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NORMS OF RECIPROCATION EXHIBITED BY POLISH STUDENTS IN THE TRUST GAME: EXPERIMENTAL RESULTS

Abstract. Norms of reciprocity and the level of generalised trust are components of the social capital of a society, which is argued to be associated with economic growth. This article presents results from a large scale study of Polish students based on the Trust Game, in which an initiator and respondent can obtain mutual benefits when the initiator exhibits trust in the respondent, who then expresses positive reciprocity. Based on these results, we investigate norms of positive reciprocation within the Polish student community. Analysis indicates that a large proportion of students seem to use one of four simple norms of reciprocation. In statistical terms, the level of reciprocation is rather well reflected in the expectations of the initiators.

Keywords: social capital, generalised trust, reciprocation, norms, experimental game theory, the Trust Game, Poland
JEL: C72

1. INTRODUCTION

The level of generalised trust and norms of reciprocity are components of the social capital of a society, which is seen to be strongly associated with economic growth (see Zak and Knack, 2001). Platje (2011) argues that generalised trust and positive reciprocation together lower transaction costs and thus promote innovation. Amongst the post-Soviet bloc countries, Poland has experienced the largest growth in GDP since the beginning of the economic transformation (see Poznańska and Poznański, 2015). However, data from the European Social Survey show that the expressed level of generalised trust in Poland, as measured by the answer to the so-called trust question "Can people be trusted in general?", is very low (see Growiec, 2011). This is true even in comparison to other post-Soviet bloc countries, whose populations all express relatively low levels of generalised trust. As argued by Czapiński (2008), Poland's rapid economic growth came from developing its previously underutilised human capital and modernising its outmoded production sector, rather than social capital. This is supported by

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Działek (2009), who analysed the relationship between forms of capital and economic growth at the sub-regional (NUTS3) level.

As the production sector and the skills of the workforce develop, social capital will become a limiting factor on the level of economic growth. The following question remains: is the reported level of generalised trust in Poland reflected by behaviour in games designed to elicit practical, rather than verbal, expressions of trust?

This article presents results from a large scale study of Polish students using experimental game theory. The games used in this study were the Ultimatum Game (Güth *et al.*, 1982), the Public Goods Game (Isaac and Walter, 1988) and the Trust Game (Berg *et al.*, 1995). This article considers the Trust Game, which is designed to illustrate players' levels of generalised trust and positive reciprocation. This is a two-player game in which Player 1, the initiator, can transfer money to Player 2, the respondent. The money transferred to the respondent is multiplied by a factor of three. The respondent then decides how much money to return to the initiator (which is not multiplied by any factor).

We use the following definition of positive reciprocation and trustworthiness (Ashraf *et al.*, 2006): positive reciprocation is the favourable response of an individual to someone seen to have acted in a fair manner, even when such a response involves a cost and there is no prospect of future interaction between these players. A person who exhibits positive reciprocity is called trustworthy.

An individual's level of generalised trust is understood as the degree to which he expects those outside his circle of acquaintances to exhibit positive reciprocation or behaviour that is beneficial to the group as a whole, even at the risk of a personal loss (see Putnam *et al.*, 1994, pp. 167–176).

Note that the level of generalised trust should be interpreted according to the population studied. The participants of this study are students and so form an "in-group". The level of trust exhibited in such circumstances might be higher than in a study group chosen from a wider population. However, in everyday life individuals are likely meet new acquaintances who are on average more similar to them than would be expected if such interactions occurred at random among the population as a whole. Also, the level of generalised trust in a society is inherited from previous generations and evolves slowly (see Działek 2009, Algan and Cahuc 2010). Studying social capital among students will give some indications as to how social capital might evolve in Poland in the near future.

This paper aims to analyse the norms of positive reciprocation used amongst Polish students. Studies based on the Trust Game follow one of two regimes. Under the original regime (Berg *et al.*, 1995), the recipient observes the amount transferred and then decides how much to return. Under the "strategy regime", the recipient defines how much to return for each possible transfer before the transfer is made (see Ashraf *et al.*, 2006). Although according to classical game theory these two games are equivalent, experimental studies show that the amounts returned under the strategy regime are lower (Johnson and Mislin, 2011). This difference may result from a positive emotional reaction to obtaining a transfer under the original regime (Zak *et al.*, 2005). Although the original regime is more natural than the strategy regime, one clear disadvantage of the original formulation is that one can only directly observe the actions of respondents, not the strategies (norms) underlying these actions. However, since we have a large sample, by assuming that each player follows one of a finite set of norms, we can estimate the frequency with which each norms is used.

