Truthful Disclosure of Information

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Truthful disclosure of information

Boyan Jovanovic*

This article is about disclosure of quality. The question that it seeks to answer is: Does the free market offer enough incentive for business to disclose? The article concludes that whether information is of purely private value or not, more than the socially-optimal amount of disclosure takes place. The optimal policy is for the government to subsidize sale without disclosure. The article offers no support for the policy of mandatory disclosure. The results should be viewed with care, however, as they seem to depend on special features of the model, in particular the assumed impossibility of misrepresentation.

1. Introduction

This article investigates whether the free market offers sellers enough incentive to disclose information about the quality of their product.

The issue of disclosure is a sensitive one. The law requires that in some markets, business must disclose quality—for example, sellers of gasoline must post its octane rating. Since disclosure is not costless, this has resulted in complaints that such laws waste resources.

The way this article treats disclosure is exactly the opposite of the way Akerlof (1970) does: He assumes that truthful, credible disclosure is prohibitively expensive, and that since all sellers would misrepresent quality, their claims are meaningless. Here I assume the opposite: While it may be costly, truthful disclosure is feasible, and misrepresentation is impossible. This amounts to assuming that the prospect of litigation and of loss of future business is enough to stop the seller from making a false claim. As a result, this article is silent on the effects of false claims or the threat of false claims. By way of compensation, though, the article does offer some clear results.

It concludes that whether information is of purely private value (in the sense that its disclosure leads merely to a redistribution of final allocations rather than to an increase the sum of these allocations) or not, more than the socially-optimal amount of disclosure takes place—this is similar to the result of overinvestment in the signal in Spence's (1973) example. The inefficiency can be eliminated, though, by a subsidy to sale without disclosure. A tax on disclosure is an inferior policy, and so is a policy of mandatory disclosure.

2. The model

The model has two interpretations. In the first, information and its disclosure yield only private gains—they only lead to a redistribution of income among sellers. In the

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1 Federal Trade Commission (1972). Government-mandated business disclosure has been the subject of much debate. For the free-market view, see Posner (1979); for the interventionist view, see Pitofsky (1979).

2 Costs of disclosure can be high. See Beales et al. (1980).
second interpretation, information raises welfare, because it leads goods to be traded from people who value them less, to people who value them more.

- **Purely private returns to disclosure.** Let

\[ \theta = \text{the quality of a commodity} \]
\[ s = \theta + \epsilon = \text{a signal of quality}. \]

Here \( \epsilon \) is an observation error with mean zero; \( \theta \) has mean \( \bar{\theta} \). Further, \( \theta \) and \( \epsilon \) are independently distributed. Let \( E(\theta|s) \) be the conditional expectation of \( \theta \), given the signal. There is a large number of sellers. Each seller has one unit of the good. He does not know its quality, but he privately observes a signal \( s \) which he may credibly and truthfully disclose to buyers at a cost \( c \).

Sellers get zero utility from the good. The value zero is arbitrary; what is important is that the value that the seller places on the good is not related to \( s \) (or to \( \theta \) which he does not know). We assume that \( \theta_{\min} > 0 \).

The number of potential buyers is large, so that the price of each good is bid up to its expected value to buyers.

Let \( s_{\max} \) denote the highest value (possibly infinite) of the signal, and \( s_{\min} \) the lowest value.

**Theorem 1:** If \( E(\theta|s) \) is increasing in \( s \), and if \( E(\theta|s_{\max}) - c > \bar{\theta} \), then for any \( c > 0 \) there exists a number \( \tilde{s} \) such that all sellers with \( s > \tilde{s} \) disclose, while those with \( s \leq \tilde{s} \) do not. Further, \( \tilde{s} \) satisfies

\[ E(\theta|\tilde{s}) - c = E(\theta|s \leq \tilde{s}). \] (1)

**Proof:** First we show that (1) always has at least one solution for \( \tilde{s} \). Since \( \theta \) and \( \epsilon \) both have density, both the right-hand side and the left-hand side of (1) are continuous. At \( s_{\max} \) the right-hand side is equal to \( \bar{\theta} \), so that it is smaller than the left-hand side. At \( s_{\min} \) the right-hand side is equal to \( E(\theta|s_{\min}) \) and is therefore larger than the left-hand side. Then by continuity, there is at least one \( \tilde{s} \) at which (1) holds. So the seller with signal \( \tilde{s} \) is indifferent between disclosing and not disclosing. Since \( E(\theta|s) \) is monotonic in \( s \), all sellers with \( s > \tilde{s} \) are better off if they disclose, and all those with \( s < \tilde{s} \) are better off if they do not. \( Q.E.D. \)

