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Das, Shampita and Bhattacharya, Sukanta

University of Calcutta, Kolkata, India

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Are less informed people more honest? A Theoretical Investigation with Informal Mutual Insurance

Shampita Das *
Department of Economics, University of Calcutta, Kolkata, India

Sukanta Bhattacharya
Department of Economics, University of Calcutta, Kolkata, India

Abstract

The paper analyzes the effect of improvement in the quality of information on the arrangement of informal mutual insurance. We show that equilibrium amount of insurance mostly tend to decrease as the quality of signal improves for any individual. We also show that improvement in signal quality of an individual makes her better off at the cost of her partner. With community enforcement of insurance arrangement and random matching among community members, we show that less informed individuals are more likely to behave honestly than the more informed community members.

Keywords: informal insurance, quality of information, social norms, community bonding, repeated interactions.

1 Introduction

An individual over her lifetime may experience fluctuations in the level of income due to idiosyncratic shocks. This can be framed as situation of uncertainty. Other than savings and diversification of sources of income,

*Corresponding author. Address for correspondence: Department of Economics, University of Calcutta, 56A B.T. Road, Kolkata, India 700050. E-mail: shampita.eco@gmail.com.

arrangement of insurance can act as a protection against situation of uncertainty. Insurance is mainly an act of risk pooling. It may also be described as an act of redistribution of wealth between various possible states.

Formal insurance arrangements work through written and legally binding contracts. In a low-income country, especially in rural areas, market based institutions, which offer various mechanisms for coping with risk, do not develop properly. Due to lack of efficient legal system and low education level, writing and enforcing formal market based contracts become difficult in most of the cases. Even if markets for insurance exists problems of asymmetric information may lead to market failure. As a rational response to the high level of economic vulnerability faced by poorly developed areas of developing countries, people often engage in various kinds of informal risk sharing arrangements. One of those is arrangement of informal mutual insurance.

Besley (1995) tried to summarize the available literature on non-market institution for credit and risk sharing. According to him due to various reasons like social constraints, family obligation etc in low income country savings alone cannot offer sufficient protection against the fluctuating income. That is why in those countries one can observe various other kinds of arrangements for coping up with risk.

Another important informal risk pooling arrangement is temporal as well as intertemporal contracting between individuals. For example different individuals who face nonsynchronous shocks to their incomes, or have difference in degree of risk aversion, can engage with each other in this kind of arrangements. Also a considerably good amount of empirical evidences are available on the existence of informal mutual insurance arrangement among individuals in different societies. Fafchamps and Gubert (2007) examined how risk sharing arrangement has been formed in rural Philippines. In their opinion social and geographical proximity are the main determining factors of intra village mutual insurance arrangement. Using the data on gift, family loans etc, Fafchamsa and Lundb (2003) examined the mechanism through which the rural Filipino deal with income and expenditure shocks. Ray, Genicot and Bloch (2008) investigated a structure of self enforcing network of insurance based on bilateral transaction.

All these alternative arrangements can be treated as an act of mutual cooperation. According to cognitive social science, unlike other animal societies where act of cooperation is mostly determined by genetic relatedness, in human society it is based on social norms. Though the proper explanation of existence of social norms and identification of its determining factors are still far from satisfactory, social norm can be roughly defined as consensus that prevails in a society about how each member of that society ought to behave in a given situation (Ernst Fehr and Fischbacher, 2004). Sociologists claim that social norms reduce the incentives for opportunism and thus reduce the possibility of free riding and produce high degree of social trust. This in turn results in improvement in the quality of collective economic performance. Social norms, amount of social trust, degree of civic participation, presence of social networks etc are jointly called "Social Capital".

However, in recent decades, the effect of advancement of information technology on social capital is increasingly becoming the point of concern of social scientists. Putnam (1995) has expressed his serious concern about the declining trend of civic engagement in American societies which, by weakening the strength of American democracy, reduces the quality of public life in USA. Also, analysis of the data collected in Social Capital Community Benchmark Survey, an empirical survey of trends in social capital in contemporary America, have exhibited the fact that during past two decades while the revolution in the information technology has taken place, community engagement of Americans have declined significantly.

The easy access to information which results in a sense of connectedness with the world outside one's own community can lead to a breakdown of mutual cooperation within a community by increasing the outside opportunities of community members. In this exercise, we try to understand what role improvement in quality of information plays on mutual cooperation in absence of better outside opportunities. We use a simple model of informal insurance to examine this and find that amount of insurance is inverse related to quality of information. This indirectly supports the argument what Putnam and other sociologists have tried to make. Varying quality of information for different agents can be interpreted as the concerned agent's cognitive ability to interpret the signal the agents receive. This ability is often positively linked with factors like education, family background even when the agents belong to the same community. According to Asian American Community Survey, 2010, the Asian-American (especially Indians) constitute the most educated immigrant community in America. Ecklund and Park (2005) tested a hypothesis regarding the civic participation of Asian Americans with high income and higher level of education. They found that whenever education is statistically significant, it inhibits community participation and thus leads to lower social capital. This indirectly supports our result.

