Does higher trust lead to higher performance?

An experimental investigation

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Abstract:

We report experimental data generated by a sequential game based on the investment game (Berg et al., 1995) that allows us to study the effect of higher trust on performance. In the extended game, it is the second mover’s investment that determines performance. The results show that higher trust by the first mover leads to higher performance. However we also find that overall the relative performance is weak and that removing the constraint on the second mover investment possibilities has a negative impact on performance. Furthermore, the surplus generated by trust in our game is more evenly shared among the players than in the reference treatment.

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To what extend does social capital affect economic performance? The question appears to be central for expanding market economies, in which the density of social relations is increasing due to the ease of connecting people through communication technologies. In particular it appears that trust, which represents an essential component of the social capital, plays a key role in economic and social interactions, for example for the development of business through the internet. But trust not only represents a major element of the social capital of industrialized countries, it is also a central for the cohesion of any social group (Putnam, 1993, Fukuyama, 1995).

Recent empirical studies suggest the existence of a positive relation between trust indicators and performance indicators. For example, in 29-nations based study Knack & Keefer (1997) showed that a 10% increase in their trust indicator, increase by almost 1% the growth rate. Other studies also found that trust influences economic indicators such as the growth rate, GDP per capita, or the rate of investment (La Porta et al. (1997), Knack & Keefer (1997), Zak & Knack (2001)).

So far these studies relied on a measure of stated trust, based on attitudinal questions, such as the one included in the World Value Survey (WVS) questionnaire. In this study trust is defined as the percentage of respondents who answer "yes" to the question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?", i.e. choose the answer "can be trusted". This has been criticized by Glaser et al. (2001) who showed that subjects stated trust is not a good predictor for their trusting behavior in an experimental game of trust. Furthermore, Csukas et al. (2003) showed for a group of countries that the ranking according to the WVS trust indicator is not correlated to the ranking obtained on the basis of an experimental game of trust. The available experimental evidence raises therefore some doubts about the validity of the relation between trust and on economic performance. At best the evidence is based on weak measurements of general trust.

In this paper we adopt an alternative methodology, based on laboratory experimentation, to investigate the relation between trust and performance. Our game is inspired by the investment game (Berg et al., 1995). The investment game, involves two players called A
and B, each one endowed with 10 currency units. In step 1, player A has an opportunity to send as many currency units as he likes, between 0 and 10 to player B, who receives three times the amount sent by player A. In step 2, if player B receives a positive amount from player A, he has to decide how many units, from the amount received, he wants to return to player A. A natural measure of trust in this game is the amount sent by player A, and a natural measure of performance is the sum of the payoff of the two players. At the subgame perfect equilibrium of the game, player B returns zero and therefore player A sends zero, the total performance of both players is the sum of their endowments, i.e. 20 currency units. In contrast, full trust (Player A sends his total endowment) generates a performance equal to 40 currency units.

In the investment game, by construction, trust generates automatically higher performance, since any positive amount sent by player A is tripled. In our experimental design we take therefore the standard investment game as a benchmark. To study the link between trust and performance, we introduce a new game, which allows us to separate trust and performance. Our new game is an extension of the basic investment game, obtained by adding one more step. The additional step requires player B to take a decision that generates overall performance. Step 1 of our game is almost identical to step 1 of the investment game, except that player B does not receive the tripled amount sent by player A but the exact amount sent by A. In step 2, player B must decide how many units he wants to invest. We consider a constrained treatment and an unconstrained treatment. In the constrained treatment player B cannot invest more than the amount sent to him by player A. In the unconstrained treatment, player B can decide to invest more units than received from player A, by investing additional currency units from his own endowment which can add to the amount sent by player A. Regardless of the treatment, the amount invested by player B is tripled and the resulting return goes to player A. In step 3, player A who received three times the amount sent by B has the opportunity to send back to player B any amount of his choice. The story behind our extended invested game is the following: player B has an opportunity to invest into a project whose benefits accrue to player A. Under the constrained treatment, player B can only invest the amount lent to him by player A. Under the unconstrained treatment he can add his own endowment to the amount lent by player A. After player B has eventually invested, player A can decide to reward him for the realized benefits of his investment decision.
Our extension of the investment game has several interesting features. The most important one, is that trust and performance are clearly distinguished. If we interpret the amount sent by player A as trust, in the modified game trust is obviously not a sufficient condition for generating performance. Performance depends on the actions chosen by both players. In the constrained treatment, the social optimum can be attained only if player A sends his whole endowment to player B and player B re-invests all. Larger levels of investments by player A do not necessarily lead to higher levels of performance, since player B can steal part of the money that he receives. Low or null re-investment by player B can occur both under high and under low investment by player A. This might occur if player A sends a low amount, i.e. player A exhibits low trust. Player B might be tempted to keep the amount received, since low trust might signal a low propensity to reciprocate. On the other hand if player A exhibits high trust by sending a large amount, player B might nevertheless be tempted to keep the whole received amount, since he cannot be sure that player A will reciprocate. Therefore, there is no reason to believe a priori that higher trust by player A will lead to higher performance.