**Remark:** \( \tilde{s} \) is not necessarily unique; more than one value of \( \tilde{s} \) may satisfy (1).

Note that \( s_{\min} < \tilde{s} < s_{\max} \) so that while a positive fraction of sellers discloses, there always are some who do not. See Figure 1.

Two things are of note here. First, disclosure is a social waste, because the gains are entirely private. This type of overinvestment appears in most signaling models, beginning with Spence (1973). Second, it is the **higher quality sellers that disclose.** This result agrees with the results of Spence (1973) and Stiglitz (1975); they also imply a positive relation between quality and signaling.

If \( c = 0 \), then everyone discloses, for then (1) cannot hold as an equality except for the lowest seller, and he would be indifferent between disclosing and not disclosing. A similar result is proved by Stiglitz (1975) and by Grossman and Hart (1980).

- **Socially valuable information.** As before, let \( \theta \) be the quality of the good. Let \( \epsilon \) be the quality of the match between the good and a trader. Now let \( s = \theta + \epsilon \) be the value to the trader of owning the good. He knows \( s \), but not \( \theta \) or \( \epsilon \). If the good is traded, the new owner gets utility \( s' = \theta + \epsilon' \), where \( \epsilon' \) (the quality of the new match) is independent of \( \epsilon \).
As a description of the preferences of buyers and of sellers, this set-up may seem restrictive, and in some respects it is: utility is additive in the quality and match variables, everyone is risk-neutral, and the only real difference between a buyer and a seller is that the seller has some of the good, while the buyer has none. On the other hand, we wish to highlight the nonhierarchical nature of quality in many markets; the independence of $\epsilon$ and $\epsilon'$, along with additivity and risk-neutrality, provides us with a tractable way of doing so.

Before we proceed with the analysis, let us discuss some examples of markets in which one can describe preferences in this way. Take Akerlof's used car market, for example. Is there a problem of matching cars to owners? Clearly, the answer is yes. The uses of a car are many: you may need the car to make infrequent but longer trips, while I may use it to make short, frequent trips. Our driving time may be the same, but your use of the car puts more strain on the tires and on the fuel-injection system, while mine is more taxing on the transmission and on the starter. Then $\bar{\theta}$ can be the average quality of all of the car's components, and $\theta$ the quality of those components on which one's driving habits place a heavy strain.

Another example is the labor market, where workers match with jobs. Let $s$ be the worker's productivity, $\theta$ his ability, and $\epsilon$ the quality of the match between him and his employer. The independence of $\theta$ and $\epsilon$ means that the able worker is no more likely to find a good match than is anyone else. The worker's productivity with his current employer, $s$, is known to them; they may, if they so wish, disclose it to others at a cost $c$. By analogy to the product market, we assume that it is too expensive to screen for $s$, $\theta$, or $\epsilon$ before employment begins, and it is impossible to find out whether a worker is productive because of his ability, or because he matches well with his job. We continue the analysis in terms of the product market. The translation to the labor market will be clear.

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3 Greenwald (1980), Johnson (1978), and Jovanovic (1976) use this decomposition of productivity to study turnover.
Let $p(s)$ be the price of a good with a disclosed signal $s$. Let $\bar{p}$ be the price of a good about which nothing is disclosed by the seller. The seller then has three options:

(i) disclose $s$ truthfully at a cost $c$, and sell the good, getting $p(s) - c$ as his net return;
(ii) disclose nothing and sell the good, and get $\bar{p}$;
(iii) keep the good and get $s$; that is, the seller withdraws from the market.