We also look at enforcement of informal insurance contract under repeated interaction when members within the community are matched randomly each period. It is well known that under repeated interaction (Fundenberg and Maskin 1986) act of cooperation can be achieved as a subgame-perfect equilibrium only if players attach enough value to future payoffs. We adopt community enforcement using community norms. Kandori (1992) showed that community norms can support efficient outcomes in infrequent transactions, if not only the deviators from the desired cooperative behavior but any person who fails to punish or unwilling to punish are also handed punishment. This makes an informal economic arrangement enforceable.

However, achievement of cooperation in repeated game frame work also depends on degree of information flow within community members. In such situations where flows of information regarding behavioral history of a player is absent, sustainability of cooperative outcome cannot be ensured on the basis of social norms. In absence of perfect information flow, other mechanisms may emerge (Ghosh and Ray, 1996). We examine how quality of information affects the incentive for mutual cooperation. We adapt the model of Coate and Ravallion (1991) for studying informal insurance arrangement. We show that for people who have low quality information never cheats if they care about future at all.

2 The Basic Model

Let N be the set of individuals in a community. Individual i's future private endowment realisation $x_i \in \{0, 1\}$ is uncertain. For each individual, future endowment can be either 0 or 1. Suppose individual i has a prior belief π_i about realization of $x_i = 1$, i.e.

$$Pr(x_i = 1) = \pi_i \tag{1}$$

The priors are common knowledge and without loss of generality we assume[1] that $\pi_i = \pi_j = \frac{1}{2}$. Though an individual does not know exactly which state is going to be realized, she receives a cost free signal S_i about possible future state of the world. Signals are independent draws from a state-dependent distribution satisfying

$$Pr(S_i = 0|x_i = 0) = Pr(S_i = 1|x_i = 1) = p_i \tag{2}$$

We assume that the signal is partially informative, i.e. $p_i \in (\frac{1}{2}, 1)$.

In this paper, we are exploring the possibility of informal mutual insurance within a community where formal insurance is not available to the community members. Throughout our analysis, we assume that when an individual within the community is matched with another for the purpose of risk-pooling, both observe the signal quality of their partners.

However, this assumption merits some discussions. The usefulness of signals often depends on its proper interpretation and this in turn depends on the signal receiver's education, cognitive abilities and intelligence. In our structure, p_i represents individual i's ability to properly process the signal. We assume that this is common knowledge. However, the realization of the signal may or may not be private information.

Individuals are risk averse with concave utility functions $u(x)$, $u' > 0$, $u'' < 0$ where x is an individual's disposable endowment in a particular state.

[1]This is a simplifying assumption and enables us to drop two parameters from our model. The results we obtain are qualitatively unaffected by this assumption.

Individual i's disposable endowment may be different from her actual endowment. If i enters into an informal insurance contract with individual j in which i is supposed to pay j an amount $\theta \in (0, 1)$ in the event of endowment realizations $(x_i = 1, x_j = 0)$ and vice versa, then i's disposable endowment in $(x_i = 1, x_j = 0)$ is $1 - \theta$. For the time being, we assume that such an arrangement is enforceable. This requires that every endowment vector is observable by all members of the community and the social capital in the said community is sufficiently high to impose a strong enough punishment to a member who reneges on this informal contract. We will later relax this assumption and attempt to model incentive compatible informal insurance arrangement.

In this simple set-up if individuals i and j agree to an insurance contract θ, then i's disposable endowment in different states are

$$Z_i = \begin{cases} 0 & \text{if} \quad x_i = 0 \text{ and } x_j = 0 \\ 1 - \theta & \text{if} \quad x_i = 1 \text{ and } x_j = 0 \\ \theta & \text{if} \quad x_i = 0 \text{ and } x_j = 1 \\ 1 & \text{if} \quad x_i = 1 \text{ and } x_j = 1 \end{cases} \tag{3}$$

2.1 Timing of the Game

1. Individual i receives her signal S_i and forms her belief.

2. Given her belief about realization of different states and her private signal S_i, individual i chooses a vector stating how much insurance she desires. The informal insurance contract between the individuals is mutually agreed upon and thus determined by the lower demand in different states.