In the unconstrained treatment, trust becomes two-sided whenever player B decides to invest part of his own endowment, in the sense that Player B must trust that player A will reward his own investment decision. In contrast to the constrained and the reference treatments, player B's minimum payoff can be less than 10 in the unconstrained treatment. Therefore, both players can decide to trust each other in the unconstrained game, although the positions are not symmetric since player B can observe player A’s level of trust before deciding on his own level of trust.

Like the investment game, our extended investment game has a unique subgame perfect equilibrium: in step 3 player A does not return anything to player B, therefore in step 2 player B does not send anything to player A, and in step 1 player A therefore sends zero to player B.

The extended game has still another interesting feature: player A has both the role of trustor and of reciprocator. Therefore, although player A has to commit to initial trust, he also has the opportunity to divide the realized surplus if ever player B decides to invest. A clear result of the standard investment game is that the surplus is divided very unequally when player B is the reciprocator. On average, player A receives a compensation which is
just equal to the cost of his investment, while player B keeps all the net surplus created by A's investment. Allowing player A to act both as trustor and reciprocator might lead to a more equal surplus division. This raises the question as to an eventual relation between trusting and reciprocal behavior. Are more trustful players also more reciprocal? Finally, in our extended game player A does not need to worry about player B's reciprocity but only about player B's trustworthiness. Note that if player B re-invests exactly 1/3 of the amount received by player A, player A breaks even and keeps his endowment intact, while player B gets an additional surplus with no harm for player A. However, such an issue is detrimental for the group performance.

In section 2 we introduce our extended investment and the experimental design and in section 3 we present and discuss the results.

2. Experimental design

2.1 The extended trust game

\[ w_A = 10 \]

\[ S_A \in \{0, 1, \ldots, 10\} \]

\[ w_B = 10 \]

\[ S_B \in \{0, 1, \ldots, S_A\} \]

\[ R_A \in \{0, 1, \ldots, 3S_B\} \]

Payoff of player A

\[ y_A = 10 - S_A + 3S_B - R_A \]

Payoff of player B

\[ y_B = 10 + S_A - S_B + R_A \]

Figure 1: the extended trust game (constrained treatment)
Figure 1 presents our extended trust game in the constrained case. $S_A$ and $S_B$ correspond to the amount invested by player A and player B respectively. $w_A$ and $w_B$ are the players' initial endowments. $R_A$ represents the amount returned by player A and $y_A$ and $y_B$ the players' payoffs. Note that for the unconstrained game, $S_B \in \{0,1, \ldots, S_A + 10\}$. The joint payoff is equal to $y_A + y_B = 20 + 2S_B$. This notation clearly shows the key role of player B for generating the surplus of the investment.

2.2 Experimental procedures

A total of 120 student subjects participated in the experiment. They were split into 6 sessions involving 20 subjects each. In each session 10 subjects were randomly assigned to the role of player A and 10 subjects to the role of player B. We introduced as a treatment variable a constraint on player B's sending opportunities. In the control treatment, called "constrained treatment" thereafter, player B can only send the amount received from player A. In the "unconstrained treatment" player B can also use his own endowment for sending. The investment game, which is our reference treatment, is taken as a benchmark for comparing the results of our new treatments. For each treatment, we ran two sessions. Note that in the unconstrained treatment, the maximum performance is equal to 60 instead of 40 in the constrained treatment. A standard double blind procedure was implemented in order to avoid that subjects send positive amounts just because they know that the experimenter could observe their individual decision.