Many identical buyers are again assumed; they bid up the price of each good to its expected value:

$$p(s) = E(s'|s) = E(\theta|s)$$

(the second equality holds because of the independence of $\epsilon$ and $\epsilon'$). We assume that $E(\theta|s)$ is monotonically positive. Then, since the appeal of the first and the third option goes up with $s$, this establishes

**Lemma 1:** If a seller observing $s = s_o$ chooses the second option, so do all sellers for whom $s \leq s_o$.

Next we impose a “regularity” condition on $E(\theta|s)$: For any $s'$ and $s''$,

$$|E(\theta|s') - E(\theta|s'')| < |s' - s''|.$$  

This condition requires $E(\theta|s)$ to have slope less than one as $s$ varies. It means that when forming expectations, a fraction of any increase in the signal is attributed to $\theta$, and only the rest to $\epsilon$.

**Theorem 2:** if $E(\theta|s)$ is monotonically increasing in $s$, and if (3) holds, then one of the following three kinds of equilibrium exists:

(a) If $c = 0$, then there exists a unique number $\bar{s}$ such that sellers with $s \geq \bar{s}$ choose option (iii), and sellers with $s < \bar{s}$ choose option (i). No seller chooses option (ii).

(b) If $c$ is sufficiently large, then there exists a number $\delta$ such that all sellers with $s \geq \delta$ choose option (iii), and all sellers with $s < \delta$ choose option (ii). No seller chooses option (i).

(c) If $c$ is positive but not very large, then there are two numbers $s_1$ and $s_2 (s_1 < s_2)$ such that sellers with $s \geq s_2$ choose option (iii), sellers with $s \in (s_1, s_2]$ choose option (i), and sellers with $s < s_1$ choose option (ii).

**Proof:** This proof is simple, but long; we leave it for the Appendix.

The claims of Theorem 2 are simple. Part (a) says that if disclosure is costless, all sellers who sell their goods disclose. This equilibrium is shown in Figure 2. Since $E(\theta|s)$ has slope less than one, every seller to the left of $\bar{s}$ is better off if he discloses. Since disclosure is costless, all sellers who sell also disclose. For, by Lemma 1, if seller $s_o$ does not disclose (but sells the good at $\bar{p}$) then neither does any other seller with $s \leq s_o$. But then the highest seller ($\delta$) who does not disclose will want to disclose, as $E(\theta|\delta) > E(\theta|s \leq \bar{s})$.

Part (b) says that if disclosure is expensive enough no seller will use it. Whatever sales do take place in such an equilibrium occur without disclosure. This is shown in

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$4$ This is not a strong restriction. Since $s = E(\theta|s) + E(\epsilon|s)$, a sufficient condition for inequality (3) to hold is that $E(\theta|s)$ and $E(\epsilon|s)$ are both monotonically positive. If $\theta$ and $\epsilon$ are normally distributed with variances $\sigma^2_\theta$ and $\sigma^2_\epsilon$, then

$$E(\theta|s) = \bar{\theta} + \frac{\sigma^2_\theta}{\sigma^2_\theta + \sigma^2_\epsilon}(s - \bar{\theta})$$

so that condition (3) is satisfied. More generally, if $E(\theta|s)$ is required to be linear in $s$, then the inequality (3) holds for all nondegenerate distributions of $\theta$ and of $\epsilon$ (see Diaconis and Ylvisaker, 1977).
Figure 3. Of course, here $\bar{p} = E(\theta|s \leq \delta)$, and for seller $\delta$ to be indifferent between his second and third options, one must have $\delta = \bar{p}$.

Part (c) says that for some values of $c$ that are positive but not too large, among the sellers who stay in the market, some disclose and some do not. This is shown in Figure 4. Seller $s_1$ is indifferent between the first and second options (but finds the third inferior) so that

$$E(\theta|s \leq s_1) = E(\theta|s_1) - c > s_1,$$

while seller $s_2$ is indifferent between the first and third options (but finds the second inferior) so that

$$E(\theta|s \leq s_2) < E(\theta|s_2) - c = s_2.$$

Note that it is the high-quality sellers that withdraw from the market, and the low-quality goods that are traded. As we shall see, it is optimal that this should take place. The withdrawal of high-quality sellers usually brings to mind Akerlof's adverse selection principle, but we have shown that it may take place even if, at the time that
trade takes place, informational symmetry prevails between buyers and sellers. It remains true, though, that before disclosure, sellers know more than buyers.