3. States realized and insurance transaction takes place according to the contract.

2.2 Insurance under private signal

We first assume that signals are private information, i.e. individual i observes S_i but not S_j. If individuals i and j are matched to enter into an insurance contract, there are four possible signal vectors under which the said insurance arrangement can take place:

1. $(S_i = 0, S_j = 0)$
2. $(S_i = 1, S_j = 0)$
3. $(S_i = 0, S_j = 1)$
4. $(S_i = 1, S_j = 1)$

We first derive the the actual amounts of insurance under different realization of the signals. In order to do that first of all we have to derive the optimal insurance demand of each individual under different signal realization.

Given $S_i = 0$, individual i's expected utility from an insurance amount of θ is given by

$$\begin{aligned} EU_i(\theta|S_i = 0) &= \Pr(x_i = 0|S_i = 0)[\Pr(x_j = 0)u(0) + \Pr(x_j = 1)u(\theta)] \\ &\quad + \Pr(x_i = 1|S_i = 0)[\Pr(x_j = 0)u(1 - \theta) + \Pr(x_j = 1)u(1)] \end{aligned} \tag{4}$$

Given our signal structure

$$\begin{aligned} \Pr(x_i &= 0|S_i = 0) \\ &= \frac{\Pr(S_i = 0|x_i = 0)\Pr(x_i = 0)}{\Pr(S_i = 0|x_i = 0)\Pr(x_i = 0) + \Pr(S_i = 0|x_i = 1)\Pr(x_i = 1)} \\ &= p_i \end{aligned}$$

and similarly

$$\begin{aligned} \Pr(x_i &= 1|S_i = 0) \\ &= 1 - p_i \end{aligned}$$

Thus, individual i's expected utility from entering into an insurance agreement of amount θ after receiving $S_i = 0$ is

$$EU_i(\theta|S_i = 0) = p_i[\frac{1}{2}u(0) + \frac{1}{2}u(\theta)] \\ + (1 - p_i)\,[\frac{1}{2}u(1-\theta) + \frac{1}{2}u(1)] \quad (5)$$

Hence, upon receiving a signal $S_1 = 0$ individual i will agree to participate in the informal insurance if and only if

$$\frac{d}{d\theta}\left[EU_i(\theta|S_i = 0)\right]\Big|_{\theta=0} > 0$$

$$\Leftrightarrow p_i u'(0) - (1 - p_i)\,u'(1) > 0$$

$$\Leftrightarrow \frac{u'(0)}{u'(1)} > \frac{1 - p_i}{p_i}$$

Similarly, upon receiving a signal $S_i = 1$, individual i will agree to a positive insurance amount if and only if

$$\frac{u'(0)}{u'(1)} > \frac{p_i}{(1 - p_i)}$$

Notice that since the signal is informative, $\frac{p_i}{(1-p_i)} > \frac{(1-p_i)}{p_i}$. Hence, the sufficient condition for individual i's willingness to participate in informal insurance under both signals is

$$\frac{u'(0)}{u'(1)} > \frac{p_i}{(1 - p_i)}$$

Since $\frac{u'(0)}{u'(1)} > 1$, for every i there exists some $\bar{p} \in \left(\frac{1}{2}, 1\right)$ such that individual i would have incentive to enter into an insurance arrangement under both signal realizations whenever $p_i \leq \bar{p}$.

If individual i with $p_i \leq \bar{p}$ receives signal $S_i = 0$, then her optimal choice can be obtained from

$$\frac{u'(\theta_0^i)}{u'(1 - \theta_0^i)} = \frac{1 - p_i}{p_i}$$

Similarly, individual i's optimal choice under $S_i = 1$ can be obtained from

$$\frac{u'(\theta_1^i)}{u'(1 - \theta_1^i)} = \frac{p_i}{1 - p_i} \quad (6)$$

Let θ_m^i be individual i's optimal insurance amount under the signal $S_i = m$. We can then characterize the insurance demand using the following Lemma.

Lemma 1. *Suppose $\frac{1}{2} < p_j \leq p_i < \bar{p}$. Then, $\theta_1^i \in \left(0, \frac{1}{2}\right)$ and $\theta_0^i \in \left(\frac{1}{2}, 1\right)$. Moreover, $1 > \theta_1^j \geq \theta_1^i$ and $\frac{1}{2} < \theta_0^j \leq \theta_0^i$. If $p_i \geq \bar{p}$, $\theta_1^i = 0$ and $\theta_0^i \in \left(\frac{1}{2}, 1\right)$.*

Proof. Please see Appendix 1. □

Since insurance is mutual, the actual amount of insurance is determined by

$$\theta^* = \min\{\theta^i, \theta^j\}$$

We now assume that $p_i \geq p_j$. This essentially states that individual i has access to better quality signal than individual j. Given this assumption, we can now characterize the actual amount of insurance between the two agents. This is described in the following Lemma.

