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Reciprocal preferences and the unraveling of gift-exchange

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Reciprocal Preferences and the Unraveling of Gift-Exchange*

Aurélie Dariel Arno Riedl

June 21, 2013

Abstract

We elicit reciprocal preferences in a firm-worker gift-exchange setting and relate them to actual behavior in a repeated gift-exchange game. We find that only a small minority of 10 percent of workers is materially selfish whereas 90 percent exhibit reciprocal preferences. However, the intensity of reciprocal preferences is weak in the sense that firms maximize profits by not relying on gift-exchange but by offering the lowest possible wage. Workers behavior in the repeated gift-exchange game is predicted by their elicited preferences, but the correlation between preferences and behavior is imperfect. Together with profit maximizing behavior of firms these observations can explain the observed unraveling of gift-exchange over time in our experiment and some recent field experiments.

Keywords: gift-exchange, reciprocal preferences, consistency

JEL Classification: C72, C92, J59

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1 Introduction

Incomplete contracts in labor markets and the question of how to overcome moral hazard has been a topic of continuing interest for economists. Several mechanisms have been proposed to reduce incentives for moral hazard of workers (e.g., Grossman and Hart, 1981, Shapiro and Stiglitz, 1984, Mas-Colell et al., 1995). Akerlof (1982, 1984) was the first to suggest that workers may be driven by fairness and a taste for reciprocity, which may help overcome moral hazard. In his model workers may be willing to exert higher levels of effort in response to higher wages, even when effort is not enforceable. In anticipation of workers' reciprocity, profit maximizing firms may be willing to offer wages above workers' reservation wages. Akerlof (1982) coined the term *gift-exchange* for this reciprocal relation between firms and workers.

Fehr et al. (1993, henceforth FKR) were the first to test Akerlof's hypothesis in the laboratory and developed the gift-exchange game (henceforth, GEG) for this purpose. The GEG is a simple two-stage game. In the first stage, a firm offers a wage to a worker who, in the second stage, decides how much effort to exert. Effort is costly for the worker and beneficial for the firm. Therefore, under standard assumptions of rationality and material self-interest, the unique subgame-perfect Nash equilibrium of the finitely-repeated GEG is for the worker to exert minimum effort and for the firm to offer the smallest possible wage, satisfying worker's participation constraint. Both parties would be materially better off, however, if the firm offered a higher wage and the worker reciprocated by exerting higher levels of effort. In contrast to the standard prediction and in line with Akerlof's prediction, FKR found that workers do reciprocate higher wages with higher effort levels. This result attracted considerable attention as it suggested that reciprocal behavior may indeed help to overcome the moral hazard problem inherent in incomplete contracts. Consequently, in a stream of studies the existence and robustness of gift exchange in various situations has been investigated.[1]

[1]See, e.g., Fehr et al. (1997, 1998b,a), Fehr and Falk (1999), Charness (2004) for studies on gift exchange and, e.g., Fehr and Gächter (2000), Charness and Rabin (2002), Camerer and Fehr (2004), Dufwenberg and Kirchsteiger (2004), Sobel (2005), Falk and Fischbacher (2006) for a more general discussion of reciprocity. Fehr et al. (2009), Charness and Kuhn (2011), Cooper and Kagel (2012), Casoria and Riedl (2013) provide recent surveys on gift exchange experiments and related issues.

Most studies corroborate the initial finding of workers' willingness to reciprocate high wages with higher effort levels as a robust phenomenon in laboratory experiments. However, some studies have also shown that the sustainability of gift exchange may depend on a number of factors, as salience of monetary incentives (Charness et al., 2004), potential efficiency gains (Engelmann and Ortmann, 2009), participants' background (Hannan et al., 2002), the presence of a minimum wage (Kagel and Owens, 2010), or the ability to establish a long-term relationship between firms and workers (Brown et al., 2004). Further, few field experiments suggest that workers' positive effort response to an unexpectedly high wage may fade out over time (Gneezy and List, 2006, Kube et al., 2013).

In our paper we look at the fundamental issue of workers' preference for reciprocity in GEG. Specifically, we investigate the intensity of these preferences and their heterogeneity among workers and how this relates to the wage-effort dynamics in a finitely repeated GEG. Our experiment consists of two parts. In the first part, we elicit (amongst others) workers' reciprocal preference in a one-shot GEG. In the second part, workers play a finitely-repeated GEG.[2]

We find that only a minority of subjects in the role of a worker exhibits materially selfish preferences, whereas 90 percent of the workers exhibit reciprocal preferences. That is, a huge majority is willing to respond to higher wages with higher effort levels, even in a one-shot situation. Importantly, however, all reciprocal workers show a relatively weak intensity of reciprocal preferences, in the sense that firms could earn a higher profit, would they offer the smallest possible wage. In the finitely-repeated GEG we observe a steady decline of effort and wage levels over time. We find that in the repeated GEG workers behavior is strongly correlated with their elicited preferences. However, we also observe that their exerted effort is not fully consistent with the elicited preferences. We argue that the observed downward cycle of wages and effort can be attributed to a combination of firms' maximizing profits, workers' relatively weak intensity of reciprocal preferences, and the imperfect correlation between preferences and behavior. This also offers an explanation for the unraveling of

[2]To our knowledge only a few other studies have elicited workers' preference for reciprocity in the GEG (Maximiano et al., 2007, Gächter and Thöni, 2010, Maximiano et al., 2013). These papers differ from our study as they do not classify workers types as we do in this paper and they also do not investigate the relation of elicited preferences on behavior in the finitely-repeated game. Moreover, these studies use variants of the GEG with multiple workers.

gift-exchange observed in some other gift-exchange experiments in the laboratory (Brown et al., 2004, Engelmann and Ortmann, 2009) and the field (Gneezy and List, 2006, Kube et al., 2013).

The rest of the paper is organized as follows. In Section 2 we introduce the design of the experiment. In Section 3 we present the results and Section 4 concludes.

