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LEARNING ABOUT A POPULATION AND THE EMERGENCE OF TRUST IN TRANSITION ECONOMIES

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Learning About a Population and The Emergence of Trust in Transition Economies

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Abstract

This paper characterizes a recursive pure strategy equilibrium of a dynamic trade game in which buyers are trying to identify an 'honest' seller in order to enter into a permanent trading relationship. In such a setup, temporary cheating might permanently impede trade due to the negative reputational externality that cheaters exert on new names. This happens exactly when in a static environment honests would not have been able to induce separation by incurring initial losses. In addition, in this equilibrium increases in 'trust' do not necessarily lead to improvements in welfare.

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1 Introduction

Transition economies have been plagued by crime and fraud[1]. There seems to be a consensus around the notion that such behavior is temporary, and will eventually disappear, both as the legal system develops, and as longer-term trading relationships based on 'trust' emerge[2].

This paper focuses on the 'trust' aspect, and explores whether such optimism is justified in the context of very stylized dynamic trade game.

In this game, there will be two types of sellers, namely, longer lived honests who always supply high quality, and one-period-lived cheaters who always supply inefficiently low quality. Buyers will be assumed to learn about the composition of the sellers' population (as between cheaters and honests) from their trade experiences [3].'Trust' will be embodied in 'customer relationships', i.e., a permanent pairing of a buyer with a seller, which will result whenever a buyer is supplied a high quality good by a seller[4]. As buyers will only be able to sample one seller at a time, and will be assumed (implicitly)

[1]For descriptive accounts of this experience, see, for example, Gustafson 1999, Humphrey and Schmitz 1998, Lieberman and Nellis 1995.

[2]Other papers that also deal with the issue of trust emergence in incipient trade are Fafchamps 1998, though the focus there is on whether customer relations, specifically, the threat of terminating such a relation (relational contracting, in that author's terminology) can sustain trust. As such this paper is very close to Ghosh and Ray 1996 and Kranton 1996. A different model of fraud in transition yielding similar results is presented in Filipovich 2000b.

[3]A feature taken from Bower, Garber and Watson 1996.

[4]This is admittedly a very broad metaphor for 'trust', but it does capture the essential features: Positive experiences lead to optimistic beliefs which in turn form the basis for longer term relationships. See also the concluding remarks of this paper.

not to share their information widely, the process of identifying an honest seller and establishing a customer relationship will take time. Only during an interim will cheaters operate. Eventually they will cease selling. This will happen when either all buyers have entered customer relationships, or when buyers become so 'discouraged' that they refrain from trading at all (repeated cheating will discourage trade with new names, as it will make buyers increasingly pessimistic about the composition of the sellers' population). Note the reputational externality at work here: Cheating in the past will affect the attitude of buyers towards all new names[5].

If trade is discouraged, fraud will have permanent effects. Such discouraged trade will arise precisely when, in a static version of this model, honests would not have been able to squeeze cheaters out by pricing low enough. In other words, when the cost advantage enjoyed by cheaters is too large, or when the quality advantage enjoyed by honests is not large enough to generate sufficiently high future revenues to compensate for losses that might have to be incurred to displace cheaters from the market today.

The reputational externality just mentioned is key for temporary fraud to have permanent effects. This externality will inevitably obtain in any incipient trade process in which buyers start out in a state of relative ignorance and grope their way towards longer term relationships. This will be so even if customer relationships are established after just one single positive trade experience, as is the case here[6]. Note that no additional considerations, in-

[5]Bower, Garber and Watson 1996 also emphasize how this learning might lead to a permanent breakdown in 'trust', though they work with a rather different model.

[6]Note that often it is not possible to establish customer relationships of this sort (for example, buyers might only be able to partially control which business they get matched

stitutional or otherwise, need be invoked in order to generate discouraged trade, in particular, it would seem that some such behavior would obtain regardless of the effectiveness of the legal system[7].

The possibility that temporary fraud might affect trade permanently emphasizes the danger of assuming that because fraud is temporary, the best course of action might be to just sit it out.