A description of the game is conducted in Section 2. Section 3 describes the study procedure. Sections 4 and 5 describe the observed behaviour of the initiator and respondent, respectively. The method of inferring the distribution of norms used is described in Section 6. A summary and directions for future research are given in Section 7.

2. THE TRUST GAME

This game is based on Berg *et al.* (1995). The term payoff is used specifically to refer to the amount of money obtained by a player. Player 1 (the initiator, referred to as she) has 10PLN. She can transfer an integer number x PLN to Player 2 (the respondent, referred to as he). The value of the transfer is multiplied by 3. Thus the respondent can receive up to 30PLN. He then decides how much money y to transfer back to the initiator. Denote the payoff of Player i resulting from the decisions x and y by $v_i(x,y)$. We have

$$v_1(x,y) = 10 - x + y; \qquad v_2(x,y) = 3x - y,$$

where $x \in \{0,1,2,\dots,10\}, y \in \{0,1,2,\dots,3x\}$.

In experiments, games are described in non-emotive terms. However, Dunning *et al.* (2012) note that most players see that risk and trust are inherent aspects of this game. Fehr and Schmidt (2006) note that individuals' behaviour results from social norms and assume that players' utility does not just depend on their own payoff, but also on the difference between payoffs. Using the argument that players' roles are chosen at random rather than by "merit", assume that an equal share in the payoffs is seen as fair. From the description of the game, (15, 15) might seem to be a natural reference payoff vector, as this is the Pareto optimal solution at which both players obtain equal payoffs. However, the players' payoffs can be equalised in various ways and there is no clear reference point like the equal split in the Ultimatum Game (Güth *et al.*, 2001).

Markowska-Przybyła and Ramsey (2014) derive a Bayesian equilibrium for this game when players' utility depends on both the payoff obtained and the level of inequality. Assume that a respondent is either a reciprocator or selfish. If after the initial transfer a reciprocator has more money than Player 1, then he will equalise the payoffs. A selfish respondent will not pay any money back. At such an equilibrium, when an initiator:

i) has a sufficiently high level of trust that the respondent will reciprocate, then she transfers all her money.

ii) has a low level of trust, but is sufficiently egalitarian, then she transfers enough money to equalise the payoffs.

iii) is neither trusting nor egalitarian, then she will not transfer any money to the respondent.

This equilibrium is qualitatively similar to the behaviour observed in studies (Johnson and Mislin, 2011), but does not reflect the whole range of transfers made by the initiators or reciprocation observed. For example, Migheli (2012) carried out a very similar study among students from Western Europe and notes that an initiator often transfers around 25% of her endowment to ensure equality.

3. OUR STUDY

The study involved students from state universities studying in a capital of each of the 16 Polish regions and was carried out between 16.04.2014 and 12.06.2014. There were between 88 and 100 participants at each site and 1540 in total. The study was performed by "EU-CONSULT" Ltd. under the supervision of the authors. At each site, students were split into three or four sessions, run one after the other. The decisions made were not significantly associated with the session number (analysis of variance), nor the number participating in a session (Spearman's test of association). All questionnaires, descriptions of games and decisions were written on forms coded to identify the player and their "opponents" in the appropriate games. In each session, participants were split randomly into two groups (without knowing which group other players were in). First, they made their decision in the Public Goods Game and then the decision of Player 1 in the game appropriate to their group (the Trust Game or the Ultimatum Game). Time was given to read the descriptions of these games and ask questions. The participants then obtained both the instructions for Player 2 in the game they had not played yet and the decision of the student assigned to them (who played the role of Player 1). All the decisions were then gathered and the payoffs calculated, while the students filled in the questionnaire, which took 20 to 30 minutes and was required for participants to obtain their payoff. In total, each session lasted around an hour and the mean payoff was about 45PLN (approx. €11).

The two questionnaire responses considered in this paper are as follows:

a) The trust question – "Can the majority of people be trusted?" The possible answers were: 1 – No, 2 – Generally no, 3 – I do not know, 4 – Generally yes, 5 – Yes.

b) "What proportion of the money obtained by Player 2 do you think will be returned?" This was only asked to Player 1.