2 Experimental design and procedures

2.1 Experimental design

The experiment consists of two parts. In the first part, we elicit participants' reciprocal preferences in the gift-exchange game using the strategy method introduced by Selten (1967) (see Brandts and Charness, 2011, for a recent survey). In the second part, participants play a finitely-repeated version of gift-exchange game. In the following we first introduce the gift-exchange game we implemented. Thereafter, we discuss the details of the two parts of the experiment and report on the experimental procedures.

The implemented gift-exchange game is a two-person game consisting of two stages. The first player (*firm*) decides on the wage $w \in \{0, 5, 10, 15, ..., 95, 100\}$ to be paid to the second player (*worker*). Knowing the wage the worker decides on a level of effort $e \in \{1, 2, 3, ..., 10\}$ to exert. Effort is costly for the worker and the costs of effort $c(e)$ are shown in Table 1.

Table 1: Costs of effort

e	1	2	3	4	5	6	7	8	9	10
$c(e)$	0	1	2	4	6	8	10	12	15	18

The profit of the firm and the earnings of the worker are given by

$$\begin{aligned} \pi &= 10e - w + 50 \\ u &= w - c(e) + 20, \end{aligned}$$

respectively. These payoff functions closely resemble those used in Brown et al. (2004).

Assuming common knowledge of rationality and narrow material self-interest the unique subgame-perfect Nash equilibrium is given by the firm

offering the lowest possible wage ($w = 0$) and the worker exerting the lowest possible effort ($e = 1$). However, a number of experiments have shown that many workers are willing to respond to higher wages with higher effort levels. That is, effort is an increasing function of wage: $e = e(w)$ and $e'(w) > 0$. For a profit maximizing firm anticipating this relation the maximization problem becomes

$$\max_w \pi = 10e(w) - w + 50.$$

An important implication of this relationship is that offering a wage higher than the lowest possible wage can be profitable for the firm, provided the worker is sufficiently reciprocal. For our set-up, this will be the case when $e'(0) > 1/10$, as this implies $d\pi/dw(0) > 0$.

Part 1: Elicitation of reciprocal preferences and beliefs. To elicit workers' reciprocal preferences in the GEG we use the strategy method. Assuming that workers reciprocal preferences do not change, at least in the short term, the results from the strategy method will allow us to test the impact of these preferences on workers' effort choices in the finitely-repeated GEG. It also allows us to examine the intensity of reciprocal preferences and whether the extent of reciprocity will be sufficient for firms to earn higher profits with positive wages than with the lowest possible wage of zero.

At the start of Part 1, participants in the experiment were randomly assigned the role of either a firm or a worker. These roles remained fixed throughout the experiment. Each participant in the role of a worker was asked to fill out a wage-effort table were s/he had to state the effort level s/he was willing to exert for each possible wage $w \in \{0, 5, 10, 15, ..., 100\}$ offered by the firm. Hence, each worker had to make 21 effort decisions.

Each participant in the role of a firm had to decide on the wage that would actually be paid to a randomly matched worker. All firms and workers made their decisions independently and anonymously. The actual wage and the chosen effort corresponding to that wage determined participants earnings in this part,[3] which guaranteed incentive compatibility of both effort and wage choices.

After having made their wage and effort decisions, firms and workers were asked to state their beliefs regarding the actions of their matched counterparts.

[3]For example if the firm offers a wage of 15, and the worker entered effort level 2 in the wage-effort table, firm's earnings are 55 and worker's earnings are 34.

That is, each worker had to provide an estimate of the wage s/he would be offered by the firm and each firm had to provide an estimate of the effort chosen by the matched worker for the actually offered wage. Participants were rewarded for the accuracy of their estimates. If the estimate was exactly right, three additional points were earned. If the estimate deviated by one unit (two units) from the actual decision, then two (one) additional point(s) were earned. Larger deviations earned nothing.

At the end of Part 1, each worker was informed about the wage actually offered by the matched firm and each firm got to know the effort exerted by the matched worker. They were also informed about the accuracy of their estimates.

Part 2: The finitely-repeated gift-exchange game. The second part of the experiment consisted of a gift-exchange game repeated for ten periods. Each participant stayed with the same role (firm or worker) as in Part 1, but workers and firms were randomly re-matched at the beginning of each period. Each period consisted of two stages. In the first stage, firms had to decide on a wage level and to provide an estimate of the effort that would be chosen by the matched worker. At the same time, workers had to indicate the wage they believed the matched firm will offer. In the second stage, workers learned the actual wage and had to decide on the effort level.[4]

2.2 Procedures

The experiment was conducted at the Maastricht University Behavioral and Experimental Economics laboratory (BEElab). Four sessions were run with a total of 40 participants. All participants were students at Maastricht University. They were recruited via e-mail and had to register on-line. Interactions in the experiment were fully computerized using Z-tree (Fischbacher, 2007).

At the beginning of each session participants were randomly allocated to a closed cubicle where they could make their decisions in complete anonymity from the experimenter and other subjects. The instructions (available in the Supplementary Materials) were given to participants on paper and each of the parts was explained in detail. Instructions for Part 1 were handed out

[4]Since the game is played for a known finite number of periods, a subgame-perfect Nash equilibrium of the stage game is also an equilibrium of the finitely repeated game.

first. Participants were informed that there would be a second part of the experiment, but did not receive any information on the content of the second part. Instructions for the second part were not given until Part 1 was finished.

When participants were ready with reading the instructions, they were asked to answer a set of comprehension questions. The experiment did not start until all participants had correctly answered all questions. These procedures were the same in both parts of the experiment. At the end of the experiment the total amount of points earned in Part 1 were converted to Euro at rate of 1 point = 12 Euro cent and the total amount of points earned in Part 2 were converted to Euro at the rate of 1 point = 2 Euro cent. A typical session lasted about 90 minutes and participants earned on average €19,–.

3 Results

We first analyze workers' elicited reciprocal preferences in Part 1 and then proceed to examine whether they can explain the behavioral dynamics in the finitely-repeated GEG.