Finally, the model throws light on the issue of whether increases in honesty or 'trust' are necessarily a good thing[8]. The answer, surprisingly at first, is negative. In fact, the reason for this is not mysterious: Increases in trust or honesty in this incipient stage will have opposing effects: The obvious positive one, more honesty meaning less dishonesty; but also an ambigous trade-enabling effect, with a positive aspect, more honesty or trust leading to longer searches for good buyers; and a negative aspect, as this additional search enables cheaters to operate during a longer time. As this suggests, the effect on welfare will depend on how the losses from cheating compare to the gains from establishing a customer relationship.

This ambigous effect on welfare justifies some caution not only towards 'moralizing' recipes, but also towards assuming that simply restricting entry by cheaters (without fully preventing it) will necessarily improve matters.

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with each period, even though they might still be able to refuse to trade; think of the many times one visits a business only to discover that the brands one is looking for are not available). Moreover, in practice it will invariably take more than one positive trade experience for a customer relationship to emerge.

[7] If only because the legal definition of fraud is hardly tight enough to exclude all cheating that might fit the very ample definition in this paper.

[8] It has been suggested that the problem of fraud in transition economies originates at least in part in an 'ethical' deficit inherited from the previous regimes, see Sztompka ?.

The paper is organized as follows: The model is outlined in Section 2. Equilibrium is characterized in Section 3. The effects of increases in 'trust' are dealt with in Section 3. Finally, Section 4 offers some concluding remarks.

2 The Model

The horizon is infinite and time discrete. At any given time t, there will be $2N$ agents in the economy. Those agents will be divided into two classes, N buyers and N sellers. Denote by b_{lt} a buyer alive at time t, $l = 1, ..., N$. Similarly, let s_{lt} stand for a seller alive at time t, $l = 1, ..., N$. Buyers and sellers will be paired each period in a way to be specified. Each pair will then decide whether to trade one unit of a good of either low or high quality at an exogenously set price (for the details of pricing and trade procedure, see below). Let q stand for 'quality', with $q \in \{H, L\}$, H denoting high quality, and L low quality. The value to a buyer of one high quality unit will be given by v_H, while that for a low quality one will be v_L. Of course, $v_H > v_L$. The cost to a seller of producing a high quality item will be c_H , and that for a low quality one, c_L. It will be assumed that

$$v_H > c_H > c_L > v_L$$

Note that this implies that a buyer will not knowingly pay a price above cost for a low quality good.

There will be two types of sellers, 'cheaters' and 'honests'. 'Cheaters' will live for one period only, and will decide whether to sell or not, but if they sell, will invariably supply low quality. Honests will live so long as they sell, and will also decide whether to sell or not[9], but, if they sell, will always provide high quality. Let τ designate the type of a seller, $\tau \in \{C, A\}$, where C stands for 'cheater', while A for 'honest'. A seller of type τ will be denoted by $s(\tau)$.

Buyers will not be able to tell ex-ante (prior to trade) whether a seller is of one or the other type. They will only know that each seller is drawn independently from an identical large (continuum) population, but they will ignore the exact composition of that population as between cheaters and honests. They will just be aware that with probability λ, the fraction of honests in the population is ρ_h, and with the complementary probability, ρ_l, with $\rho_h > \rho_l$. Buyers will live only for one period, but they will share their 'experience' (to be defined) across generations, i.e., within 'families', but not amongst contemporaries (between 'families). Precisely, there will be exactly N families of buyers, a family denoted by F_m, $m = 1, ..., N$,with each buyer alive at time t belonging to a different family (i.e., for any two buyers, b_{mt}, b_{nt}, $n \neq m$, if $b_{mt} \in F_m$ then $b_{nt} \notin F_m$). This feature embodies limited information flows in the economy[10],[11].

[9]This peculiar feature is introduced to simplify the analysis. I conjecture that in a model with long-lived honests, there will exist an equilibrium broadly resembling the one studied here. The main difference arising from allowing honests to continue to trade even if they do not sell would seem to be that in such a setup refusing to sell might operate as an additional means of sorting (besides pricing), analogously to 'waiting' in 'attrition' games.

[10]The implications of the absence of information flows of this sort in community interactions has been studied by Ghosh and Ray 1996.