4. THE INITIATORS' BEHAVIOUR

We analyse the initiator's behaviour according to sex and expressed level of trust. Table 1 illustrates the distribution of initial transfers. The mean transfer is 4.79. On average, males transfer more than females (males 5.29, females 4.64, p = 0.021, Student t-test). This agrees with the results of Migheli (2012) and other studies, e.g. carried out in Russia (Bahry *et al*., 2002) and among the US general population (Garbarino and Slonim, 2009). The standard deviation of transfers made by males is significantly higher (males 3.45, females 2.85, p<0.001, Levene's test). Males are more likely to either not transfer any money, which is in agreement with males being statistically more individualistic (Markowska-Przybyła and Ramsey, 2015) or transfer all the money, which is in agreement with males being statistically less risk averse (Borghans *et al.*, 2009).

Table 2 gives the mean transfers according to expressed level of trust. Mean transfers are increasing in the expressed level of trust (r = 0.126, p < 0.001, Spearman's test of association).

Table 1

Transfers made according to sex. The percentages given in brackets refer to the proportion of individuals of a given sex transferring that amount

Transfer	0	1	2	3	4	5	6	7	8–9	10
Female	53 (9.0)	23 (3.9)	79 (13.4)	54 (9.2)	58 (9.9)	149 (25.3)	36 (6.1)	33 (5.6)	39 (6.6)	64 (10.9)
Male	27 (15.0)	3 (1.7)	10 (5.6)	21 (11.7)	11 (6.1)	31 (17.2)	11 (6.1)	14 (7.8)	9 (5.0)	43 (23.9)
Total	80 (10.4)	26 (3.4)	89 (11.6)	75 (9.8)	69 (9.0)	180 (23.4)	47 (6.1)	47 (6.1)	48 (6.3)	107 (13.9)

Source: The authors' research.

Table 2

Mean transfers according to expressed level of trust. The numbers of observations are in brackets

Answer	No	Rather no	Do not know	Rather yes	Yes
Mean	4.19 [93]	4.56 [320]	4.26 [42]	5.23 [286]	5.81 [27]

Source: The authors' research.

The initiators were asked what proportion of the money obtained by the respondent would be returned. This expectation and the value of the initial transfer are clearly correlated (Spearman's test of association, $r = 0.448, p < 0.001$).

Peaks exist in this distribution at 50% (324 of 770 initiators, 42.1%), around 33.3% (159 out of 770, 20.6%, gave a value between 30 and 40%) and at 0% (96 out of 770, 12.6%). Asking an initiator who did not transfer anything what proportion she expected back only has sense in a hypothetical setting where she actually transferred money. Of those who sent a positive amount, these frequencies are 309 (44.9%), 154 (22.4%) and 50 (7.3%), respectively, out of 688. Some initiators did not expect anything to be returned, but still transferred money. Hence, some players have preferences for equality. Also, some individuals did not transfer any money, although they expected that 50% would be returned. Hence, risk aversion is clearly a factor in defining behaviour. Assuming that the initiators and respondents form two samples from the student population, it is reasonable to infer that the percentage returned should also be concentrated on these three values, i.e. the behaviour expected by the initiators is reflected in the respondents' behaviour. This is supported by the results of Bahry *et al.* (2002) obtained in Russia and Baran *et al.* (2010) conducted on US students. However, one should not infer that the proportion returned should be increasing in the initial transfer, since the initial transfer depends on the expectation (character) of the initiator, which is independent of the respondents' character.

5. THE RESPONDENTS' BEHAVIOUR

The mean return is 5.13, thus on average initiators profit. Since the amount that the respondent can return depends on the initial transfer, we consider the proportion of the money that the respondent obtains which is returned, given that the initiator transfers a positive amount (688 cases). This proportion is 33.36%, which is very similar to the proportion returned (33.9%) in Migheli's (2012) study of Western European students. Linear regression indicates that the proportion returned by the respondent is increasing in the value of the transfer ($p < 0.001$). This is in agreement with the hypothesis of a positive emotional reaction from a recipient to a generous initiator, but may result from respondents equalising the payoffs. The regression equation is $P = 24.113 + 1.729X$, where P is the proportion returned, X the initial transfer.

To test whether sex or expressed level of trust are associated with trustworthiness, we control for the initial transfer, i.e. we test for an association between the residual from the regression model and these two traits. Gender is not associated with trustworthiness ($p = 0.687$, Student t-test). This agrees with the results of Bahry *et al.* (2002) and Migheli (2012), although some studies indicate that females are more trustworthy (e.g. Vyrastekova and Onderstal, 2005, as well as Croson and Buchan, 1999, based on studies in the USA, Japan, China and Korea). The expressed level of trust and trustworthiness are uncorrelated ($r=0.034$, $p=0.372$, Spearman's test of association). On the other hand, some studies suggest that an expression of generalised trust is correlated with an individual's trustworthiness (e.g. Glaeser *et al.,* 2000).