Lemma 2. *For different signal realizations of the two individuals, the actual insurance contract between them takes the following form:*

$$\theta^* = \begin{cases} \theta_0^j & \textit{if } S_i = 0, S_j = 0 \\ \theta_1^j & \textit{if } S_i = 0, S_j = 1 \\ \theta_1^i & \textit{if } S_i = 1, S_j = 0 \\ \theta_1^i & \textit{if } S_i = 1, S_j = 1 \end{cases}$$

Proof. The proof immediately follows from Lemma 1. □

We are now in a position to state our first proposition. This proposition shows how changes in the quality of signal affect the actual amount of insurance.

Proposition 1. *Assume $p_i \geq p_j$. With an increase in p_i, amount of insurance between the agents decreasess under $S_i = 1$ and remains unchanged under $S_i = 0$. With an increase in p_j, the amount of insurance decreases on average under $S_j = 1$, and increases on average under $S_j = 0$.*

fig1.jpg

The proof of the proposition is pretty straightforward and can be deduced from the diagram above. It can be inferred that a further improvement in the quality of signal of the individual with already better information leads to an unambiguous fall in the average quantity of mutual insurance. While if the quality of signal improves for the relatively less informed individual, the effect on average amount of insurance is ambiguous.

If $p_i \geq p_j$, and $S_i = 1$, the equilibrium insurance contract is θ_1^i irrespective of the realization of S_j (Lemma 2). As p_i increases, θ_1^i falls. Under $S_i = 0$, the equilibrium contract is determined by p_j. Thus a change in p_i does not affect the amount of insurance. Similarly, the results can be easily shown when p_j changes.

We now analyze the effects of change in signal quality on individual welfare.

Proposition 2. *An increase in p_i (p_j) increases expected utility of individual i(individual j), but reduces that of individual j (individual i).*

Proof. Please see Appendix 2. □

2.2.1 Impact on social Welfare

We have already shown that if quality of signal of an individual improves, her own utility goes up, but utility of the other individual goes down. We now show that even if utility is transferable, the increase in utility of one person (for whom the quality of signal improves) cannot offset the fall in utility of the other person. So if we consider a utilitarian social welfare function, increase in quality of information leads to a fall in total welfare. This is stated in our last proposition of this section.

Proposition 3. *Under a utilitarian social welfare function, social welfare falls when signal quality improves for any individual.*

Proof. Please see Appendix 3. □

When signal received by an individual is her own private information, though improvement in the quality of the signal of an individual increases her own expected utility from the act of mutual insurance, it reduces her partner's expected utility. Consequently if the social welfare function is of utilitarian type, increase in the quality of information for any individual, leads to reduction in the level of social welfare.

We have already argued earlier that community bonding or degree of connectivity among the community members acts as the prerequisite for arrangement of informal mutual insurance to exist. Thus presence of informal mutual insurance arrangements among the members of a community can be treated as an indicator of the level of social capital in the same community. In our analysis we have seen that in a community as quality of information improves, amount of informal mutual insurance falls. From this we can make a conjecture that improvement in the quality of information may have an adverse effect on the amount of social capital of a community.

3 Community Enforcement of Informal Insurance under Repeated Interaction

In our static model, we have ignored the problem of ex-post incentive compatibility of the insurance contracts between the agents. Implicitly we assumed that in the community there exists a strong enough social capital that can ensure enforcement of any contract between the agents. In other words, there exists a governance institution at the community level. We now turn our attention to self-enforcement of contracts. Of course we need repeated interaction among the community members for self-enforcement. If there is only one period, a self seeking individual for whom a good state is realized has no incentive to share her wealth with her partner for whom the bad state is realized.Thus informal mutual insurance contracts often face the problem of ex-post incentive incompatibility. But nonbinding informal risk sharing arrangement can be sustainable if there exists scope of more than one interaction. Then the threat of future non-cooperation may provide an incentive for a self-seeker to behave honestly in the current period.

Suppose the individuals are characterized by their signal quality $p \in \left(\frac{1}{2}, 1\right)$. We assume that individuals belonging to the community are distributed over $\left(\frac{1}{2}, 1\right)$ with density $f(p)$ where $f(p) > 0$ for all p. In each period an individual is matched randomly with another. Thus, at the beginning of each period, the probability that any individual will be matched with another with signal quality p is given by $f(p)$. If both agree to an insurance arrangement, then they enter into an informal insurance contract which must be self-enforcing. If any one of them refuses to enter into an insurance arrangement, both of them consume their realized endowment. Next period matching occurs afresh and the process is repeated.