[11]A consequence of assuming that there are N families is that there won't be 'free riding' behavior in this setup (though, of course, a reputational externality will still operate, as

Sellers will be assumed to know the whole history of the economy, the parameter of the population and be able to identify exactly the buyer they are matched with (i.e., know the experience of the family of the buyer).

The economy then evolves as follows: Initially, buyers and sellers are randomly matched 1:1. After being thus paired, a buyer and a seller proceed to play a straightforward 'stage game': The seller decides whether or not to commit to sell at an exogenously set price which equals the expected value of the good for this buyer,given the 'experience' of the buyer (including this seller's eventual sale decision)[12]. If trade takes place, the seller provides high or low quality, depending on whether he is a 'cheater' or an 'honest'. If high quality is provided, this buyer 'sticks' to this seller from now on. In other words, forms a 'customer relationship' with this seller. Otherwise, the match dissolves, cheaters exit and are replaced by new sellers (drawn again from the same population), and buyers and sellers transit to the next period.

The experience of a buyer is made up of all the items that buyer can observe directly, namely, that seller's sale decision, the quality of the good and the price.

More precisely: The actions available to an 'honest' in the stage game are $\{(s,h),0\}$,where s stands for 'sell', h for 'high quality', 0 for 'not sell'. Similarly, the actions available to a 'cheater' are $\{(s,l),0\}$, where l stands

explained in the introduction). Excluding this type of behavior does not seem to bear on the substance of the argument. For a detailed discussion of this point, though in a different -if related- context, see Filipovich 2000a.

[12]The rather unusual formulation of the stage game is harmless -just a reduced form of the 'natural' trade game cooked in such a way as to neutralize signalling through prices (which for that reason are assumed set exogenously).

for 'low quality'. The outcome of a match at time t involving the member of family $F_m, m_t(F_m)$, is given by $o(m_t(F_m)) \in \{0, (s,h), (s,l)\}$.

The experience of family F_m as of $t, e_t(F_m)$, encompasses the outcomes of all matches in which members of this family have participated,

$$e_t(F_m) = [o(m_l(F_m))]_{l=0}^{t-1}$$

Note that buyers cannot observe the type of the seller. Nor can the buyer observe what happens in contemporaneous matches (the N families assumption implies this).

3 Equilibrium

The solution concept that will be used is sequential equilibrium.

The analysis will concentrate on equilibria recursive in family's experience (a precise definition follows), in which both honest sellers and buyers play pure strategies. The restriction of honests' play to pure strategies can be derived from a 'bilateral rationality' requirement in the spirit of Ghosh and Ray 1996 (see below), plus a genericity restriction on parameters. The restriction of buyers' play to pure strategies, on the other hand, is of no consequence, as all the arguments below will go through regardless of whether buyers mix or not[13]

In characterizing equilibrium, the relevant state variable will be $L(e_t(F_m))$, a binary variable denoting whether this family is in a customer relationship at time t or not (which takes the value one if this family is in such a relationship,

[13] This is so, since, if the buyer refuses to buy, sellers won't have to produce.

0 otherwise). Clearly,

$$L\left(e_t\left(F_m\right)\right)=1\rightarrow L\left(e_{t'}\left(F_m\right)\right)=1\ \ \forall\, t'>t$$

Focusing on symmetric equilibria, the (behavioral) strategy of $s_{lt}\left(L\right)$ will be a mapping

$$\sigma_t\left(L\right):E_t\rightarrow\Delta\{(s,l),0\}$$

While that of $s_{lt}\left(H\right)$ is a mapping

$$\sigma_t\left(H\right):E_t\rightarrow\Delta\{(s,h),0\}$$

where E_t stands for the set of all possible experiences as of time t. Note that, in principle, these strategies should be mappings from the set of histories of the whole economy and the parameter of the population to mixtures over trade decisions. This less general formulation is what is meant by the equilibrium being 'recursive in families' experience'[14].