3.1 Reciprocal preferences

Result 1 *Ninety percent of workers exhibit reciprocal preferences and only ten percent are fully selfish.*

SUPPORT: For the classification of workers as reciprocal or selfish types we adapt the method introduced by Fischbacher et al. (2001) and Fischbacher and Gächter (2010). The rules for determining the type of a worker are as follows. If the effort choices of a worker exhibit a monotonic pattern with at least one increase with increasing wage, then the worker is classified as having *reciprocal preferences* (or being a *'reciprocator'*). A worker is also classified as being a reciprocator if there is a significant positive correlation at the 1-percent level between effort and wage, using Spearman's rank correlation coefficient. Workers who always exert the lowest possible effort (i.e., $e = 1$ for all $w \in \{0, 5, ..., 95, 100\}$) are classified as *selfish*. Workers who do not meet any of these criteria are classified as *other*. Using the described criteria, we can classify 10 percent of workers as selfish and 90 percent as reciprocators. We do not identify any other types.

The share of reciprocators is with 90 percent remarkably high. However, the fact that a worker exerts higher effort for higher wages does not necessarily imply that a high wage is profitable for the firm. Whether high wages are profitable for firms depends on the intensity of the worker's reciprocal preferences. For instance, in our experiment, if $w = 50$ and $e = 5$ then a firm earns 50 and the worker 64. In such a case a profit maximizing firm would be better off offering the smallest possible wage, $w = 0$, which secures a profit of 60. For $w = 50$ to be more profitable for the firm than $w = 0$, a worker must exert an effort of at least 6. Hence, only if the intensity of workers' reciprocal preferences is strong enough firms' will have an incentive to offer high wages, which is a necessary condition for gift-exchange to prevail.

In the following we develop a measure that allows us to quantify the intensity of reciprocal preferences and determine whether it is sufficient to allow for sustained gift-exchange. We call this measure the reciprocation index, RI, which classifies workers with respect to the extent of their reciprocation. For each individual i, the index is defined as

$$RI_i = \frac{\sum_{k=0}^{M} (e_{ki} - \underline{e})}{M(\overline{e} - \underline{e})}$$

where e_{ki} is the effort level of individual i for wage $w = k$, $\overline{e}$ is the maximum effort possible (in our case, 10), $\underline{e}$ is the lowest effort possible (in our case, 1), and M is the number of different wage levels (in our case 21). The index ranges from 0 to 1, where 0 depicts a selfish worker who always chooses the lowest possible effort, and 1 depicts an unconditional 'altruistic' worker who always chooses the highest possible effort.

In the following we distinguish between *strong* and *weak* reciprocators. A worker is called strong reciprocator when s/he displays an intensity of reciprocal preferences that makes it profitable for the firm to offer a wage above the lowest possible wage. That is, for all wages above zero the firm earns a profit at least as high as the profit it could guarantee by offering exactly zero.[5] Weak reciprocators are then those who, although responding to higher wages with

[5]Classifying workers in that way as strong reciprocators is rather conservative as it assumes narrowly selfish firms which engage in gift-exchange only if it increases their profits. Later we briefly discuss an alternative approach in which reciprocators are classified as strong when they choose effort levels that make firms not worse off than themselves.

higher effort, on average, leave firms worse off when they offer wages higher than the lowest possible wage than when they offer exactly that wage.

In our experiment the profit a firm can guarantee itself by paying the lowest possible wage ($w = 0$) is $\pi = 60$. The reciprocation index of a worker i who, on average, chooses effort levels that leaves the firm with $\pi = 60$ is $RI_i = 0.57$. Therefore, we call worker i a strong reciprocator if $RI_i \geq 0.57$ and a weak reciprocator if $RI_i < 0.57$. Note, that this classification does not imply that firms matched with a weak reciprocator will be worse off for all wages larger than the lowest possible wage. However, on average, firms matched with weak reciprocators will be better off offering them $w = 0$.

Result 2 *All workers with reciprocal preferences are weak reciprocators, in the sense that a firm maximizes its profit by offering the lowest possible wage.*

SUPPORT: Figure 1 displays the distribution of the reciprocation index of workers as reciprocators. Selfish participants have an index of 0 and are not shown. As can be clearly seen *none* of the reciprocal workers has an reciprocation index equal or greater than 0.57. Consequently, all workers with reciprocal preferences are weak reciprocators.

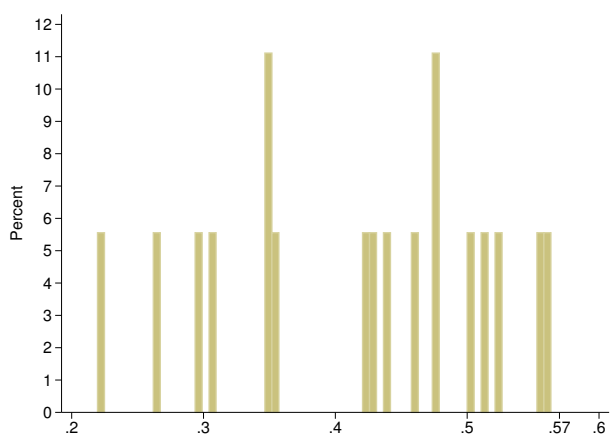


Figure 1: Distribution of reciprocation index

Figure 2 shows the average effort as a function of wage for our identified types. In the figure, 'reciprocators' and 'selfish' are defined as explained in the support of Result 1. The 'reference level of effort,' $r(w)$, is the effort level that

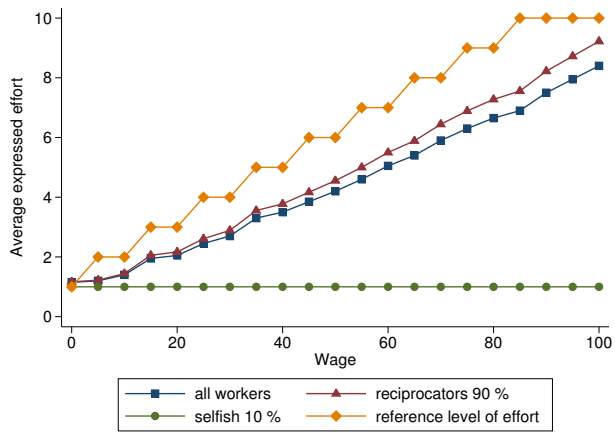


Figure 2: Effort as a function of wage (all workers and by types)

guarantees the firm a profit of at least 60 for each wage level. It is given by

$$r(w) = \begin{cases} \arg\min_e \{\pi(w;e) \geq 60\} & \text{if } w < 95 \\ 10 & \text{otherwise,} \end{cases}$$

for each wage $w \in \{0, 5, ..., 100\}$.[6]