At the beginning of a session each subject took an envelope marked with a personal code number and containing 10 Euros (in coins). Subjects whose code number begun with the letter A were assigned to room A and those with the letter B to room B. Subjects once seated received written instructions that were read aloud. They were told that each of them was randomly assigned to a player pair, the other member of their pair being seated in the other room. They were asked to complete a short questionnaire to check their correct understanding of the instructions. This was essentially used to check whether they understood correctly the double blind procedure, and were therefore aware that nobody could observe at any time their decision. To avoid any noise signal that could be due to the manipulation of coins, we used a specially designed box for each subject pair
containing 40 small (noiseless\(^1\)) partitions in which subjects had to deposit the coins they wanted to send to the player with whom they were paired.

3. Results

3.1 Trust

Let us begin with a comparison of the treatments with respect to amounts sent by player A and the average realized performance.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>Treatment 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount sent by player A</td>
<td>(s_A)</td>
<td>5.00</td>
<td>4.90</td>
</tr>
<tr>
<td>Amount sent by player B</td>
<td>(s_B)</td>
<td>3.25</td>
<td>7.35</td>
</tr>
<tr>
<td>Payoff of player A</td>
<td>(y_A)</td>
<td>10.65</td>
<td>13.70</td>
</tr>
<tr>
<td>Payoff of player B</td>
<td>(y_B)</td>
<td>19.35</td>
<td>12.75</td>
</tr>
<tr>
<td>Total payoff</td>
<td>(y)</td>
<td>30.00</td>
<td>26.50</td>
</tr>
<tr>
<td>Efficiency</td>
<td>(y/w)</td>
<td>75%</td>
<td>66.25%</td>
</tr>
</tbody>
</table>

**Table 1**: Summary data of amounts sent and players' payoffs

Table 1 provides a general picture of the relation between trust of player A and performance. Compared to the standard investment game, the average level of trust is slightly lower in the constrained treatment and slightly higher in the unconstrained treatment. However, these differences are not significant at the 5% level (Wilcoxon-Mann-Whitney). The fact that player A is aware that player B has to engage in trust has no effect on player A's level of trust.

Table 1 also reveals that the average performance is lowered when an additional step is introduced to treatment 1. Even more surprising is the fact that relative performance, measured by the percentage of total surplus which is realized (\(y/w\)), is lower when player

\(^1\) Unfortunately, since 1 Euro bills were not available at the time the experiment was run, we had to use coins. We wanted to avoid that the noise made by some subjects by putting their coins into the box could reveal something about their sending to the other player and therefore influence players belonging to other player pairs present in the same room.
B is not constrained by player A’s sending. Test results confirm that the realized
percentage of the potential surplus is significantly larger in the reference treatment
compared to the two other treatments, and is significantly larger when player B is
constrained than when she is not constrained (Wilcoxon-Mann-Whitney, 5%). These
surprising results suggest that trust is more effective when it is one-sided than when
player A can reciprocate.

A second interesting result is that the average payoffs of the two players are closer to each
other in our new treatments compared to the reference treatment. In the reference
treatment player A receives 35.5% of the total payoff while player B gets 64.5%, a
difference which is significant at 0.1% (Wilcoxon-Mann-Whitney). In the constrained and
the unconstrained treatments the relative payoff of the two players are not significantly
different, so that we can conclude that they receive equal shares of the total surplus.

