Honesty in a Model of Strategic Information Transmission

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We consider the following simple model of consumer fraud. Consumers need one of two possible repairs—an expensive repair (denoted E) or an inexpensive repair (denoted I). The exogenous probability that a consumer needs the more costly remedy is r. Each consumer is assumed to know r. An expert can observe with certainty which of the two repairs is needed and can offer to sell either to the consumer. (In a simple extension, we allow for uncertainty with respect to the expert's observation.) We assume that selling the expensive remedy to a consumer who needs only the inexpensive one is more profitable than selling the inexpensive one. Thus, $\Pi(E|I) > \Pi(I|I)$, where Π denotes profit and $|$ denotes "conditional on needing." The profit functions are increasing in the price of the respective repairs. (For convenience, we suppress the dependence of Π on prices in our notation.) We also assume that a consumer prefers to obtain the appropriate repair to the inappropriate one. Thus, $u(E|E) > u(I|E)$ and $u(I|I) > u(E|I)$, where u is the consumer's payoff. Lastly, we assume that the functions $u(E|E)$ and $u(E|I)$ are decreasing in the price of the expensive repair and that $u(I|E)$ and $u(I|I)$ are decreasing in the price of the inexpensive repair. We also assume that $u(I|E)$ is decreasing in the price of the expensive repair since the consumer ultimately buys the expensive repair in this case. (See below for further assumptions regarding the repairs.)

We are interested in the equilibrium levels of honesty in this model. How honest is the expert at the equilibrium? Do consumers always follow the expert's advice? Does the level of honesty increase as the interests of the agents become more similar (in a sense to be defined below)?

Our assumptions are similar to those in the abstract strategic information transmission models of Vincent Crawford and Joel Sobel (1982), and Jerry Green and Nancy Stokey (1980). We follow the former paper which asks whether the signals sent become less noisy as the agents' preferences become more similar. Despite the similarity of our model to Crawford-Sobel's, we arrive at some different conclusions with respect to the expert's honesty vis-à-vis the agents' closeness of interests. We explain this in detail in Section III. In addition we allow that the expert may be uncertain about the true state of the world. We also explicitly model the level of expert honesty, which extends Crawford-Sobel.

The outline of the paper is as follows. In Section I we provide the details of the model and show that a unique equilibrium exists. Comparative static results and a simple extension (incorporating the assumption of the incompetent expert) are given in Section II. We draw comparisons with Crawford-Sobel in Section III. In Section IV we conclude with a brief summary.

I. The Model and the Solution

The model works as follows. First, the expert, knowing the true repair needed, announces the sale of one of the two available repairs to the consumer. The consumer can choose either to obtain this repair or to disregard the advice. For simplicity, we as-

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sume that whenever the expert's advice is ignored, the consumer obtains a remedy from someone else. (For example, in the automobile repair industry, do-it-yourself repairs are possible. In the medical industry, second opinions and alternative treatments are available.)

Finally, we make three additional assumptions concerning the repairs. We assume that the consumer can detect only whether the problem still exists. If the problem no longer exists, the type of repair actually performed is unknown. Thus, the repair is a credence good (see Michael Darby and Edi Karni, 1973). In addition, we assume that the expensive remedy repairs either problem, while the inexpensive one is only good for the inexpensive problem. Suppose that an expert advises a consumer to obtain an inappropriate inexpensive repair. If the consumer acts on this advice, the consumer's problem remains unrepaired. However, then it is clear that the expert lied to the consumer. These assumptions thus make it reasonable to suppose that a liability rule is in effect concerning the sale of an inexpensive repair when an expensive one is necessary. The rule makes the expert liable for advice, which results in the consumer's obtaining an inappropriate inexpensive repair. (For example, a liability rule might require the expert to refund any expenses that the consumer incurs in such an event.) Such a liability rule prevents the expert from profiting by advising consumers to obtain the less expensive remedy when the more expensive one is needed.

The model is described by the strategic game in Table 1, once duplicated and dominated strategies have been deleted. The strategies of the consumer and the expert are as follows. The first character in the consumer's strategy indicates acceptance (A) or rejection (R) of advice to obtain the expensive repair; the second character, acceptance or rejection of inexpensive repair advice. The first character in the expert's strategy indicates telling the truth (T) or not (N), if the true repair needed is the expensive one; the second character, telling the truth or not, if the inexpensive one is needed. (Because of the liability rule, AA and RA dominate AR and RR, respectively, and TT and TN dominate NT and NN, respectively. Thus, the strategic form is as described in Table 1, once dominated and duplicated strategies have been eliminated.) The assumptions on the payoffs made earlier are equivalent to the following:[1] $E_2 > E_1$, $E_3 > E_4$, $C_1 > C_3$. We make the additional assumption that $C_4 > C_2$ in order to create the underlying tension. Otherwise, the expert always lies. (This last assumption is equivalent to an upper bound on r.)