Figure 2 also summarizes Results 1 and 2 and highlights two points.[7] First, overall, there is a clear positive relation between wages offered by firms and effort expended by workers. Second, while nearly all workers can be classified as reciprocators, their intensity of reciprocal preferences is below the reference level of effort, $r(w)$. A linear regression analysis (OLS and Tobit) with effort as the dependent variable and wage as the independent variable corroborates the expression gained from the figure. The OLS estimated coefficient for wage is approximately 0.09, which is slightly below the marginal effort of 1/10, necessary for positive wages to be profitable for firms (cf. Section 2.1). Therefore, the extent of workers' reciprocal preferences is not sufficient to make firms better off in monetary terms, than they were when they would offer the lowest possible wage. Consequently, in case workers reciprocal preferences carry over to the finitely-repeated GEG, the prospects of sustaining gift-exchange are rather grim. This is what we explore next.

[6]For $w \geq 95$ there is no effort level that guarantees firms a profit of at least 60. In the experiments only in 2 out of 200 instances, a firm offered $w \geq 95$.

[7]Graphs showing the relationship between wages and effort levels for each individual worker can be found in the Appendix A.1.

3.2 The finitely-repeated gift-exchange game

Next we are exploring participants' behavior in the repeated gift-exchange game and relate it to the elicited (reciprocal) preferences. We will first investigate whether there is a positive wage-effort relationship in the repeated gift-exchange game and whether workers behavior is consistent with their elicited preferences. Then, we will look at the level and dynamics of wages and efforts and how these could be related to workers' preferences.

Result 3 *In the repeated gift-exchange game, workers reciprocate a higher wage with higher effort. Moreover, workers' elicited reciprocal preferences are a good predictor of effort choices in the repeated game.*

SUPPORT: Table 2 presents the results from GLS random effects panel regression analyses with effort exerted by worker i in period t, e_{it}, as the dependent variable.[8] Model 1 investigates how workers effort choices respond to received wages. The significantly positive coefficient of the wage variable indicates that workers reciprocate higher wages with higher effort choices, which is in line with most previous results of gift-exchange experiments. The estimated coefficient is rather small, however. As discussed above, from a firm's perspective gift-exchange is profitable only if the marginal effect is larger than 0.1. Therefore, this suggests that gift-exchange will be difficult to sustain. Model 2 estimates the same relationship but excludes workers classified as selfish in Part 1. As expected the positive wage-effort relationship is stronger than in Model 1. However, the change is only marginal.

To test whether workers effort choices can be predicted with their elicited reciprocal preferences we construct the variable *predicted effort*. This variable takes for each actually received wage in the repeated GEG the value of the effort chosen in the strategy method in Part 1. Elicited preferences have predictive power for actual effort choices in the repeated GEG when the coefficient is significantly positive. Perfect consistency would be reflected by a coefficient that equals one. This is tested in Model 3. As the estimated coefficient is highly positively significant the results indicate that workers indeed show behavior consistent with their elicited preferences. However, the estimated coefficient is

[8] Since effort is bounded below by 1 and above by 10 we also ran Tobit random effects models which are reported in Appendix A.2. The results are qualitatively similar to the results reported here, with random effects at the individual level. See Charness et al. (2004) for a discussion of estimation methods in repeated gift-exchange games.

Table 2: Explaining effort choices in the repeated GEG

	Dependent variable: effort e_{it}			
Model	1	2	3	4
Workers used	All	Reciprocators	All	Reciprocators
Period	−0.010	−0.021	−0.033	−0.038
	(0.037)	(0.040)	(0.035)	(0.039)
Wage	0.038***	0.042***		
	(0.005)	(0.005)		
Predicted effort			0.540***	0.532***
			(0.059)	(0.063)
Constant	1.456***	1.560***	1.041***	1.129***
	(0.303)	(0.323)	(0.318)	(0.348)
R^2 (overall)	0.23	0.26	0.24	0.22
Wald $\chi^2_{(2)}$	76.51	79.11	89.65	77.69
Observations	200	180	200	180

Note: *** indicates significance at 1 percent level; regressions are GLS random effects models clustered on individuals (clustering on sessions level yields similar results; see Appendix A.2); standard errors in parantheses.

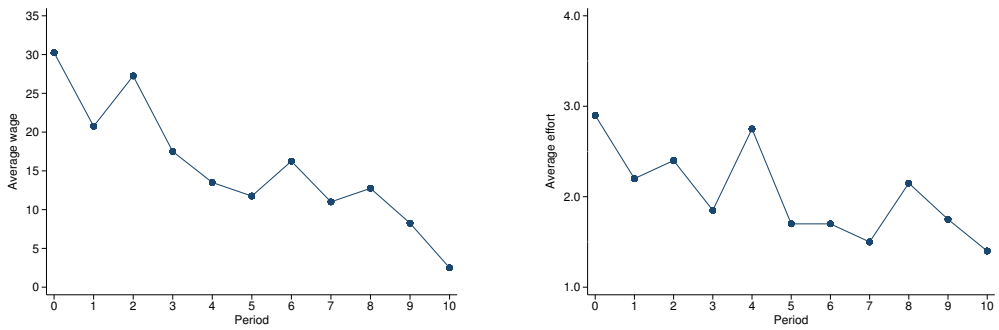
only slightly above one-half and, hence, elicited preferences do only imperfectly predict behavior. The same result holds when looking only at reciprocators (Model 4).