Since signals are private, i.e. signal realizations are observed only by the concerned individuals, once a pair of individuals is matched, the insurance arrangement is as in subsection 3 of the last section. How is cheating defined here? Once an insurance arrangement is agreed upon, an individual may decide not to honour the agreement after the states are realized. Notice that this may occur only after the concerned individual has the good fortune to enjoy enodowment in a good state (1) while her partner is in a bad state.

Suppose individual i with signal quality p_i is matched with individual j with signal quality p_j in the current period. We assume that both p_i and p_j are less than $\bar{p}$, because otherwise there won't be any insurance[2].

First consider the case that $p_i \geq p_j$. Notice that there are four possible signal realizations and the equilibrium amount of insurance (Lemma 2 of Section 3) is given by:

$$\theta^* = \begin{cases} \theta_0^j & \text{if } S_i = 0, S_j = 0 \\ \theta_1^j & \text{if } S_i = 0, S_j = 1 \\ \theta_1^i & \text{if } S_i = 1, S_j = 0 \\ \theta_1^i & \text{if } S_i = 1, S_j = 1 \end{cases}$$

Given our assumption that $p_i \geq p_j$, $\theta_0^j > \theta_1^j \geq \theta_1^i$. Now notice that if

[2] If p and p' are common knowledge, only then this argument is valid. Otherwise an individual may enter into an insurance arrangement with sole objective of cheating. This in itself is an interesting exercise but beyond the scope of this paper. In our structure, if any individual has $p > \bar{p}$, her partner immediately knows that she will inevitably be cheated and hence refuses to enter into any insurance arrangement.

for individual i the realized endowment is 1, for her partner the realized endowment is 0, only then i can cheat her partner and her immediate gain from cheating is

$$U(1) - U(1-\theta^*)$$

On the other hand, if $p_i < p_j$, the equilibrium amounts of insurance under different signal realizations are given by:

$$\theta^* = \begin{cases} \theta_0^i & \text{if } S_i = 0, S_j = 0 \\ \theta_1^j & \text{if } S_i = 0, S_j = 1 \\ \theta_1^i & \text{if } S_i = 1, S_j = 0 \\ \theta_1^j & \text{if } S_i = 1, S_j = 1 \end{cases}$$

where $\theta_0^i > \theta_1^i > \theta_1^j$

Suppose that any news of cheating is immediately transmitted[3] to the rest of the community and the community norm requires that everybody else punishes the cheater next period onwards. So once a member is identified as a cheater, from next period onwards every member of the community refuses to enter into any mutual insurance arrangement with the cheater. Of course this requires that the potential punishers has incentive to punish a cheater. We assume that the community norm is such that if a member refuses to punish a cheater in any period, that member will be treated as a cheater from next period onwards for violating the community norm.

We are interested in finding out for what values of p, players behave honestly. Consider player i with signal quality $p_i \leq \bar{p}$. If i is matched with a player j with $p_j \leq p_i$, player i's immediate gain from cheating is maximum when $S_i = 0, S_j = 0$ and this gain is

$$U(1) - U\left(1 - \theta_0^j\right)$$

[3]One can think of a structure where information transmission among the community members is imperfect. It will be more difficult to maintain honest behaviour in such a framework. However, exploring that possibility is interesting in itself and is agenda for future research.

On the other hand if $p_i < p_j$, player i's immediate gain from cheating is maximum once again when $S_i = 0, S_j = 0$ and this gain is

$$U(1) - U\left(1 - \theta_0^i\right)$$

Notice that since $\frac{d\theta_0^j}{dp_j} > 0$ as p_j rises for a given p_i, the gain from cheating rises as long as $p_j \le p_i$ and then becomes a constant. Thus the highest gain from cheating is realized when individual i cheats her partner who happens to enjoy the same or higher signal quality as herself and both receive bad signals $S_i = S_j = 0$. This is described in our next proposition.

Proposition 4. *The gain from cheating is maximum when an individual is matched with another individual with same or higher signal quality and both receive the bad signal.*

Hence for any individual with signal quality p_i the maximum possible gain from cheating is given by

$$U(1) - U\left(1 - \theta_0^i\right)$$

On the other hand if individual i continues to cooperate, her expected utility in future periods will be

$$EU_i(p_i, p_j) = \begin{matrix} \frac{1}{4}\left[u(0) + (1-p_j)u(\theta_0^j) + p_j u(\theta_1^j) + (1-p_i)u(\theta_1^i) + p_i u(1-\theta_1^i) + u(1)\right] & \text{if } p_i \le p_j \\ \frac{1}{4}\left[u(0) + p_i u(\theta_0^i) + (1-p_i)u(\theta_1^i) + p_j u(\theta_1^j) + (1-p_j)u(1-\theta_1^j) + u(1)\right] & \text{if } p_i > p_j \end{matrix}$$

Notice that from Lemma 3 of the previous section, $\theta_0^i = 1-\theta_1^i$ and $\theta_0^j = 1-\theta_1^j$. Substituting this in the above expression, we get

$$EU_i(p_i, p_j) = \frac{1}{4}\left[u(0) + (1-p_j)u(\theta_0^j) + p_j u(1-\theta_0^j) + (1-p_i)u(1-\theta_0^i) + p_i u(\theta_0^i) + u(1)\right] \tag{7}$$

for all $p_i, p_j \le \bar{p}$.