To interpret the behaviour of respondents, we first consider the amount returned for initial transfers $x = 2, 5, 10$. Tables 3 and 4 give the distribution of these returns when $x = 2$, i.e. the respondent obtains 6PLN, and $x = 5$, respectively.

Table 3

Returns made when the respondent obtains 6PLN

Amount Returned	0	1	2	3	4
Frequency	25 (28.1%)	12 (13.5%)	30 (33.7%)	18 (20.2%)	4 (4.5%)

Source: The authors' research.

Table 4

Returns made when the respondents obtains 15PLN

Amount Returned	0	1–2	3–4	5	6	7	8	≥10
Frequency	22 (12.2%)	5 (2.8%)	9 (5.0%)	102 (56.7%)	6 (3.3%)	21 (11.7%)	5 (2.8%)	10 (5.6%)

Source: The authors' research.

In both cases, a high proportion of respondents return 0%, 33.3% or (approximately) 50%. As noted, one possible norm of reciprocation is to equalise the payoffs given that after the initial transfer the respondent has more money than the initiator, otherwise do not return anything. When $x = 5$, this rule is indistinguishable from the "pay back 33.3%" rule, as both suggest that 5PLN should be returned. It is thus unsurprising that when $x = 5$ the returns show a very sharp peak at this point. The equalisation rule is defined as follows:

i) when $x \leq 2$, do not return any money,

ii) when $x \geq 3$, return $2x - 5$.

Hence, when 2PLN is transferred, both the equalisation and the "pay back 0%" norms indicate that nothing should be returned. It is thus unsurprising that a large proportion of respondents do not return anything in this case.

When the initiator transfers 10PLN, there are clear peaks in the distribution of the returns at 10PLN (35 out of 107, 32.7%) and 15PLN (42 out of 107, 39.3%). There is a minor peak at 0PLN (6 out of 107, 5.6%). In this case, the equalisation rule is indistinguishable from the "pay back 50%" rule. Hence, it is unsurprising that pay back 15PLN is the most common response. Returning 0% corresponds to economically rational behaviour, returning 33.3% corresponds to ensuring that the initiator "breaks even". Returning 50% can be seen as fair, since both players gain from the exchange.

6. MODELLING THE RESPONDENTS' BEHAVIOUR

We consider two models according to which a proportion *p* of the respondents use the equalisation rule. Under the first model, the remainder return a fixed proportion of the money obtained (either 0, 33.3% or 50%). Let these proportions be q_1, q_2 and q_3, respectively. Note that according to this model, the increase in the proportion returned according to the initial transfer is entirely due to individuals using the equalisation rule.

Under the second model, the proportion returned by those not using the equalisation rule is either 0, 33.3 or 50%, but can depend on the initial transfer. As argued above, the more generous the initiator, the more generous the respondent. Assume that each respondent has a pair of thresholds (t_1, t_2), such that when the initial transfer is less than t_1, then nothing is returned, when the initial transfer is at least t_1, but less than t_2, then 33.3% is returned and if the transfer is at least t_2, then 50% is returned. Note that different players can use different thresholds. It is assumed that $1 \leq t_1 \leq t_2 \leq 11$. "Never return any money" corresponds to $t_1 = t_2 = 11$ and "always return 50%" to $t_1 = t_2 = 1$. Let $q(t_1, t_2)$ be the proportion of respondents using the pair of thresholds (t_1, t_2).

To analyse the data, we classify the response into one of the following categories: i) equalising, ii) 0% of the initial transfer, iii) 33.3% of the initial transfer or iv) 50% of the initial transfer. There are two clear problems inherent in using such an approach:

a) The amount returned often corresponds to more than one norm of reciprocation: e.g. when the initial transfer is 5PLN, the equalisation rule proposes returning 33.3% of the amount obtained. In this case, we assume that the probability of the respondent being an equaliser is equal to the conditional probability of him being an equaliser given that he is either an equaliser or uses "the return 33.3%" norm.

b) The amount returned does not always correspond to equalising or returning 0, 33.3% or 50%. Thus we use the following procedure: the amount returned is classified as resulting from the norm (or norms) which suggests the most similar return. For example, when the initial transfer is 10PLN, the 33.3% rule says return 10PLN and both the 50% rule and equalisation rule state that 15PLN should be returned. Hence, returning less than 5PLN is classified as returning 0%, returning 5PLN classified as either returning 0% or 33.3%, returning between 6PLN and 12PLN classified as returning 33.3% and returning more than 12PLN classified as either returning 50% or equalising. It would be more natural to assume that each norm is associated with a conditional distribution of the amount actually returned given the initial transfer. However, such an approach would complicate statistical analysis of the model.