3.2 Performance

We turn now to our main question: are higher levels of trust leading to higher levels of
performance? For answering the question, we investigate the effect of player A's sending on
the total return for the data generated by our new treatments. We include a dummy variable,
D, which takes value 1 for the unconstrained treatment. The results (standard error in
brackets) are shown in equation 1:

\[ y = 2.42 s_A + 5.90D + 14.63 \]

Both variables have a significant and positive effect on the total payoff measured by \( y \).
Removing the constraint on the amount that player B can send increases the total payoff.
However, if we take efficiency as the dependent variable, the treatment variable has a
negative impact, as shown by equation 2:

\[ \frac{y}{w} = 0.045s_A - 0.127D + 0.439 \]

Trust has a stronger impact on efficiency when player A knows that his decision constraints
the total payoff that can be achieved. This result appears counterintuitive. In the
unconstrained treatment, we expected that the leading role of player A would encourage
player B to invest at least as much as player A. However, B players did not act in this way. On average, B players added 1.5 to the amount sent by player A, but 8 of the B players did not re-invest all the money received from player A, 1 reinvested exactly that amount, and 11 invested more. The average efficiency restricted to these 11 B players is therefore equal to 72% which is just slightly less than the total average efficiency for the reference treatment. But overall, it appears that there is insufficient investment by player B in response to player A's investment.

In the constrained treatment the relative loss of efficiency is due to the fact that player B steals some of the money sent by player A. Exactly half of the B players did not reinvest all the money that was sent by player A, and 3 of them steeled all the money sent. The average amount stolen by those players is 3.3, inducing an average loss of efficiency of 8.25% compared to the potential efficiency due to player A's investment. In the unconstrained treatment, 8 of the B players also steeled part of the money that was sent to them by player A. The average amount stolen by those players (3.37) is almost equal to the average amount stolen in the constrained treatment, leading therefore to a similar loss of efficiency (if we ignore player B's investment possibilities).

Why do B players steal money? A possible reason is that player A's investment could have been interpreted by player B as exhibiting low trust, a fact which could signal a low propensity to reciprocate. Therefore, if player B does not expect to get enough reward for his honesty, he will be better off stealing some of the money that was lent by player A. However, this explanation does not coincide with the data. Among the B players who steeled money from player A, some kept all the money received from player A, even in the case the amount sent was quite large. Moreover, the extra-amount invested by player B ($s_B - s_A$) is independent of player A's investment (Spearman rank order statistic). A tobit regression where $s_B - s_A$ is taken as the dependent variable and $s_A$ as the independent variable, leads exactly to the same conclusion.

While the above results are a little disappointing, it remains that player A's trust has a significant effect on player B's trust. In the case of the constrained treatment, the amount sent by player A has a positive effect on the amount sent by player B which is significant at the 1% level (tobit regression right censored). A double censured tobit regression improves slightly the likelihood. Interestingly the double censured regression reveals that for 4 of the
B-players, the amounts are left-censured, meaning that they would have liked to punish player A for sending too low an amount (see appendix 1).

For the unconstrained treatment, we find also a significant positive effect (at the 0.2% level) of the amount sent by player A on the amount sent by player B for the upper censored regression. For the double censored regression we find that 3 of the B-player wished to punish player A, while 2 of the B players would have liked to send more than their endowment + the amount received by player A (see appendix 1).

3.3 Reciprocity

In the investment game, reciprocity is measured by the percentage returned by the player who receives the gains generated by the investment. To be reciprocal player B must return more than one third of the amount received from player A (the cost of the investment). The fair return requires player B to share equally the surplus generated by player A's investment, meaning that he returns exactly 2/3 of the amount received. We rely on the same definition for the extended investment game to analyse reciprocity. However, in our game it is player A who is in a position to reciprocate. We must therefore distinguish different cases. For the constrained treatment we analyse separately the case where player B invests the total amount received from player A and the case where player B steals some of the money received from player A. In the latter case, we expect player A to punish player B, by returning zero. In the former case, we expect player A to act in a similar way as player B in the reference treatment, i.e. low positive reciprocity.

In our reference treatment, player B returns on average 38% of the amount received by player A, that is player B covers the cost of player A's investment and adds a small bonus. This is comparable to what was observed in previous experiments (e.g. Berg et al.).

In the constrained treatment, all A players sent a positive amount except one. 3 of the B players kept all the money received from player A. For the remaining 16 B players, the average level of reciprocity is 9.65%. But exactly half of them re-invested the amount received from player A and the other half re-invested less. The average level of reciprocity for the B players who re-invested the total amount received (11.85%) is larger than the
average level of reciprocity for the players who re-invested less (6.82%), but the difference is not significant (Mann-Whitney, 5%). In both cases the level of reciprocity is low. Player A keeps almost all the surplus generated by both investments. Therefore the behaviour of player A in the constrained treatment is similar to the behaviour of player B in the reference treatment: the surplus is almost fully appropriated by the subject who plays last.