Note that, because workers state reciprocal preferences in Part 1 and are behaving reciprocally in the repeated GEG, the explanatory variables wage and predicted effort are highly correlated (Spearman's $\rho = 0.785, p < 0.0001$). Therefore, in regressions with both variables included one of them becomes insignificant and the coefficients are biased. We have also run regressions where we added the expected wage as explanatory variable. The regression results do not change and expected wages are never significant. This indicates that any potential effect of the expected wage on effort choices is overwritten by the actually received wage.

Result 4 *In the repeated game gift-exchange is not maintained. That is, wages and effort levels decline over time toward the lowest possible values.*

SUPPORT: Figures 3a and 3b show the evolution of average wage and effort over the 10 periods of the repeated GEG. The figures also depict the average wage and average effort for actual wages from Part 1 as period 0. Both, wage and effort, decline over time, although the decline is not monotonic. The

average wage in Part 2 of the experiment declines from 29.8 and 20.8 in Part 1 (period 0) and period 1, respectively, to 2.5 in period 10 (the average wage over periods 1-10 is 14.2). In the last period, 85 percent (17 of 20 instances) of the wages are equal to zero. The average effort in Part 2 declines from 4.4 and 2.2 in Part 1 (period 0) and period 1, respectively, to 1.4 in period 10 (the average effort over period 1-10 is 1.9). In the last period, the lowest possible effort level of zero is chosen in 90 percent of the cases (18 of 20) and the average effort is only 1.4. Hence, gift-exchange is clearly not maintained in Part 2 of the experiment.



(a) Average wage over time

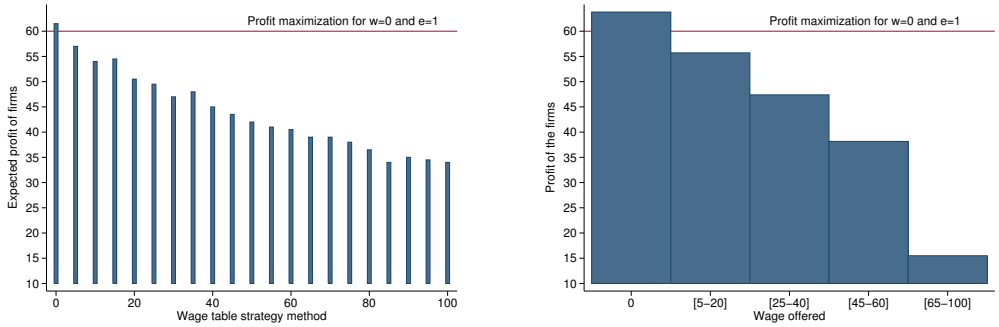
(b) Average effort over time

Figure 3: Wage and effort over time

Result 5 *Given the workers' effort responses to wages, firms maximize profits by offering the lowest possible wage.*

SUPPORT: Figure 4a presents expected profits of firms given the effort levels chosen by workers in Part 1 and Figure 4b shows it for the repeated GEG in Part 2).[9] These figures clearly illustrate that the profit maximizing strategy for firms is to offer $w = 0$ which, guarantees $\pi = 60$, in both parts of the experiment.

[9]The bins in Figure 4b are constructed such that there is a similar number of observations in each bin with $w > 0$. Specifically, there are 137 observations with $w = 0$, 21 observations with $w \in [5, 20]$, 23 observations with $w \in [25, 40]$, 19 observations with $w \in [45, 60]$, and 20 observations with $w \in [65, 100]$. To calculate the average profit in each bin, we use the *actual* average wage offered within this bins. In Figure 4a there are 20 observations for each wage level.



(a) Expected profit of firms in Part 1 (preference elicitation)

(b) Expected profit of firms in Part 2 (repeated GEG)

Figure 4: Firms profit as function of wage

4 Discussion and conclusions

There exists considerable evidence indicating individuals' willingness to reciprocate higher wages with higher effort levels in gift-exchange settings (Casoria and Riedl, 2013). Recently, however, there has been a discussion about the limits of gift-exchange in repeated interactions in the laboratory (Brown et al., 2004, Engelmann and Ortmann, 2009) as well as in the field (Gneezy and List, 2006, Kube et al., 2013). Hence, overall the evidence is a bit mixed and we miss understanding of the underlying reasons of the when and why gift-exchange can or can not be sustained in the longer-run.

In a laboratory experiment we use the strategy method to elicit reciprocal preferences of workers in a gift-exchange setting. In a subsequent repeated gift-exchange game with random matching we observe actual effort responses to wages. We find that almost all workers (90 percent) exhibit reciprocal preferences in the one-shot preference elicitation part. Nevertheless, with repetition gift-exchange unravels and wages and efforts converge to low levels. We identify two aspects of workers' behavior that – in combination with profit maximizing behavior on the firms side – lead to the observed breakdown of gift-exchange. First, the relatively weak intensity of reciprocal preferences. Second, the imperfect correlation of actual effort choices with elicited preferences.

The weak intensity of reciprocal preferences is reminiscent of the phenomenon of self-servingly biased fairness preferences in bargaining (Babcock et al., 1995, Gächter and Riedl, 2005) and incomplete conditional cooperation in public goods problems (Fischbacher et al., 2001, Fischbacher and Gächter,

2010). Hence, it appears that workers are reciprocal in such a strongly self-serving manner that it makes gift-exchange unsustainable in the longer run.

An alternative explanation for the relatively weak intensity of reciprocal preferences may be that workers care about the inequality in earnings between themselves and the firms. Taking this possibility into account, one may wonder whether equality of earnings requires lower levels of effort than those which secure firms a profit of 60. This is not the case, however. The level of effort required to minimize the earnings difference between firms and workers is indeed $e = 1$ when $w \leq 20$, but it increases quickly for $w \in \{25, ..., 75\}$. For example, a worker who wishes to minimize inequality in earnings for $w = 65$ should already choose $e = 9$. Specifically, the level of effort required to minimize inequality in earnings is greater than the level of effort that guarantees firms a profit of 60 when $w > 60$.