Estimating the parameters of this model would be highly complex, since there are 66 such threshold rules. Thus we split non-zero transfers into three groups corresponding to the peaks in the distribution. This categorisation takes place after categorising the return into one (or more) of the four possible classes. Secondly, this categorisation is very similar to the one made by Migheli (2012) in his study on Western European students.

i) Transfers of less than 4PLN. These are made by initiators with low levels of trust, but feel disutility from inequality.

ii) Transfers of between 4 and 7PLN. These are made by initiators who have limited trust.

iii) Transfers of between 8 and 10PLN. These are made by initiators who trust the respondent.

Assume that when a respondent does not use the equalisation rule, then the proportion of money returned depends on the category that this transfer belongs to. Since the proportion returned is non-decreasing in the initial transfer, there are 10 such rules, which can be described by a pair of indexes (i, j) such that an individual returns 33.3% if the category number of the transfer is at least i, but less than j, returns 50% if this category number is at least j and otherwise does not return anything, $1 \leq i \leq j \leq 4$. These rules are

- (1, 1) – Always return 50%
- (1, 2) – Return 33.3% if the initial transfer is less than 4PLN, otherwise return 50%
- (1, 3) – Return 33.3% if the initial transfer is less than 8PLN, otherwise return 50%
- (1, 4) – Always return 33.3%
- (2, 2) – Return nothing if the initial transfer is less than 4PLN, otherwise return 50%
- (2, 3) – Return nothing if the initial transfer is less than 4PLN, return 33.3% if the initial transfer is at least 4PLN and less than 8PLN, otherwise return 50%
- (2, 4) – Return nothing if the initial transfer is less than 4PLN, otherwise return 33.3%
- (3, 3) – Return nothing if the initial transfer is less than 8PLN, otherwise return 50%
- (3, 4) – Return nothing if the initial transfer is less than 8PLN, otherwise return 33.3%
- (4, 4) – Never return anything.

The proportion of individuals using the rule (i, j) is denoted $q_{i,j}$. The categorisation of transfers and returns based on this approach is given in Table 4. The parameters are estimated using the maximum likelihood approach. Since the amount returned can correspond to more than one of the norms considered, the Expectation Maximisation (EM) algorithm is used (Dempster *et al.*, 1977).

Table 5

Categorisation of transfers and returns (eq – return ascribed to the equalisation rule, eq/33.3 return corresponds to both the equalisation rule and returning 33.3%, etc.). The probability of belonging to a given column under the first model is in the final row

	eq	0	33.3	50	eq/0	eq/0 /33.3	eq/33.3	33.3/50	0/33.3	eq/50
Transfer 1–3PLN	14	11	62	45	33	12	13	0	0	0
Transfer 4–7PLN	35	46	49	81	0	0	118	9	2	3
Transfer 8–10PLN	11	12	54	14	0	0	0	0	9	55
Total	60	69	165	140	33	12	131	9	11	58
Probability	p	q_1	q_2	q_3	$p+q_1$	$1-q_3$	$p+q_2$	q_2+q_3	q_1+q_2	$p+q_3$

Source: The authors' research.

6.1. Estimating the parameters of the first model

we must estimate four proportions, p, q_1, q_2, q_3. Essentially, this involves estimating 3 parameters, since these proportions sum to one. According to this model, when the equalisation rule is not used, the proportion returned is independent of the transfer. Thus the frequencies from the penultimate row of Table 4 are sufficient to derive the likelihood function, which is given by

$$l(p, q_1, q_2, q_3) = p^{60} q_1^{69} q_2^{165} q_3^{140} (p + q_1)^{33} (p + q_1 + q_2)^{12} (p + q_2)^{131} \times$$
$$\times (q_2 + q_3)^9 (q_1 + q_2)^{11} (p + q_3)^{58}.$$