**Welfare.** When disclosure is costless (Case (a)), the market solution is socially optimal. Equilibrium is (in all three cases) such that all the gains from trade go to the sellers, and trade in this equilibrium maximizes these gains.

When disclosure is too costly (Case (b)), there is too little trade, and a subsidy to the active sellers would improve welfare in the sense that the gains from trade would go up. Society would be at an optimum if trade took place for all signals $s$ for which $E(\theta|s) > s$ (that is, for all $s < \bar{s}$ in Figure 2) and if no disclosure costs were incurred. There is too little trade if $\hat{s} < s$. To prove that $\hat{s} < s$, note that in the equilibrium of type (b), seller $\hat{s}$ is indifferent between keeping the good and selling it at $\hat{p}$:

$$\hat{s} = \hat{p} = E(\theta|s < \hat{s}) < E(\theta|\hat{s})$$

so that $\hat{s} < E(\theta|\hat{s})$. But since $\hat{s} = E(\theta|\hat{s})$, condition (3) implies that $\hat{s} < \bar{s}$. So a subsidy to the seller of size $x$ is needed for which

$$E(\theta|s < \bar{s}) + x = \bar{s},$$

that is, so that seller $\bar{s}$ is indifferent between selling the good and keeping it. The subsidy is strictly positive, because $E(\theta|s < \bar{s}) < E(\theta|\bar{s}) = \bar{s}$. The gain to society from the subsidy is

$$\int_{\hat{s}}^{\bar{s}} (E(\theta|s) - s)h(s)ds,$$

where $h(\cdot)$ is the density of the signal. This does assume, though, that the subsidy is financed by a lump-sum tax which does not lead to distortions elsewhere.

In case (c), there are two inefficiencies. First, fewer than the optimal number of goods are traded. In Figure 4 it is seen that $s_2 < \bar{s}$. Second, all sellers in the interval $[s_1, s_2)$ are incurring disclosure costs. Therefore, again a subsidy of the amount $x$—the
same $x$ that solves (7)—would improve welfare and would bring about the optimal amount of trade. The gain from the subsidy is

$$\int_{s_1}^{s_2} h(s) ds + \int_{s_2}^{s} [E(\theta|s) - s] h(s) ds.$$ 

Of course, when $c = 0$, then $s_2 = \bar{s}$, and the gain is zero.

A subsidy equal to $x$ would eliminate all disclosure, because all sellers with $s \geq \bar{s}$ would withdraw from the market, while sellers with $s < \bar{s}$ would sell without disclosing.

In both cases (b) and (c), however, the change in welfare is not a Pareto improvement: someone is made worse off. If the government knew each seller’s $s$, it could collect the tax from the appropriate sellers in the form of a lump-sum tax and then return it to them (conditional upon the seller’s actually making a sale) as a subsidy, thereby making everyone at least as well off as before. However, the seller’s information is private to him, so such a scheme is not feasible.

A tax on disclosure (instead of a subsidy on sale without disclosure) would not lead to the same outcome. While the amount of resources spent on disclosure might go down (the number disclosing is $H(s_2) - H(s_1)$, and while $s_2$ is sure to go down in response to the tax, $s_1$ may move either way), the amount of trade, already at a suboptimal level, would decline because $s_2$ does. Of course, subsidizing disclosure is also an inferior policy, because, while it increases the amount of trade ($s_2$ increases), it is also likely to lead to an increase in the total amount of real resources, $c[H(s_2) - H(s_1)]$, that are spent on disclosure.

3. Conclusion

The main result of this article is that in a world where false claims cannot occur, the free market offers ample incentives for disclosure. These incentives are so large, in fact, that the government would raise welfare if it were to subsidize sale with no disclosure. Needless to say, the analysis provides no support for a policy that makes business disclosure mandatory.

These results are strong, but the specialized nature of the model limits their relevance for policy. Let us close by pointing to three things in the model which, as much as anything, lead to its conclusions.

First, the signal gives no information on where the good should finally be allocated, but only on whether the seller should part with it. This is one reason why welfare can be at a maximum when there is no disclosure. If, instead, disclosure were to indicate which of the buyers was likely to value the good most, then one can think of situations in which disclosure would be desirable.