Once individual i cheats, according to the community norm from next period onwards no community member would cooperate and she would be compelled to consume her endowment. Hence from next period onwards her expected utility would be $\frac{1}{2}[U(0)+U(1)]$ each period. On the other hand, her expected pay-off from cooperation each period is given by

$$\int_{\frac{1}{2}}^{\bar{p}} EU_i(p_i,p)\,f(p)\,dp + (1-F(\bar{p}))\frac{1}{2}[U(0)+U(1)] \tag{8}$$

Individual i can enter into an insurance arrangement in any period only if she is matched with a partner with signal quality below $\bar{p}$. Otherwise, she woulld be compelled to consume her own endowment. Thus, i's expected future loss from cheating is given by

$$\begin{aligned} & \frac{\delta}{1-\delta}\left[\left\{\int_{\frac{1}{2}}^{\bar{p}} EU(p_i,p)\,f(p)\,dp + (1-F(\bar{p}))\frac{1}{2}[U(0)+U(1)]\right\} - \frac{1}{2}[U(0)+U(1)]\right] \\ = & \frac{\delta}{1-\delta}\left[\int_{\frac{1}{2}}^{\bar{p}} EU(p_i,p)\,f(p)\,dp - F(\bar{p})\frac{1}{2}[U(0)+U(1)]\right] \end{aligned}$$

where δ is the common discount factor. Notice that

$$\begin{aligned} & \int_{\frac{1}{2}}^{\bar{p}} EU_i(p_i,p)\,f(p)\,dp - F(\bar{p})\frac{1}{2}[U(0)+U(1)] \\ = & \int_{\frac{1}{2}}^{\bar{p}}\left[EU_i(p_i,p) - \frac{1}{2}[U(0)+U(1)]\right] f(p)\,dp \\ > & \; 0 \end{aligned}$$

since $EU(p_i,p) > \frac{1}{2}[U(0)+U(1)]$ for all $p_i < \bar{p}$. Therefore, co-operation can always be sustained whenever

$$\frac{\delta}{1-\delta}\left[\int_{\frac{1}{2}}^{\bar{p}} EU_i(p_i,p)\,f(p)\,dp - F(\bar{p})\frac{1}{2}[U(0)+U(1)]\right] \geq u(1) - u\left(1-\theta_0^i\right) \tag{9}$$

Both the LHS and RHS of (9) are increasing in p_i for any given δ since $\frac{\delta E_i(p_i,p)}{\delta p_i} > 0$ and $\frac{\delta\theta_0^i}{\delta p_i} > 0$. We now establish a Lemma that enables us to compare between the two sides of the above equation. For the sake of notational advantage, we define

$$L(p_i) = \int_{\frac{1}{2}}^{\bar{p}} EU_i(p_i,p)\,f(p)\,dp - F(\bar{p})\frac{1}{2}[U(0)+U(1)]$$

and

$$R(p_i) = u(1) - u\left(1-\theta_0^i\right)$$

Lemma 3. $\lim_{p_i \to \bar{p}} R(p_i) > \lim_{p_i \to \bar{p}} L(p_i)$

Proof. Please see Appendix 4. □

We now can argue that since both $L(p_i)$ and $R(p_i)$ are continuous in p_i, for $\delta = \frac{1}{2}$, there exists some $\hat{p} < \bar{p}$, such that any individual with $p_i > \hat{p}$ will have incentive to cheat at least for some matches and for some signal realizations. Thus the zone of absolute honesty is a subset of $(\frac{1}{2}, \hat{p}]$. Whether this zone is a contiguous zone or union of some disjoint intervals depends of the shape of the $L(p_i)$ and $R(p_i)$ functions. If these two functions intersect only once for $\delta = \frac{1}{2}$, the zone is a contiguous zone. For example, if the utility function takes the form $u(x) = x^{\frac{1}{2}}$, and the distribution of signal quality is uniform between $\left(\frac{1}{2}, 1\right)$, the zone of absolute honesty is the interval $(0.50, 0.81)$.

We can now state our result from the above discussion.