Since direct maximisation of this function involves solving a system of non-linear equations, we use an iterative procedure to approximate the solution, i.e. the EM algorithm. We start with an initial set of estimates $\hat{p} = \hat{q}_1 = \hat{q}_2 = \hat{q}_3 = 0.25.$ Given that we cannot classify a return to a single rule, we assume that the conditional probability that any of the possible rules is used is proportional to the proportion using that rule. Hence, if the rule used is either equalisation or return 0%, then the probability that it is equalisation is $\hat{p}/(\hat{p} + \hat{q}_1)$. Since there are 33 such returns, the number that should be classified as resulting from the equalisation rule has a binomial distribution with parameters 33 and $\hat{p}/(\hat{p} + \hat{q}_1)$, the Bin $(33, \hat{p}/(\hat{p} + \hat{q}_1))$ distribution. Similarly, the number of such returns that should be classified as resulting from the return 0% rule has a Bin$(33, \hat{q}_1/(\hat{p} + \hat{q}_1))$

distribution. Hence, the total number of returns classified as resulting from the equalisation rule, returning 0%, returning 33.3% and returning 50% are given by $60 + N_1, 69 + N_2, 165 + N_3, 140 + N_4$, respectively, where

$N_1 = X_1 + X_2 + X_3 + X_4$, $N_2 = Y_1 + Y_2 + Y_3$,

$N_3 = U_1 + U_2 + U_3 + U_4$, $N_4 = V_1 + V_2$

and

$$X_1 \sim \text{Bin}\left(33, \frac{\hat{p}}{\hat{p} + \hat{q}_1}\right), \quad X_2 \sim \text{Bin}\left(12, \frac{\hat{p}}{\hat{p} + \hat{q}_1 + \hat{q}_2}\right),$$

$$X_3 \sim \text{Bin}\left(131, \frac{\hat{p}}{\hat{p} + \hat{q}_2}\right), \quad X_4 \sim \text{Bin}\left(58, \frac{\hat{p}}{\hat{p} + \hat{q}_3}\right),$$

$$Y_1 \sim \text{Bin}\left(33, \frac{\hat{q}_1}{\hat{p} + \hat{q}_1}\right), \quad Y_2 \sim \text{Bin}\left(12, \frac{\hat{q}_1}{\hat{p} + \hat{q}_1 + \hat{q}_2}\right), \quad Y_3 \sim \text{Bin}\left(11, \frac{\hat{q}_1}{\hat{q}_1 + \hat{q}_2}\right)$$

$$U_1 \sim \text{Bin}\left(12, \frac{\hat{q}_2}{\hat{p} + \hat{q}_1 + \hat{q}_2}\right), \quad U_2 \sim \text{Bin}\left(131, \frac{\hat{q}_2}{\hat{p} + \hat{q}_2}\right),$$

$$U_3 \sim \text{Bin}\left(9, \frac{\hat{q}_2}{\hat{q}_2 + \hat{q}_3}\right), \quad U_4 \sim \text{Bin}\left(11, \frac{\hat{q}_2}{\hat{q}_1 + \hat{q}_2}\right)$$

$$V_1 \sim \text{Bin}\left(9, \frac{\hat{q}_3}{\hat{q}_2 + \hat{q}_3}\right), \quad V_2 \sim \text{Bin}\left(58, \frac{\hat{q}_3}{\hat{p} + \hat{q}_3}\right).$$

The conditional likelihood of the data given N_1, N_2, N_3, N_4 is

$l(p, q_1, q_2, q_3 | N_1, N_2, N_3, N_4) = p^{60+N_1} q_1^{69+N_2} q_2^{165+N_3} q_3^{140+N_4}$.

At each iteration, we maximise the conditional likelihood when N_1, N_2, N_3, N_4 take their expected values given the present estimates of the proportions, where

$$E(N_1) = \frac{33\hat{p}}{\hat{p} + \hat{q}_1} + \frac{12\hat{p}}{\hat{p} + \hat{q}_1 + \hat{q}_2} + \frac{131\hat{p}}{\hat{p} + \hat{q}_2} + \frac{58\hat{p}}{\hat{p} + \hat{q}_3}$$

$$E(N_2) = \frac{33\hat{q}_1}{\hat{p} + \hat{q}_1} + \frac{12\hat{q}_1}{\hat{p} + \hat{q}_1 + \hat{q}_2} + \frac{11\hat{q}_1}{\hat{q}_1 + \hat{q}_2}$$

$$E(N_3) = \frac{12\hat{q}_2}{\hat{p} + \hat{q}_1 + \hat{q}_2} + \frac{131\hat{q}_2}{\hat{p} + \hat{q}_2} + \frac{9\hat{q}_2}{\hat{q}_2 + \hat{q}_3} + \frac{11\hat{q}_2}{\hat{q}_1 + \hat{q}_2}$$

$$E(N_4) = \frac{9\hat{q}_3}{\hat{q}_2 + \hat{q}_3} + \frac{58\hat{q}_3}{\hat{p} + \hat{q}_3}.$$