Define 'extended' experience of family $F_m, e'_t\left(F_m\right)$ at time t, as including the experience of that family as of that time, plus that seller's current sale decision, $S\left(s_t\left(F_m\right)\right)\in\{0,s\}$,

$$e'_t\left(F_m\right)=\left\{\left[o\left(m_l\left(F_m\right)\right)\right]_{l=0}^{t-1},S\left(s_t\left(F_m\right)\right)\right\}$$

where $s_t\left(F_m\right)$ stands for the seller matched at time t with family F_m.

[14]This is, on the other hand, not that restrictive. For any given trade decision within a match, a seller's payoffs do not vary with the parameter of the population or across histories of the economy associated with the same experience for the family this seller is matched with. This follows since cheaters live only for one period, while honests dissappear if they do not sell, and form a customer relationship otherwise.

Letting E_t' stand for the set of all possible extended experiences as of time t, define an 'extended' beliefs' function,

$$\Psi(b_{tm}) : E_t' \to \Delta\{C, A\}$$

Then the price charged in the match $m_t(F_m)$ is given by

$$p_t(e_t'(F_m), \sigma) = \Psi(b_{tm})(e_t'(F_m))(H) v_H + [1 - \Psi(b_{tm})(e_t'(F_m))(H)] v_L$$

with σ the profile of sellers' strategies.

Consistency of beliefs then implies that,

$$\Psi(b_{tm})(e_t')(A) =$$

$$[\sigma_t(A)(e_t(F_m))(S(s_t(F_m))) \rho_h pr_t(\rho = \rho_h | e_t'(F_m)) +$$

$$\sigma_t(A)(e_t(F_m))(S(s_t(F_m))) \rho_l pr_t(\rho = \rho_l | e_t'(F_m))]/$$

$$\textstyle\sum_{\rho \in \{\rho_h, \rho_l\}} \sum_{\tau \in \{A, C\}} [\sigma_t(\tau)(e_t(F_m))(S(s_t(F_m))) \times$$

$$pr_t(s_t(F_m) = \tau | \rho, e_t'(F_m)) \, pr_t(\rho | e_t'(F_m))]$$

$$if \;\; L(e_t(F_m)) \neq 1 \vee e_t'(F_m) \;\; obtains\ with\ positive\ probability\ under\ \sigma$$

$$\Psi(b_{tm})(e_t')(H) = 1 \qquad if \;\; L(e_t(F_m)) = 1$$

with $pr_t(\rho = \rho_h | e_t'(F_m))$ denoting the probability as of time t that the buyer assigns to the parameter of the population being ρ_h, given what the buyer's family has observed until this point in the game; and $pr_t(s_t(F_m) = A|\rho, e'_t(F_m))$ denoting the probability that the buyer assigns to the seller he or she is currently matched with being of type A, given that the parameter of the population is ρ, and given what the buyer's family has experienced until now. The first expression is just Bayes' Rule, while the second follows from the limiting condition in the definition of consistency[15].

A (symmetric) equilibrium of the game is then a profile of strategies σ, and a system of beliefs Ψ, such that these strategies are sequentially rational, bilaterally rational, and Ψ is consistent given σ.

3.1 Characterizing Equilibrium

Proposition 1

i) If honests (not in a customer relationship) sell, so do cheats.

ii) If honests do not sell, neither do cheaters.

iii) In any selling equilibrium, price must exceed c_L

Proof. i) Assume honest type sells, while cheats do not. A sale commitment reveals the seller as honest, and the price must be v_H. But then it pays for a cheater to sell as well.

ii) If honests do not sell, but cheaters do, then a sale commitment identifies the seller as a cheater. But then the price falls to $v_L < c_L$, and it does not pay for a cheater to sell.

iii) Else, cheater would not sell. But then commitment to sell identifies a seller as honest, and the price would be v_H. ■

[15] While I don't prove this, it follows straightforwardly fromthe customer relationships' feature. I think that out-of-equilibrium beliefs are otherwise unrestricted.

It is easy to see that the best response correspondence for a cheater is given by

$$if \;\; p_t\left(e_t'\left(F_m\right),\sigma\right) - c_L \gtreqless 0$$

$$then \;\; \sigma_t\left(s_t\left(F_m\right)\right)(L) = 1, \in [0,1], 0$$

where $p_t(.)$ is the price charged at t in the match.