Result 1*: For every δ, the zone of absolute honesty, if it exists, exists for lower values of the signal quality.*

This result shows that people who are less informed (with bad quality signals), behave honestly more often than people with high quality signals. Anecdotal evidences also suggest that similar things happen in poor communities. Community members who become more educated or more connected with outside world generally are the first to break community norms.

Notice also that the zone of absolute honesty also depends on the parameter δ. As δ increases, the LHS of (9) shifts up. This results in an increase in $\hat{p}$. So the critical value above which people definitely will have some incentive for cheating under certain circumstances tends to rise. As δ tends to 1, $\hat{p}$ tends to $\bar{p}$. In such a scenario, the cost of cheating is infinitely high and thus everyone cooperates. Exactly opposite happens when δ is small.

Result 2*: The zone of absolute honesty expands as people become more patient.*

This is intuitive. Since the cost of cheating is incurred in future, those who are very patient has less incentive for cheating and cooperation is more sustainable. However, interestingly when cheating occurs, the more informed individuals do have higher incentives to cheat in our set-up.

If individuals are expected to interact for more than one period, an individual's incentive of cheating of depends on the amount by which she discounts the future. Individual for whom future is sufficiently valuable prefers to behave honestly than to cheat. However for some values of discount factor, whether a particular individual will behave honestly or choose to cheat that depends on the quality of the signal received by that individual. Individuals whose signal quality is higher than a critical value ($\hat{p}$), will have incentive for cheating at least for some signal realizations and some partners.

4 Concluding Comments

Revolution in the information technology hhas transformed the world into a "Global village". It has reshaped human relationships. Idea of "being connected" now has been rediscovered. Communication does not any longer depend on time and space. Thus one can expect much higher bonding among human communities than it was few decades ago. Unfortunately the real story is something different. In reality improvement in the information technology has increased the spread of connectedness at the cost of depth. While it has enhanced connectivity among people living in different parts of the world, degree of connectedness among the neighbors has declined significantly. Its adverse impact on social bonding of various communities is becoming more and more visible.

In this paper we have made an attempt to capture the effect on information revolution on informal economic arrangements which are based on social or communal bonding. Our analysis reflects the fact that improvement in the quality of information accessed by an individual may be treated as one of the causes behind breaking down of various informal economic arrangements. In our static model of mutual insurance, we show that equilibrium amount of insurance mostly tend to decrease if quality of signal improves for any individual. The effect is more pronounced if the quality improves for the agent with already better quality signal. Moreover, for given signal quality of the partner, any improvement in the signal quality of an individual makes herself better off while making her partner worse-off. For utilitarian social welfare function, this leads to a fall in the level of social welfare.

We also show that in presence of repeated interaction among the community members and community norm to enforce cooperation, individuals with lower signal quality signals behave more honestly. People with good quality signals have more incentive to cheat at least for some signal realizations and some matchings. We conclude that the less informed people are more likely to cooperate than the better informed ones.

Appendices

Appendix 1

Lemma 1 Suppose $\frac{1}{2} < p_j \leq p_i < \bar{p}$. Then, $\theta_1^i \in \left(0, \frac{1}{2}\right)$ and $\theta_0^i \in \left(\frac{1}{2}, 1\right)$. Moreover, $1 > \theta_1^j \geq \theta_1^i$ and $\frac{1}{2} < \theta_0^j \leq \theta_0^i$. If $p_i \geq \bar{p}$, $\theta_1^i = 0$ and $\theta_0^i \in \left(\frac{1}{2}, 1\right)$.

Proof. For $i = 1, 2$,

$$\frac{u'(\theta_0^i)}{u'(1-\theta_0^i)} = \frac{1-p_i}{p_i} < 1 \tag{10}$$

since $p_i \in \left(\frac{1}{2}, 1\right)$. Therefore, $u'(\theta_0^i) < u'(1-\theta_0^i)$. Since $u'' < 0$, this implies that

$$\theta_0^i > 1 - \theta_0^i$$

and hence $\theta_0^i > \frac{1}{2}$. Similarly, we can show that $\theta_1^i < \frac{1}{2}$.

Notice that if $p_i \geq p_j$, then

$$\frac{u'(\theta_0^i)}{u'(1-\theta_0^i)} \leq \frac{u'(\theta_0^j)}{u'(1-\theta_0^j)} \tag{11}$$

Since $\frac{u'(\theta)}{u'(1-\theta)}$ is strictly decreasing in θ, it immediately follows that $\theta_0^i \geq \theta_0^j$. Similarly it can be shown that $\theta_1^i \leq \theta_1^j$. □

Appendix 2

Proposition 2 An increase in p_i (p_j) increases expected utility of individual i (j), but reduces that of individual j (i).