TABLE 1—THE STRATEGIC GAME

		Expert	
		TT	TN
Consumer	AA	(C_1, E_1)	(C_2, E_2)
	RA	(C_3, E_3)	(C_4, E_4)

It is immediate that a unique equilibrium exists, and that this equilibrium is completely mixed. In the equilibrium the expert always tells the truth if the repair needed is the expensive one and tells the truth with probability $0 < \hat{p} < 1$, if the repair needed is the inexpensive one, where

$$(1)\quad \hat{p} = r[u(E|E) - u(I|E)] \div (1-r)[u(I|I) - u(E|I)].$$

The consumer always acts on the expert's advice to obtain the inexpensive repair, and acts on advice to obtain the expensive repair with probability $0 < \hat{q} < 1$, where

$$(2)\quad \hat{q} = \Pi(I|I)/\Pi(E|I).$$

In equilibrium the expert's payoff is $\hat{q}[r\Pi(E|E) + (1-r)\Pi(E|I)]$ and the consumer's is $ru(I|E) + (1-r)u(I|I)$.

[1] The payoffs are as follows: $C_1 = ru(E|E) + (1-r)u(I|I)$, $C_2 = ru(E|E) + (1-r)u(E|I)$, $C_3 = C_4 = u(I|E) + (1-r)u(I|I)$; $E_1 = r\Pi(E|E) + (1-r)\Pi(I|I)$, $E_2 = r\Pi(E|E) + (1-r)\Pi(E|I)$, $E_3 = (1-r)\Pi(I|I)$, $E_4 = 0$.

II. Comparative Statics

In this section we consider the effects of price and quality controls on expert honesty levels and utility levels. The quality we control is that of the product which is in need of repair.

A. *Quality Control*

The quality of the faulty product is indexed by r. Decreasing r lessens the probability that the repair needed is the expensive one. Suppose that r decreases. (This might be achieved by advertising preventive health measures in a medical context, or by regulating automobile product quality in an auto repair context.) To analyze this effect we need to know how both $\hat{p}$ and $\hat{q}$ depend on r. From equations (1) and (2) we see that $\hat{p}$ decreases in r and that $\hat{q}$ is independent of r. Thus, decreasing the probability that the repair needed is costly has the effect of increasing the expert's honesty. In effect, if it is less probable that a consumer needs the more expensive repair, then the expected cost of ignoring the expert's advice (when the expert advises an expensive repair) is lower. Consequently, the expert needs to be more honest than before to keep the consumer from always ignoring this advice. The consumer clearly prefers (i.e., has a higher payoff at) the equilibrium outcomes associated with a lower r, while the expert prefers the outcomes with a higher r (see fn. 1).

B. *Price Controls*

If the price of the expensive repair is decreased, then we assume that $\Pi(E|I)$ decreases, while the difference $\Pi(E|E)-\Pi(E|I)$ remains the same. In addition we assume that $u(E|E)$, $u(E|I)$ and $u(I|E)$ increase, while the difference $u(E|E)-u(E|I)$ remains the same. But then by equations (1) and (2), $\hat{p}$ and $\hat{q}$ both increase. Thus, decreasing the price of the more expensive repair increases both the probability that the expert is dishonest and that a consumer obtains the more costly remedy when advised to. The intuition is as follows. Decreasing the price of the more expensive repair decreases the expected cost of following the expert's advice to obtain the expensive repair. In effect, it allows the consumer to be less particular about choosing the expensive repair (i.e., $\hat{q}$ increases). This, in turn, allows the expert to exploit the consumer's loss of vigilance.

In addition, the lower the price of the expensive repair, the higher the consumer's expected payoff, and the lower the expert's expected profit at the equilibrium outcome (see fn. 1).

Lastly, we consider the effects of an increase in the price of the inexpensive repair. This increase is assumed to result in increases in $\Pi(I|I)$ and in $u(E|E)-u(I|E)$, and a decrease in $u(I|I)-u(E|I)$. Thus, using equations (1) and (2), we obtain higher values for both $\hat{q}$ and $\hat{p}$. In other words, increasing the price of the less costly remedy increases both the dishonesty of the expert and the probability that a consumer obtains the more expensive repair when advised to. The intuition is as follows. Increasing the price of the less costly remedy increases the expected cost of ignoring the expert's advice (when the expert advises an expensive repair). This makes the consumer less particular in listening to advice. This in turn allows the expert to be more dishonest.

With respect to equilibrium payoffs, the consumer is worse off, while the expert is better off at the equilibrium outcome associated with the higher price for the inexpensive repair (see fn. 1).