The best response correspondence for an 'honest' seller is given by

$$if \;\; \left(p_t\left(e_t'\left(F_m\right),\sigma\right) - c_H\right) + \frac{1}{N}\beta\frac{v_H - c_H}{1-\beta} \gtreqless 0$$

$$then \;\; \sigma_t\left(s_t\left(F_m\right)\right)(H) = 1, \in [0,1], 0$$

Proposition 2 *In a bilaterally rational equilibrium honests mix strictly iff*

$$(c_L - c_H) + \frac{1}{N}\beta\frac{v_H - c_H}{1-\beta} = 0$$

Proof. If honests do, then it must be that they are indifferent between selling and not, i.e.,

$$(p_t - c_H) + \frac{1}{N}\beta\frac{v_H - c_H}{1-\beta} = 0$$

If p_t is strictly above c_L, then cheaters will sell with probability one. But then, not selling and renegotiating would be better for honests. It follows that $p_t = c_L$ ■

In the light of the previous result, which shows that 'generically'[16] strict mixing by honests types will not obtain in equilibrium, I concentrate in what

[16]'Generically' meaning that the set of parameter constellations inducing this behavior has measure one if one imposes a Lebesgue measure on the parameter space.

follows on characterizing equilibria in which honests sell with probability one (or not at all)[17].

In order to do this, it is convenient to define p_A to be the price p such that

$$(p - c_H) + \frac{1}{N}\beta\frac{v_H - c_H}{1-\beta} = 0$$

Further, let $p_A(k, L = 0|1)$ denote the price that would result in a new match if both cheats and honests were to sell with probability one to a buyer whose family has experienced k low quality trades. Now,

$$pr_t(\rho = \rho_h | e'_t(F_m)) = pr_t(\rho = \rho_h | e_t(F_m))$$

This follows from the fact that sellers' trade decision (whether to sell or not) will only depend on the current buyer's family experience. In other words, sellers' trade decisions do not signal any information regarding the parameter of the population.

Hence, one can write

$$pr_t(\rho = \rho_h | L(e_t(F_m)) \neq 1) = \frac{(1-\rho_h)^{t-1}\lambda}{(1-\rho_h)^{t-1}\lambda + (1-\rho_l)^{t-1}(1-\lambda)}$$

And so,

$$\begin{aligned} p_A(k, L = 0|1) &= pr_k(\rho = \rho_h | L = 0)(\rho_h v_H + (1-\rho_h)v_L) + \\ &\quad pr_k(\rho = \rho_l | L = 0)(\rho_l v_H + (1-\rho_l)v_L) \end{aligned}$$

[17]For certain parameter values, there are recursive equilibria in which in arbitrarily selected new matches neither type sells (simply assume that a sale commitment leads to buyers believing that the seller is a cheat). I will ignore this complication in what follows.

Let, finally,

$$k^* \equiv \max k \quad s.t. \;\; p_A\left(k, L=0|1\right) \geq p_A$$

$$k_* \equiv \max k \;\; s.t. \;\; p_A\left(k, L=0|1\right) \geq c_L$$

Proposition 3 *There will be trade in equilibrium iff there is at least one honest and*

$$\lambda\left(\rho_h v_H + (1-\rho_h)\, v_L\right) + (1-\lambda)\left(\rho_l v_H + (1-\rho_l)\, v_L\right) \geq p_A$$

Proof. Sufficiency: Given that honests sell with probability one, one can always have cheaters sell with a sufficiently small probability, so as to induce posteriors that raise the price to c_L. Then, if $p_A < c_L$, this price will support trade. With $p_A \geq c_L$, selling by both types with probability one will be equilibrium behavior to start with if the condition in the proposition is satisfied. Necessity: Assume the condition is violated, then both types selling with probability one is not an equilibrium, as the resulting price will be below p_A, while having cheaters sell with probability less than one requires the price to be c_L, which, being below p_A, cannot sustain trade by honests.