Since the number of respondents who obtain a transfer is 688, the updated estimators are given by

$$\hat{p} = \frac{60 + E(N_1)}{688}, \hat{q}_1 = \frac{69 + E(N_2)}{688}, \hat{q}_2 = \frac{165 + E(N_3)}{688}, \hat{q}_3 = \frac{140 + E(N_4)}{688}.$$

Given these new estimates of the parameters, we re-estimate $E(N_1), E(N_2), E(N_3), E(N_4)$ and again update the estimates of the parameters. This procedure is repeated until convergence. Using a program written in the R language, we obtain the estimates

$$\hat{p} = 0.2377, \hat{q}_1 = 0.1234, \hat{q}_2 = 0.3868, \hat{q}_3 = 0.2520.$$

Under this model, around 24% of players use the equalise rule, 12% never return anything, 39% return a third of the money received and 25% return half.

6.2. Estimating the parameters of the second model

again, assume that a proportion p of respondents use the equalisation rule. We must derive the probability of not using the equalisation rule and returning a certain proportion of money given the value of the transfer. For example, suppose that the return 0% response was invoked when the transfer was less than 4PLN. This requires that the first index corresponding to that rule is at least 2 (i.e. a transfer of at least 4PLN is required to make the respondent return any money). The probability of such behaviour according to this model is $q_{2,2} + q_{2,3} + q_{2,4} + q_{3,3} + q_{3,4} + q_{4,4}$. Arguing similarly, the probabilities of various percentage returns given the transfer are given in Table 5.

Table 6

Probabilities of evoking various percentage returns given the initial transfer according to the second model

	0%	33.3%	50%
Transfer 1–3PLN	$q_{2,2} + q_{2,3} + q_{2,4} + q_{3,3} + q_{3,4} + q_{4,4}$	$q_{1,2} + q_{1,3} + q_{1,4}$	$q_{1,1}$
Transfer 4–7PLN	$q_{3,3} + q_{3,4} + q_{4,4}$	$q_{1,3} + q_{1,4} + q_{2,3} + q_{2,4}$	$q_{1,1} + q_{1,2} + q_{2,2}$
Transfer 8–10PLN	$q_{4,4}$	$q_{1,4} + q_{2,4} + q_{3,4}$	$q_{1,1} + q_{1,2} + q_{1,3} + q_{2,2} + q_{2,3} + q_{3,3}$

Source: Authors' research.

When a return cannot be unambiguously categorised (see Table 4), then the probability corresponding to a given cell is given by the appropriate sum of probabilities in that row. For example, the probability of a response corresponding to either the equalisation rule or return 33.3% when the transfer is between 4 and 7PLN inclusively is given by $p + q_{1,3} + q_{1,4} + q_{2,3} + q_{2,4.}$ The likelihood function under this model is then given by

$$l(p, q_{1,1}, q_{1,2}, q_{1,3}, q_{1,4}, q_{2,2}, q_{2,3}, q_{2,4}, q_{3,3}, q_{3,4}, q_{4,4}) = \prod_{\substack{1 \le i \le 3; \\ 1 \le j \le 10}} r_{i,j}^{n_{i,j}},$$

where $r_{i,j}$ and $n_{i,j}$ are the probability and frequency, respectively, corresponding to the cell in row i and column j of Table 4. This likelihood function was maximised by the EM algorithm using a program written in the R language (due to space limitations, further details are omitted). The maximum likelihood estimates of these parameters are as follows:

$$\hat{p} = 0.2335, \hat{q}_{1,1} = 0.2342, \hat{q}_{1,2} = 0.0190, \hat{q}_{1,3} = 0.0283, \hat{q}_{1,4} = 0.3503,$$

$$\hat{q}_{2,2} = \hat{q}_{2,3} = \hat{q}_{2,4} = 0, \hat{q}_{3,3} = 0.0027, \hat{q}_{3,4} = 0.0443, \hat{q}_{4,4} = 0.0877.$$

According to this model, the vast majority of individuals who do not use the equalisation rule return a fixed proportion of the money obtained. The index pairs corresponding to the strategies a) do not return anything, b) return 33.3% and c) return 50% are (4,4), (1,4) and (1,1), respectively. Hence, more than 90% of the respondents use either one of these strategies or the equalisation rule.

