If information cannot be conveyed credibly, however, a party cannot gain any advantage from revealing it in bargaining. Hence, disclosure rules are irrelevant, and the value of

information to a party is solely that he may use the information himself. It follows that when information does not have social value, that is, when it cannot raise the value of a good, information will not be acquired. When information does have social value and it is sellers who may acquire information, it is possible that they will decide to acquire information, but only if they might decide to keep the good for their own use. When it is buyers who may acquire information, they will have the socially optimal motive to invest in it.

(e) *Value of a good to a seller: for his own use versus for sale to alternative buyers.* In the model, it was assumed that if a seller did not sell to the buyer with whom he was bargaining, the seller could derive value from the good by using it himself; this value governed the amount the buyer had to offer the seller to induce him to sell. Another possible determinant of the seller's alternative value for the good is the possibility that he could sell it to other buyers. For the most part, taking this determinant into account would not seem to alter the conclusions, but in one respect, it would. Suppose that a buyer reveals unfavorable information to a seller (aerial surveys showing that prospects for the seller's land having valuable deposits of ore are poor) in order to convince the seller to accept a low price. If the seller is able to keep this unfavorable information secret from an alternative buyer, then the present buyer may not be able to drive down the price by very much. In other words, issues surrounding the transferability of information, not just its credibility between the seller and the buyer, become relevant.

(f) *What are the relative abilities of buyers and sellers to acquire information?* In many situations, the seller may enjoy a natural advantage in the ability to acquire information about his good because he possesses the good. Thus, determining the quantity of oil in an underground reservoir may require entry onto the land under which the reservoir is located, or estimating the value of antique jewelry may require that it be handed over to an expert appraiser. In such cases a buyer would be unable

unilaterally to acquire information, and the assumption that the seller alone decides whether to acquire information is apposite.

However, possession of property rights in a good are not always necessary for evaluation of worth. In *Texas Gulf Sulfur,* information about land was gathered by a company that did not own it, using an aerial survey. If a buyer is considering purchasing a business, he may obtain significant information about its earnings prospects (by studying the industry, competitors, and so forth) even though he does not have access to its books. Further, a buyer may sometimes have prior knowledge unknown to a seller that leads the buyer to undertake an investigation (as was the case in *Texas Gulf Sulfur*). Hence, it seems that there are a substantial number of instances in which the assumption that buyers but not sellers choose whether to acquire information approximates reality.

An assumption not considered in the model is that sellers and buyers each have opportunity to acquire information prior to sale, as when either could hire an expert to appraise a piece of undeveloped land (assuming, as would often be true, that the appraiser need not set foot on the land to make the appraisal). Under this assumption, if disclosure is voluntary, it appears that both may have a motive to invest in information, for each knows the other may not disclose what he knows. If disclosure is required, it seems that only if the information is socially valuable would it be acquired, and then only by sellers. These conjectures aside, the assumption of equal access by buyer and seller to information may be worth formal investigation.

(g) *Adventitious acquisition of information.* In the model, acquisition of information was assumed to be the product of intentional, costly, effort by the buyer or by the seller. In fact, however, information may come to a party by accident (as I pass by a second-hand book store, I notice a rare book worth thousands of dollars marked for $5) or as a concomitant of ownership (by virtue of living in my house, I learn whether the basement leaks after a heavy rain). To the degree that this is

the case, the issue of incentives to acquire information is moot; thus the freedom to keep information secret is not needed to spur its acquisition, and mandatory disclosure becomes attractive.[36]

(h) *Acquisition of information prior to sale versus after sale.* Thus far, acquisition of information has been assumed to take place prior to sale; acquisition of information after sale has not been taken into account. What issues does the latter possibility raise? When information has no social value, acquisition of information after sale has no relevance: no buyer would rationally engage in costly acquisition of information after making a purchase if it could not be used to raise the value of his good. When, however, information does have social value, the situation changes, and it seems that the value of information, both private and social, would be attenuated by the opportunity of buyers to obtain information after making purchases.

(i) *Enforcement of requirements to disclose information.* Whereas it was assumed in the model that disclosure of information could be compelled, actual enforcement of disclosure rules is a nontrivial problem for the law. Enforcement requires discovery of concealment of information, and one suspects that our ability to uncover instances of this behavior is not great. A low probability of detecting concealment, though, can sometimes be offset by a high penalty, so that enforcement might be effective. If it is not, then we are, de facto if not de jure, in a regime in which disclosure is voluntary.

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[36]This point is stressed by Kronman (1978).

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