■

The proof of the previous proposition hints strongly at the type of equilibria that will result here:

Proposition 4 **1)** *If $p_A \geq c_L$, and the condition of the previous proposition is satisfied, then honests and cheaters start selling with probability one to families. In this case, trade by a family will stop when and if the family experiences $k^* + 1$ low quality trades.*

2) *If* $p_A < c_L$ *then*

i) *if*

$$\lambda\left(\rho_h v_H + (1-\rho_h)\, v_L\right) + (1-\lambda)\left(\rho_l v_H + (1-\rho_l)\, v_L\right) \geq c_L$$

both cheaters and honests start selling with probability one. This goes on for new matches, until the family experiences $k_* + 1$ *low quality trades and/or no-sales episodes, at which time cheaters matched with this family start mixing, until, and if, the family is paired with an honest seller. Else, in the limit, cheaters sell with probability 0. During the mixing stage the price equals* c_L*, and the probability of a sale by a cheater falls as the family gathers low quality experiences.*

ii) *If the previous condition is not satisfied, then the mixing stage starts right away.*

Proof. Start by noting that

$$p_A\left(k, L = 0|1\right)$$

is strictly falling in k. This implies that

$$if \ \ p_A \geq c_L \ \ then \ \ k^* \leq k_*$$

The condition for trade guarantees that, both, k_* and k^*, are defined. Now, since the condition for trade must be satisfied, both types selling with probability one is here sustainable in equilibrium. As a family experiences additional low quality trades, if both honests and cheaters keep selling with probability one, the price falls for goods sold in new matches, until eventually it is lower than p_A. At this point, which by definition is reached when this family has experienced $k^* + 1$ low quality trades, honests are not prepared to sell if cheaters sell with probability one. For cheaters to sell with less than probability one, the price must equal c_L, but such a price is too low to support sales by honests. So, no sales take place in new matches after this family has experienced $k^* + 1$ low quality trades.

If, now, $p_A < c_L$, and condition in i) above is satisfied: Then again it is feasible in equilibrium that both types start selling with probability one. On the other hand, now it must be that

$$k^* \geq k_*$$

With $k_* + 1$ low quality trades, cheaters sell with probability less than one, so that price goes up to c_L, at which price sales by honests can be supported. As families experience additional low quality trades or no-sales episodes, the probability of sales by cheats must go down in order to keep the price at c_L. This process only stops if a family trades with an honest.

Finally, if the condition in i) is not satisfied, mixing must start straight away. ■

In the first case (when $p_A \geq c_L$), some families become so suspicious of new names (because they have experienced so many low quality trades) that it does not pay to sell to them anymore, given the rather low price these families are prepared to pay. Sellers in new matches prefer not to sell at all to these families, rather than incur big losses today. Note that this situation arises when the costs of producing low quality are relatively low, so that it is impossible for honest firms to separate themselves from cheaters by taking current losses.

When the cost of producing low quality is relatively high, i.e., when $p_A < c_L$, honests can force separation, to a steadily increasing degree. This is what is happening when cheaters start selling with lower and lower probability.

The following proposition characterizes the behavior in the limit in such an equilibrium,

Proposition 5 *In case (1) of the previous proposition, there will be two absorbing states, namely, the no-sales situation reached when a family experiences $k^* + 1$ low quality trades, and the situation where a family is matched with an honest seller before experiencing $k^* + 1$ low quality trades. The probability of the first state is $(1 - \rho)^{k^*+1}$, while that of the second is given by $\rho \left[1 + (1 - \rho) + ... + (1 - \rho)^{k^*}\right]$ (with ρ the realized value of the population parameter).*

In case (2) of the previous proposition, there is only one absorbing state (getting matched with an honest). Moreover,

$$\Pr \{Match\ With\ an\ Honest < T \mid \rho\} \rightarrow 1\ as\ T \rightarrow \infty$$

Proof.