Second, the distribution of quality is exogenous. In fact, one would expect this distribution to be sensitive to the way in which goods are traded. If sellers disclose quality, $p(s) = E(\theta|s)$, and, depending how accurate the signal is, the seller gets a reward for improving the quality of his product. Now, if equilibrium involves no disclosure on the part of sellers in the lower range of quality, then none of them has any incentive to produce at a quality higher than the minimum. So, ex ante, optimality seems to require more disclosure than is optimal ex post. Curiously, this is quite the opposite of Hirshleifer’s (1971) conclusion on ownership rights (patents) on information that is generated at a cost: there, ex ante, optimality requires no disclosure (patents), while ex post, it is optimal to disclose the information (no patents).

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5 Here $H(\cdot)$ is the cumulative density function of the signal.

6 This was pointed out to me by Steve Shavell.

7 This assumes away dynamic considerations such as loss of business.

8 Ex post in the sense of a given distribution of quality.
Finally, the article stresses "brand-specific" information: consumers know the distribution of quality. Whatever the seller may disclose does not cause demanders to revise their opinions on the quality of the other products sold in the market. If they did not know the distribution of quality, there would be an externality: the seller's disclosures would teach consumers not just about his product, but about the products of his competitors as well.

Appendix

Proof of theorem 2

(a) If equation (3) holds, then there is a unique value \( \hat{s} \) at which \( E(\theta|s) = \hat{s} \), and such that \( E(\theta|s) \leq s \) as \( \hat{s} \leq s \). All that remains to be shown is that option (ii) cannot be preferred. But when \( c \) is zero, option (i) is always preferred, because \( \bar{p} = E(\theta|s < 1) \leq E(\theta|\hat{s}) \) for any value of \( \hat{s} \).

(b) By assumption, \( c \) is so large that disclosure is not a relevant alternative. At \( s_{\text{min}} \), \( E(\theta|s_{\text{min}}) = E(\theta|s < s_{\text{min}}) > s_{\text{min}} \), while \( E(\theta|s < s_{\text{max}}) < s_{\text{max}} \). Therefore, by continuity there exists at least one value \( \hat{s} \) such that \( E(\theta|s) \leq \hat{s} = \hat{s} \). Then, clearly all sellers with \( s < \hat{s} \) will choose option two, while the rest will withdraw from the market.

(c) For any \( c > 0 \), the existence of the signal level \( s_1 > s_{\text{min}} \) such that all sellers with \( s \in [s_{\text{min}}, s_1) \) choose option two, is proved by a combination of the proof of part (b) together with the proof of Theorem 1, so that, the argument is not repeated here. The remainder of the proof proceeds by choosing \( c \) sufficiently small that the assertions in part (c) are true. The definition of \( s_1 \) is that it must satisfy \( E(\theta|s \leq s_1) = E(\theta|s_1) - c \). Let \( s_1(c) \) denote the solution for \( s_1 \) for a given \( c \). The solution to this equation is not necessarily unique, therefore \( s_1(c) \) is a correspondence. However, any member of this correspondence must tend to \( s_{\text{min}} \) as \( c \) tends to zero. Suppose that there were some \( s^* > s_{\text{min}} \) such that some member of the correspondence \( s_1(c) \rightarrow s^* \) as \( c \rightarrow 0 \). Since \( s \) has positive density everywhere on \( [s_{\text{min}}, s_{\text{max}}] \), one therefore has

\[
E(\theta|s = s^*) = E(\theta|s^*) - \delta \tag{A1}
\]

for some \( \delta > 0 \). But then \( c \) can be chosen sufficiently small such that equation (A1) is violated.

The definition of \( s_2 \) is that it must satisfy \( E(\theta|s_2) = c = s_2 \). To complete the proof, it is sufficient to prove that \( \lim_{c \to 0} s_2 > s_{\text{min}} \). But if this inequality did not hold, one would have \( E(\theta|s_{\text{min}}) = s_{\text{min}} \), and equation (3) then implies that \( E(\theta|s) < s \) for all \( s > s_{\text{min}} \), that is \( E(s'|s) < s \) for all \( s > s_{\text{min}} \). But then

\[
E(s') = \int E(s'|s)h(s)ds < \int sh(s)ds = E(s),
\]

which is a contradiction, because the unconditional distributions of \( s \) and \( s' \) are the same and must therefore have the same mean. Q.E.D.

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