To test formally how concerns for inequality may affect effort levels, we constructed the variable *fair_effort* $:= \arg\min_e\{\pi - u\}$ and run a Tobit regression with individual random effects for the reciprocal workers using the level of effort expended by the worker in the strategy method as the dependent variable and *fair_effort* as the independent variable. For comparison, we run a similar regression using the reference level of effort $r(w)$[10] as the independent variable. Both explanatory variables are significantly correlated with effort, but the log-likelihood of the second empirical model is substantially lower than that of the first model (-461.92 vs. -536.41) suggesting that it provides a better explanation for workers behavior.

The second aspect on workers side contributing to the decline in gift-exchange over time is that reciprocators only imperfectly adhere to their elicited reciprocal preferences. Fischbacher and Gächter (2010) observe a similar phenomenon in repeated public goods games. In their experiment behavior is also only imperfectly predicted by elicited preferences. They identify "confused subjects" and beliefs about others contributions to the public good as explanatory factors for the discrepancy between elicited preferences and behavior. In our experiment none of these factors can help explaining the gap between preferences and behavior. First, none of our workers appears to be confused in the preference elicitation part. All are easily and clearly classifiable as either

[10]Recall, that $r(w)$ is the minimal effort level that guarantees the firm a profit of at least 60 for each wage level.

selfish or reciprocal. Second, beliefs – in our case expected wages – turn out to be unimportant in the determination of effort choices. This is also not too surprising given the sequential nature of the gift-exchange game. This leaves us with speculating about the reason of the imperfect correlation between elicited preferences and behavior. In our view, a reasonable explanation is that reciprocal preferences are actually not fixed but may respond to the environment the worker is in and the experiences a worker makes. Such an explanation is consistent with theoretical ideas arguing that (social) preferences indeed respond to the economic environment and experiences made within the environment, which recently also have been found some empirical support (Bowles, 1998, Brandts et al., 2009, Bowles and Polania-Reyes, 2012). In our study the relatively low wages experienced in Part 1 of the experiment and in early rounds of Part 2 of the experiment may have crowded out reciprocal preferences or at least further weakened their intensities.

We find that profit maximization on the firm's side together with reciprocal preferences that are too weak to make high wages profitable for the firm can help explaining the breakdown of gift-exchange in some gift-exchange experiments in the laboratory as well as the field (Brown et al., 2004, Gneezy and List, 2006, Engelmann and Ortmann, 2009, Kube et al., 2013). On top of this we identify the imperfect translation of reciprocal preferences into reciprocal actions as another reason for the breakdown of gift-exchange. As neither confusion nor beliefs are factors explaining the imperfect translation of preferences to actions the identification of factors that can explain it is a worthwhile avenue of future research.

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Appendix

A Additional statistics

A.1 Individual effort choices

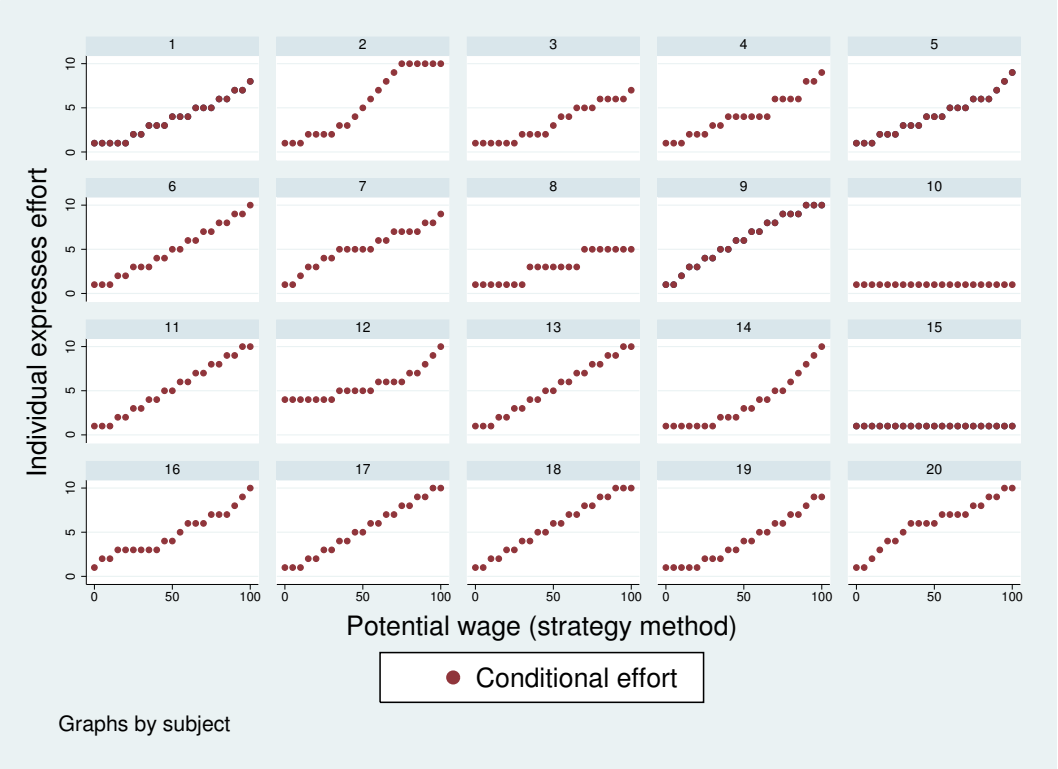


Figure A.1: Individual effort choices in strategy method

A.2 Robustness estimates

Table A.1: Explaining effort choices in the repeated GEG (Tobit)

	Dependent variable: effort e_{it}			
Model	1	2	3	4
Workers used	All	Reciprocators	All	Reciprocators
Period	−0.071	−0.083	−0.140	−0.144
	(0.127)	(0.125)	(0.121)	(0.122)
Wage	0.106***	0.106***		
	(0.016)	(0.016)		
Predicted effort			1.387***	1.340***
			(0.201)	(0.201)
Constant	−3.109**	−2.430**	−3.889***	−3.377***
	(1.239)	(1.160)	(1.295)	(1.280)
Log-L	−194.33	−189.94	−193.61	−191.77
Wald $\chi^2_{(2)}$	47.92	49.14	51.02	48.19
Observations	200	180	200	180

Note: *** (***) indicates significance at 1 (5) percent level; regressions are random effects Tobit models clustered on individuals; standard errors in parantheses.