1) Given population parameter ρ, the probability of getting matched with an honest in k^* rounds or less, is

$$\rho + (1 - \rho) \rho + (1 - \rho)^2 \rho + ... + (1 - \rho)^{k^*} \rho$$

Now,

$$\rho\left[1+(1-\rho)+(1-\rho)^2+...+(1-\rho)^{k^*}\right]+(1-\rho)^{k^*}(1-\rho)=$$

$$\rho\left[1+(1-\rho)+...+(1-\rho)^{k^*-1}\right]+\rho(1-\rho)^{k^*}+(1-\rho)^{k^*}(1-\rho)=$$

$$\rho\left[1+(1-\rho)+...+(1-\rho)^{k^*-2}\right]+\rho(1-\rho)^{k^*-1}+(1-\rho)^{k^*-1}(1-\rho)=$$

$$...=$$

$$\rho+(1-\rho)^{k^*-(k^*-1)}=1$$

2)

$$\Pr\{Match\ With\ an\ Honest<T\mid\rho\}=\rho\left[1+(1-\rho)+...+(1-\rho)^{T-2}\right]$$

Clearly, as $T\rightarrow\infty$, this expression goes to

$$\rho\frac{1}{1-(1-\rho)}=1$$

■

In words, in the second case, fraud is temporary in the sense that eventually, for some sufficiently high but finite date, a family will surely have been matched with an honest. In the first case, on the other hand, there is positive probability that a family is never matched with an honest seller. Fraud is temporary here merely in the sense that it does not take place in either of the two absorbing states.

3.2 'Increases' in Honesty

An 'increase in honesty' can mean here an increase in ρ_h,and/or in ρ_l, and/or in λ.

Proposition 6

1*) Changes in* ρ_h, ρ_l *or* λ *do not lead to a change in the type of equilibrium ((1) or (2), as in proposition 4 -so long as existence is warranted).*

2) Increases in ρ_l *and* λ *will increase* k^*, k_**. The effect of an increase in* ρ_h *on these variables will depend on parameters.*

Proof. The first statement follows straightforwardly from the fact that p_A does not depend on any of these magnitudes (though the condition for existence in proposition 3 does). The second follows from the fact that $p_A(k, L = 0|1)$ is strictly increasing in ρ_l and λ, but might increase or fall with ρ_h. ■

Note that the welfare implications of these changes are not a priori clear: These will depend on when exactly one evaluates welfare (ex-ante -before the realization of ρ; interim -after the realization of this variable). And also, on whether one interprets these variables as the 'objective' probabilities underlying the actual selection of sellers, or just as reflecting beliefs (so that changes in their magnitudes do not imply changes in the 'objective' selection probabilities). Finally, it will also depend on the type of equilibrium considered.

In the easier case in which one takes these probabilities to be purely 'subjective' meaning that what changes is the level of trust in the economy as reflected in agents' beliefs, rather than the actual level of honesty. This implies that only behavioral parameters, i.e., k^*, k_*,and the probabilities of sale by cheaters, will be changing (not the actual selection probabilities). The following proposition emphasizes some of the relevant trade-offs in this case:

Proposition 7 *In a type (1) equilibrium, a sufficient condition for aggregate surplus, both ex-ante and interim, to increase as ρ_l or λ increase , is*

$$v_H - c_H \geq c_L - v_L$$

In a type (2) equilibrium, increases in ρ_l and λ always decrease welfare, while increases in ρ_h decrease or increase welfare as

$$\frac{\partial \left[\rho_h pr_k \left(\rho = \rho_h | L = 0\right) + \rho_l \left(1 - pr_k \left(\rho = \rho_h | L = 0\right)\right)\right]}{\partial \rho_h}$$

is positive or negative.

Proof. 1) Since only beliefs are assumed changing here, the change in interim aggregate welfare is given by

$$\rho \left(1-\rho\right)^{k^*+1} \left\{ \left[\frac{v_H - c_H}{1-\beta} + \left(v_L - c_L\right)\left(1 + \beta + ... + \beta^{k^*}\right) \right] + \right.$$

$$\left(1-\rho\right) \left[\frac{v_H - c_H}{1-\beta} + \left(v_L - c_L\right)\left(1 + \beta + ... + \beta^{k^*+1}\right) \right] +$$

$$+ ... +$$

$$\left. \left(1-\rho\right)^{k^{*\prime} - k^*} \left[\frac{v_H - c_H}{1-\beta} + \left(v_L - c_L\right)\left(1 + \beta + ... + \beta^{k^{*\prime}-1}\right) \right] \right\}$$

where $k^{*\prime} > k^*$, and the former corresponds to the behavioral parameter after the change.