In the unconstrained treatment all A players invested a positive amount. Three of the B players kept the total amount received and 5 re-invested a smaller amount than the amount sent by player A. Player A returned on average 26.5% of the amount received. In the unconstrained treatment this includes of course the extra amount invested by player B. In the case where player B added to the previous investment of player A, the additional amount invested by player B corresponds to an average of 41% of the total investment of both players. On average, player A returned 86.8% of the additional amount received from the investment of player B, i.e. \(3 \times (s_B - s_A)\). Since there is considerable variance in these returns (standard error = .5) some B players received more than the total surplus generated by their investment in addition to the cost of their investment, meaning that player A rewarded player B on his own surplus.

In the reference treatment player B’s payoff is always at least as large as player A’s payoff. The average payoff difference between the payoff of player B and the payoff of player A \((s_B - s_A)\) is therefore equal to 8.7, which is significant (Wilcoxon signed rank, 5%). In comparison, the average payoff differences for the constrained and the unconstrained treatment are equal to –1 and –2.7 respectively. Although in both cases, player A earns a larger amount than player B, neither of these differences is significant (Wilcoxon signed rank, 5%). The players payoffs are reported in figure 2 (appendix 2), in which the player pairs are ordered according to the amount sent by player A. The figure clearly shows that payoff disparity is lower in the constrained and unconstrained treatments, compared to the reference treatment which exhibits a large payoff disparity in favour of player B.

4. Conclusion

We ran an experiment to identify the role of trust on performance. Our experiment is based on an extension of the investment game (Berg et al., 1995), the reference treatment in our
experiment. In contrast to the investment game, the extended game allows us to isolate the trust variable from the performance variable. Furthermore, in our game a higher performance can only be attained if both players are trustful, i.e., in contrast to the reference treatment a given level of performance can be reached only if both players trust each other. The main result is that trust has a positive effect on performance. But surprisingly, in the case where both players have to trust each other, the relative performance is weaker, especially in the most favourable case where both players can invest their initial endowment. As a secondary finding, the surplus generated by the subjects’ investment is more evenly divided than in the reference treatment.

References

World Values Survey (1990-1993), Third wave of questionnaire, “V27 people trusted” question
APPENDIX 1

Treatment 2, double censored regression

tobit sb sa if traiiteme==0, ll(0) ul(10)

Tobit estimates
Number of obs = 20
LR chi2(1) = 10.37
Prob > chi2 = 0.0013
Log likelihood = -39.423731 Pseudo R2 = 0.1162

| sb  | Coef.  | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-----|-------|-----------|-------|----|----------------------|
| sa  | 0.9782453 | 0.2832842 | 3.453 | 0.003 | 0.3853248 1.571166 |
| _cons | -1.784979  | 1.527104 | -1.169 | 0.257 | -4.981245 1.411286 |

_obs. summary: 4 left-censored observations at sb<=0
15 uncensored observations
1 right-censored observation at sb>=10

Treatment 3, double censored regression

tobit sb sa if traiiteme==1, ll(0) ul(20)

Tobit estimates
Number of obs = 20
LR chi2(1) = 7.78
Prob > chi2 = 0.0053
Log likelihood = -54.369663 Pseudo R2 = 0.0668

| sb  | Coef.  | Std. Err. | t     | P>|t| | [95% Conf. Interval] |
|-----|-------|-----------|-------|----|----------------------|
| sa  | 1.743926 | 0.564474 | 3.090 | 0.006 | 0.5625245 2.925328 |
| _cons | -2.97398  | 3.562648 | -0.835 | 0.414 | -10.43069 4.482728 |

_obs. summary: 3 left-censored observations at sb<=0
15 uncensored observations
2 right-censored observations at sb>=20
APPENDIX 2

reference

constrained
unconstrained

Figure 2: Individual payoffs by player pair (ranked by amount sent by A)