Table A.2: Explaining effort choices in the repeated GEG (GLS)

	Dependent variable: effort e_{it}			
Model	1	2	3	4
Workers used	All	Reciprocators	All	Reciprocators
Period	−0.013	−0.024	−0.040	−0.046
	(0.041)	(0.044)	(0.040)	(0.044)
Wage	0.037***	0.040***		
	(0.005)	(0.005)		
Predicted effort			0.465***	0.454***
			(0.061)	(0.065)
Constant	1.526***	1.615***	1.274***	1.359***
	(0.368)	(0.372)	(0.386)	(0.406)
R^2 (overall)	0.23	0.26	0.24	0.23
Wald $\chi^2_{(2)}$	60.95	63.36	62.91	52.83
Observations	200	180	200	180

Note: *** indicates significance at 1 percent level; regressions are GLS random effects models clustered on sessions; standard errors in parantheses.

B Supplementary Materials

Experimental Instructions used in

"Reciprocal Preferences and the Unraveling of Gift-Exchange"

Aurélie Dariel & Arno Riedl

Specific instructions – Part 1

In this part of the experiment you can earn money with the decisions you make. How much you earn depends on your own decisions and the decisions of other participants. We will not speak of Euro during the experiment, but rather of points. All you earnings will first be calculated in points. At the end of the experiment the total amount of points you earned in this part will be converted to Euro at the following rate:

1 point = 12 Euro cent

At the beginning of this part of the experiment all participants will be divided into pairs. **You will not get to know the identity of the other person**, neither during nor after the experiment. **The other person will also not get to know your identity**.

We now describe how this part of the experiment proceeds. First you will be introduced to the basic decision situation, thereafter you will learn more specifically how the experiment is conducted. You will also be asked some control questions that will help you to understand the decision situation.

The decision situation:

You will be randomly **paired with one other participant**. In each pair one participant will be randomly assigned the role of a **firm** and the other participant will have the role of a **worker**. You will be informed about your role at the beginning of the experiment. You - as every other participant - will keep the assigned role throughout this part of the experiment.

You have to make a decision without knowing the decision of the other participant. The other participant in your pair also has to make a decision without knowing your decision. Which kind of decision you have to make depends on your role.

If you are assigned the role of a **firm** you have to make a **wage offer.**

The **wage** you **offer** can be any amount from **0 to 100** (as long as it is a multiple of 5). That is you can

offer a wage of 0, or 5, or 10, ..., or 90, or 95, or 100.

If you are assigned the role of a **worker** you have to decide **which effort level you provide for each possible wage** offered by the firm**.**

The **effort level** you choose can be any integer number from **1 to 10**. That is you can decide to provide effort levels of 1, or 2, or 3, ..., or 8, or 9, or 10. You can choose different effort levels for different wage offers but you can also choose the same effort level for different wage offers.

To each effort level correspond some costs the worker has to bear for this effort level. How the effort levels and costs are related is show in this table:

effort	1	2	3	4	5	6	7	8	9	10
cost of effort	0	1	2	4	6	8	10	12	15	18

The earnings are calculated in the following way:

If you are a **firm:**

First, multiply the effort level chosen by the worker with 10,

second, subtract the wage you offered,

third, add an endowment of 50.

As formula:

Earnings of firm = 10 * effort level – wage offer + 50

Note: if the earnings of the firm determined in this way would be negative they are set to zero.

For example, if you are the firm and you offer a wage of 35 and the worker chooses an effort of 9 for this wage then you will earn 10*9 – 35 + 50 = 105 points; if you are the firm and you offer a wage of 85 and the worker chooses an effort of 2 for this wage you would earn 10*2 – 85 + 50 = -15 points, which will be set equal to 0 points.

If you are a **worker**:

First, take the wage offered by the firm,

second, subtract the costs associated with effort level chosen (see table),

third, add an endowment of 20.

As formula:

Earnings of worker = Wage offer – cost of effort + 20

For example, if you are the worker, the firm offers a wage 35 and you choose an effort of 9 for this wage then you will earn 35 - 15 + 20 = 40 points; if you are the worker, the firm offers a wage of 85 and you choose an effort of 2 for this wage you would earn 85 – 1+ 20 = 104 points.

Control questions – decision situation:

Please answer the following control questions. These questions are arbitrary examples of what could happen in the experiment. In the experiment you will in the role of either a worker or a firm. The questions will concern both roles. They will help you to gain an understanding of the calculation of your earnings. Your earnings vary with your own decision and with the decisions of the other person you are paired with.

Please answer all the questions and write down your calculations.

1. Assume that the firm has chosen a wage of 0 and the the worker has chosen an effort level of 0 for a wage offer of 0.
What will ***your earnings*** be if you are the ***worker***? _____
What will ***your earnings*** be if you are the ***firm***? _____

2. Assume that the firm has chosen a wage of 100 and the the worker has chosen an effort level of 10 for a wage offer of 100.
What will ***your earnings*** be if you are the ***worker***? _____
What will ***your earnings*** be if you are the ***firm***? _____

3. Assume that the firm has chosen a wage of 80 and the the worker has chosen an effort level of 2 for a wage offer of 80.
What will ***your earnings*** be if you are the ***worker***? _____
What will ***your earnings*** be if you are the ***firm***? _____