2) In the preceding proposition it was shown that increases in ρ_l and λ increase k_*. It is now shown that such increases also increase the probability that a cheater sells at any given mixing-stage. That probability is given by the solution to the following equation

$$c_L = \Psi(b_{tm})(e'_t)(A)\, v_H + (1 - \Psi(b_{tm})(e'_t)(A))\, v_L \qquad (\#)$$

where e'_t is an experience such that $L(e'_t) = 0$, the seller is currently committed to sell, and $t \geq k_* + 1$. Now, one can write

$$\Psi(b_{tm})(e'_t)(A) = \frac{\sigma_t(A)(e_t(F_m))(s)[\rho_h pr_k(\rho=\rho_h|L=0)+\rho_l(1-pr_k(\rho=\rho_h|L=0))]}{\sigma_t(A)(e_t(F_m))(s)[\%]+\sigma_t(C)(e_t(F_m))(s)[1-[\%]]} \qquad (\#\#)$$

where [%] stands for the expression in square brackets in the numerator, with

$$\sigma_t(A)(e_t(F_m))(s) = 1$$

This follows from the equilibrium selection criterium. Since

$$\frac{\partial pr_k(\rho = \rho_h|L = 0)}{\partial \lambda} > 0; \frac{\partial pr_k(\rho = \rho_h|L = 0)}{\partial \rho_l} > 0$$

It is easy to see that

$$\frac{\partial [\%]}{\partial \lambda} > 0; \frac{\partial [\%]}{\partial \rho_l} > 0;$$

But then, (##) increases, and, hence, so does the RHS expression in (#). In order to restore equality, it must then be that $\sigma_t(C)(e_t(F_m))(s)$ increases. So, not only does k_* increase, so does the probability of a sale in every period. Now, since the actual selection probabilities are unchanged, all what changes here is that cheaters, when selected, are more likely to sell. Since such sales are not efficient, it must be that now aggregate welfare (both ex ante and interim) falls.

By an analogous line of argument, it can be shown that the probability of a sale increases with ρ_h under the condition specified. All what remains to be shown is that same condition controls whether k_* increases or decreases. To see this, just rewrite $p_A(k, L = 0|1)$ as

$$(v_H - v_L)[\%] + v_L$$

■

The first part of the proposition illustrates the basic trade-off involved: As the event of discouraged trade becomes less likely, there is a potential gain from the resulting additional possibilities of meeting an honest seller. At the same time, additional opportunities for trade by cheaters are created. Whether the gains will compensate the losses will depend on how the surplus to be earned from trading with an honest compares to the losses from trading with cheaters (of course, the losses are more likely to be incurred early here, this being the reason why the condition above is only sufficient).

In a type (2) equilibrium, the situation is rather different: There any increase in k_* and, generally, the probability of sales by cheaters, will induce a net loss, as actual selection probabilities are assumed unchanged.

This latter consideration immediately points to the rather more complex trade-offs involved when one interprets these variables $(\rho_l, \rho_h, \lambda)$ as 'objective' probabilities. In this instance, in addition to the considerations above, one must take into account that it is more likely that the seller be honest.

4 Concluding Remarks

Using a stylized dynamic trade game, it has been shown that temporary fraud might have permanent effects, and that this will happen when the static condition for separation is not satisfied. Moreover, it has been shown that increases in 'trust' need not lead to improvements in welfare.

While the game analyzed is very stylized, it should be born in mind that, in a way, it represents the extreme scenario most unfavorable to the conclusions obtained: Temporary fraud is least likely to last and least likely to generate permanent effects in a setup in which customer relationships of the kind postulated are feasible and, what is more, are established for good after just one high quality purchase. It would seem that more realistic models (e.g., models in which one single high quality sale might not suffice to convince the buyer that high quality will be supplied ever after, or in which customer relationships might break up for exogenous reasons) would result in fraud going on for longer, and in temporary fraud being much more likely to have permanent effects.

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