C. *Expert Competence*

Our model can easily incorporate the existence of an expert who does not always know with certainty the repair that the consumer needs. We extend the model simply by assuming that though an expert detects an expensive repair whenever one is needed, an inexpensive repair is detected with probability s. We can then consider the effects of an increase in expert competence.

We assume that the competence level s and the exogenous probability r are such that an expert's honest opinion is the best predictor of which repair is necessary. Otherwise, the assumptions remain the same.

As before $\hat{p}$ and $\hat{q}$ denote equilibrium values.

In this case,

$$[r(u(E|E) - u|I|E)) - \hat{p} = (1-r)(u|I|I) - u|E|I))(1-s)] \div [s(1-r)(u|I|I) - u|E|I))],$$

and $\hat{q}$ remains the same as before. We see that $\hat{p}$ increases in s and that $\hat{q}$ is independent of s. Thus, an increase in expert competence results in more expert dishonesty. The intuition is as follows. At any given dishonesty level of the expert, an increase in expert competence increases the validity of the expert's advice to obtain an expensive repair. The expert can then take advantage of the situation by becoming more dishonest without affecting the consumer's actions. The expert prefers the equilibrium outcome associated with a higher[2] s, while the consumer is indifferent between levels of[3] s. The earlier comparative static results remain valid under the assumption of an incompetent expert.

III. Comparison with Crawford and Sobel

In Crawford-Sobel, the signal sent to the receiver in equilibrium becomes more informative as the agents' preferences become more similar. In our model the expert does not become more honest in equilibrium as the agents become more similar. The difference lies in the meaning of "more similar."

In the continuous framework of Crawford-Sobel, agents become more similar as a particular parameter (b) of the model approaches zero. This parameter is an index of the distance between the agents' payoff functions. It is also an index of the distance between the receiver's actions which maximize each agent's payoff function in each state. As b becomes smaller, the signaler sends signals with finer partitions in the equilibrium associated with greater similarity of agents (i.e., with smaller b). Thus, as the agents become more similar, the signal sent in equilibrium is less noisy, and both agents are better off. In effect, the benefits from distortion are reduced as agents become more similar. However, as Crawford-Sobel note, a finer partition for the equilibrium signal is not operationally equivalent to the signaler's being more honest.

In our discrete model there are two states of the world and two possible actions the consumer may take. In one state (E) the preferences of the agents are the same. In this state the maximizer of each agents' payoff function with respect to the receiver's (i.e., the consumer's) actions is identical (and equal to E). In the other state (I) the preferences of the agents are opposed. The consumer's payoff-maximizer is I but the expert's is E. Given this discrete model, there is no change in parameters that can alter this divergence of preferences in state I. There is no parameter that plays a role analogous to that played by b in Crawford-Sobel. However, we can change the parameters in such a way that the agents become closer in different ways.

For example, the changes in prices that we consider all have the effect of making the payoff functions closer but leaving the payoff-maximizing actions the same. These price changes decrease the expert's potential gain from lying and the consumer's potential loss from choosing an inappropriate repair. In addition, the change in r that we consider alters the underlying distribution of states. An increase in r results in an increase in the probability of state (E), in which the agents' preferences coincide so that they are more likely *ex ante* to have congruent interests. In our model, if state I occurs, the signaler either sends I or sends E, each with positive probability, and thus is explicitly honest or dishonest. As the agents become more similar, in the sense just described, the signaler does not always become more honest (i.e., $\hat{p}$ does not always decrease). Nor are the agents both better off. Both of these results are in contrast to those in Crawford-Sobel.

[2] The expert's equilibrium expected payoff is $ru(E|E)+(1-r)[su(E|I)+(1-s)u(E|E)]$.

[3] The consumer's equilibrium expected payoff is $ru(I|E)+(1-r)u(I|I)$ (as before).

IV. Conclusion

In our discrete model of strategic information transmission, the expert explicitly chooses to be either honest or dishonest. Any change that decreases the consumer's cost of not heeding the expert's advice to obtain an expensive repair (i.e., decreasing the probability of needing the expensive repair, decreasing the price of either repair, or decreasing expert competence) results in increased consumer vigilance and expert honesty, and thus leaves the consumers better off and the experts worse off. Unlike the Crawford-Sobel model, agents are not both better off as they become more similar in the sense described above. We also consider changing the informational structure by allowing that the expert is not completely competent.

REFERENCES

Crawford, Vincent P. and Sobel, Joel, "Strategic Information Transmission," *Econometrica*, November 1982, *50*, 1431–451.

Darby, Michael and Karni, Edi, "Free Competition and the Optimal Amount of Fraud," *Journal of Law and Economics*, April 1973, *16*, 67–88.

Green, Jerry and Stokey, Nancy, "A Two-Person Game of Information Transmission," Discussion Paper No. 751, Harvard Institute of Economic Research, March 1980.