6.3. Selecting a model

in general, one wishes to choose the simplest model which gives a good description of the data. The Akaike Information Criterion (AIC, Akaike, 1974) and Bayesian Information Criterion (BIC, Schwarz, 1978) are often used to select an appropriate model. These criteria involve maximising the value of the likelihood function for a given model minus a penalty function based on the number of parameters estimated. Given the comments at the end of Section 6.b, it is unsurprising that both criteria select the first model as the most appropriate. It should also be noted that the first model was preferred to one which assumed that there was at most one threshold at which the proportion returned increased (from 0 to 33.3%, from 0 to 50%, or from 33.3% to 50%).

7. CONCLUSION

This paper presented results from a study based on 1540 university students from all over Poland using the Trust Game. The initial transfer was positively correlated with the level of trust expressed by the initiator. Glaeser *et al.* (2000) note that the expression of generalised trust is a stronger indicator of trustworthy behaviour than of trusting behaviour. However, we did not find any association between the expression of trust and the percentage returned. The distribution of transfers is associated with gender. In particular, males were more likely than females to transfer all 10PLN or not transfer anything. These two features seem to result from males being less risk aversive (see Borghans *et al.*, 2009) and more individualistic than females (Markowska-Przybyła and Ramsey, 2015), respectively. On average, males transferred more than females.

Regression analysis shows that the mean percentage returned by the respondent increased from around 25% when only 1PLN was transferred to around 40% when all 10PLN was transferred. Analysis of the returns indicates that there are peaks in the conditional distribution of the percentage returned at 0%, 33.3% and 50% of the amount received. This agrees with the expectations of the initiators. It seems also that a number of individuals use the equalisation rule proposed by Markowska-Przybyła and Ramsey (2014). Hence, the statistical models considered norms based on either equalisation or returning one of these proportions.

There are two problems involved in analysing these data. Firstly, different norms may correspond to the same observed behaviour. However, the EM algorithm can be used to estimate the frequencies with which such rules are used, as described above.

The second, more serious, problem lies in the variability of the returns. It is possible that respondents follow one of these norms, but make errors in determining how much money should be returned. Also, others may use a different norm or "instinct" to determine how much to pay back. The statistical properties of the observed behaviour of "instinctive" individuals may be assumed to be random in some sense, but certainly not in the sense that the amount paid back is uniformly distributed over the set of possible returns. The method proposed here uses the simplistic approach that a given return results from using the norm (or one of the norms) which prescribe the most similar payoff, i.e. this method does not explicitly model "random" behaviour or errors in the use of norms. However, from the results presented, it is reasonable to assume that each of the following norms are used by a significant proportion of the respondents: a) never return anything (the economically rational strategy), b) always return 33.3% (ensuring that Player 1 breaks even), c) always return 50% (ensuring that both players gain), d) the equalisation norm, which ensures that when the respondent has more money than the initiator after the initial transfer, then the return ensures that both players obtain the same payoff.

Future research on norms of reciprocation in the Trust Game when the strategy approach is not used should also involve asking respondents how they chose their action and appropriate modelling of the errors made in determining this response.

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NORMY ODWZAJEMNIENIA UKAZANE PRZEZ POLSKICH STUDENTÓW W GRZE „ZAUFANIE": WYNIKI EKSPERYMENTALNE

Streszczenie. Zaufanie uogólnione i normy odwzajemnienia są komponentami kapitału społecznego, które według wielu ekonomistów są powiązane ze wzrostem gospodarczym. Artykuł przedstawia wyniki zakrojonych na dużą skalę badań przeprowadzonych wśród polskich studentów, bazujących na grze „zaufanie", w której inicjator i respondent mogą osiągnąć wzajemne korzyści, o ile inicjator zaufa respondentowi, a ten następnie to odwzajemni. Bazując na wynikach tych badań autorzy analizują normy pozytywnego odwzajemnienia wśród zbiorowości polskich studentów. Analizy wskazują, że duży odsetek studentów zdaje się używać jednej z czterech prostych norm odwzajemnienia. W ujęciu statystycznym, poziom odwzajemnienia jest raczej dobrze odzwierciedlony w oczekiwaniach inicjatorów.

Słowa kluczowe: kapitał społeczny, zaufanie uogólnione, norma, odwzajemnienie, gra eksperymentalna, gra „zaufanie", Polska