Proof. Since $\theta_1^i < \frac{1}{2}$, $u(1-\theta_1^i) > u(\theta_1^i)$. Also from the first order condition,

$$\frac{u'(\theta_1^i)}{u'(1-\theta_1^i)} = \frac{p_i}{1-p_i}$$

Thus, the second term vanishes while the first term is positive. Hence, $\frac{d(EU_i)}{dp_i} > 0$.

On the other hand, the first term in the expression of $\frac{d(EU_j)}{dp_i}$ is negative. Since $p_i > 1-p_i$ and $u'(\theta_1^i) >)u'(1-\theta_1^i)$ along with $\frac{d\theta_1^i}{dp_i} < 0$, the second term is negative as well. Thus, $\frac{d(EU_j)}{dp_i} < 0$.

Similarly, it can be shown that $\frac{d(EU_i)}{dp_j} < 0$ while $\frac{d(EU_j)}{dp_j} > 0$. □

Appendix 3

Proposition 3 Under a utilitarian social welfare function, social welfare falls when signal quality improves for any individual.

Proof. Suppose p_1 increases. Then expected utility of individual 1 increases but that of individual 2 decreases. Notice that

$$\begin{aligned} & \frac{d(EU_i)}{dp_i} + \frac{d(EU_j)}{dp_i} \\ = \; & \frac{1}{4}\left[u'(\theta_1^i) - u'(1-\theta_1^i)\right]\frac{d\theta_1^i}{dp_i} \end{aligned} \tag{12}$$

Since $\theta_1^i < \frac{1}{2}$, $u'(\theta_1^i) > u'(1-\theta_1^i)$. Moreover, $\frac{d\theta_1^i}{dp_i} < 0$. Thus, $\frac{d(EU_i)}{dp_i} + \frac{d(EU_j)}{dp_i} < 0$. Thus, the fall in j's utility must be more than the increase in i's utility. Similar result is obtained for an increase in p_j.

□

Appendix 4

Lemma 3 $\lim_{p_i \to \bar{p}} R(p_i) > \lim_{p_i \to \bar{p}} L(p_i)$

Proof. Notice that $\lim_{p_i \to \bar{p}} R(p_i) = u(1) - u(0)$, while

$$\begin{aligned}
\lim_{p_i \to \bar{p}} L(p_i) &= \int_{\frac{1}{2}}^{\bar{p}} EU_i(\bar{p}, p) f(p)\, dp - F(\bar{p}) \frac{1}{2} [U(0) + U(1)] \\
&= \int_{\frac{1}{2}}^{\bar{p}} \frac{1}{4} \Big[u(0) + (1-p)u(\theta_0^j) + pu(1-\theta_0^j) + (1-\bar{p})u(10) + \bar{p}u(1) + u(1) \Big] f(p)\, dp \\
&\quad - F(\bar{p}) \frac{1}{2} [U(0) + U(1)] \\
&= \int_{\frac{1}{2}}^{\bar{p}} \frac{1}{4} \Big[(1-p)u(\theta_0^j) + pu(1-\theta_0^j) + (1-\bar{p})u(0) + \bar{p}u(1) \Big] f(p)\, dp \\
&\quad - F(\bar{p}) \frac{1}{4} [U(0) + U(1)] \\
&< \int_{\frac{1}{2}}^{\bar{p}} \frac{1}{4} \left[u\left(\frac{1}{2}\right) + (1-\bar{p})u(0) + \bar{p}u(1) \right] f(p)\, dp - F(\bar{p}) \frac{1}{4} [U(0) + U(1)] \\
&= F(\bar{p}) \frac{1}{4} \left[u\left(\frac{1}{2}\right) + (1-\bar{p})u(0) + \bar{p}u(1) \right] - F(\bar{p}) \frac{1}{4} [U(0) + U(1)]
\end{aligned}$$

where the inequality follows from the fact that $(1-p)u(\theta_0^j) + pu(1-\theta_0^j) < u\left(\frac{1}{2}\right)$ since $\theta_0^j > \frac{1}{2}$. Since

$$\frac{1}{4} \left[u\left(\frac{1}{2}\right) + (1-\bar{p})u(0) + \bar{p}u(1) \right] - \frac{1}{4} [u(0) + u(1)] < u(1) - u(0)$$

$$\Leftrightarrow (5-\bar{p})\, u(1) > (4-\bar{p})\, u(0) + u\left(\frac{1}{2}\right)$$

the inequality holds. Since $F(\bar{p}) \leq 1$, this ensures that $\lim_{p_i \to \bar{p}} R(p_i) > \lim_{p_i \to \bar{p}} L(p_i)$. $\square$

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