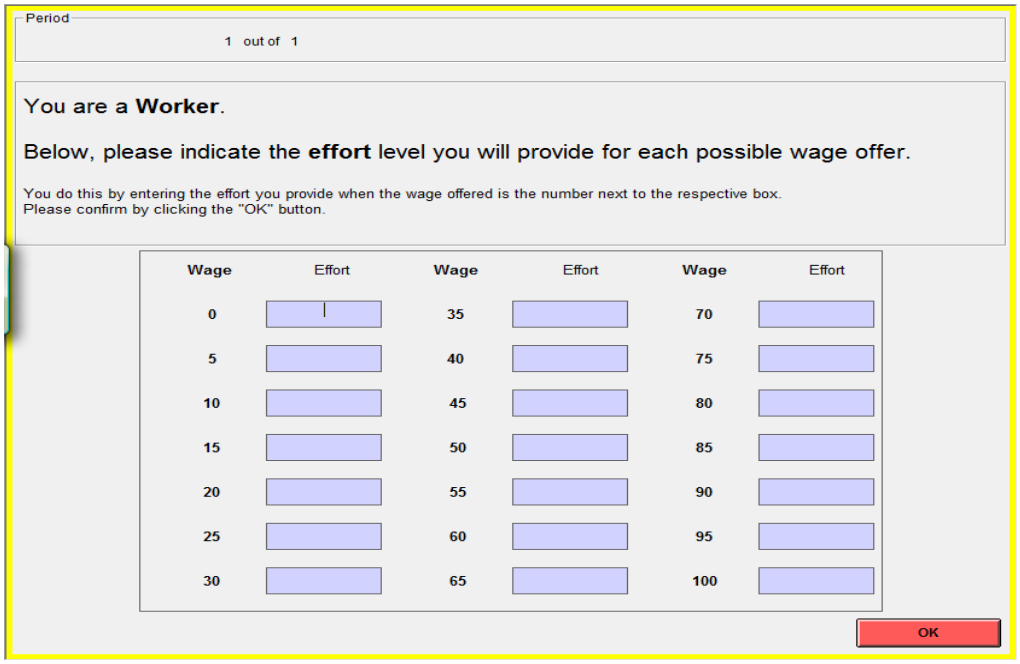
4. Assume that the firm has chosen a wage of 30 and the the worker has chosen an effort level of 7 for a wage offer of 30.
What will ***your earnings*** be if you are the ***worker***? _____
What will ***your earnings*** be if you are the ***firm***? _____

The experiment:

In experiment you will be confronted with the described decision situation only **once**. Before the experiment starts you will be assigned **either** the role of **worker or** the role of **firm**.

What **types of decisions** you have to make depends on your role. Here we explain first the types of decisions for a workers and then the decisions for a firm,

Decisions for **workers**:
If you are a worker you have to indicate your **effort level for each possible wage offer by the firm**. What this means will be immediately clear to you if you take a look at the computer screen shown below. This screen shows a table as it will be presented to you in the experiment, in case you are a worker: The numbers to the left to the empty boxes are the possible **wage offers** of the **firm**. You simply have to insert in the boxes the effort level you will choose, conditional on the indicated wage offer. **You have to make an entry into each of the boxes**. For example, you will have to indicate your effort level if the firm offers a wage of 0 points, your effort level if the firm offers a wage of 5, 10, or 15 tokens, etc. You can insert **any integer number from 0 to 10** in each box. When making your decisions you may want to consult the summary of the decision situation you received with these instructions. When you have made your entry in each box, please click “OK”.

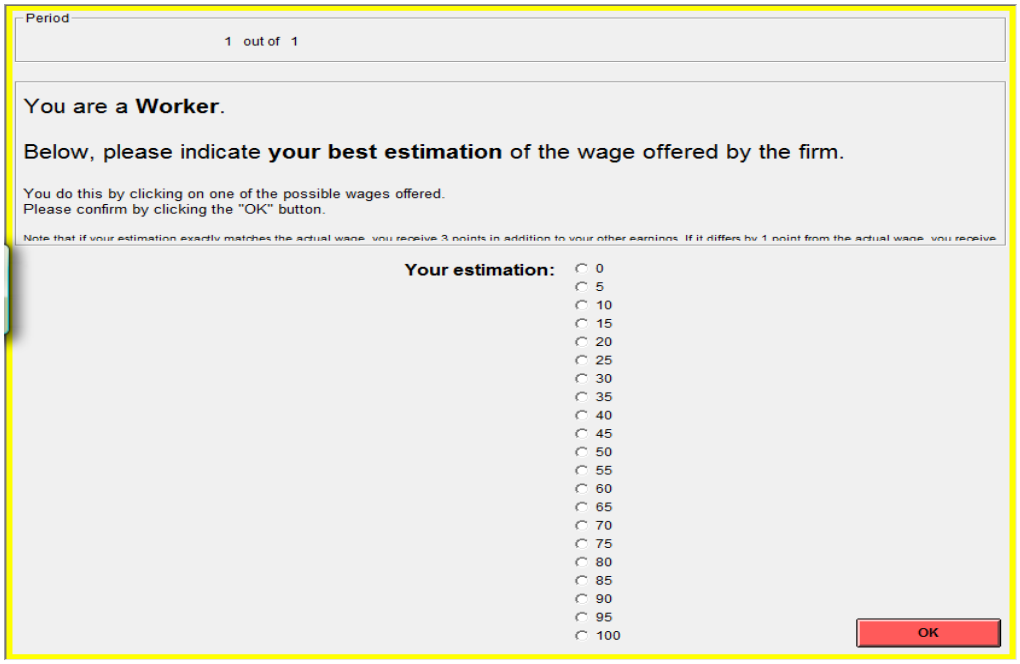


Note: You do not know the wage offer actually chosen by the firm when you make your effort level decisions.

After you have made your effort decisions you have to **estimate** the **wage offer actually chosen by the firm.** You will be paid for the accuracy of your estimate:

- If your estimate is **exactly right** (that is, if your estimate **exactly** matches the actually chosen wage offer by the firm), you will receive **3 points** extra to your other earnings from the experiment.
- If your estimate **deviates by 1 point** from the actual result, you will receive **2 points** extra.
- If your estimate **deviates by 2 points** from the actual result, you will receive **1 point** extra
- If your estimate **deviates by 3 or more points** from the actual result, you will receive **no points** extra.

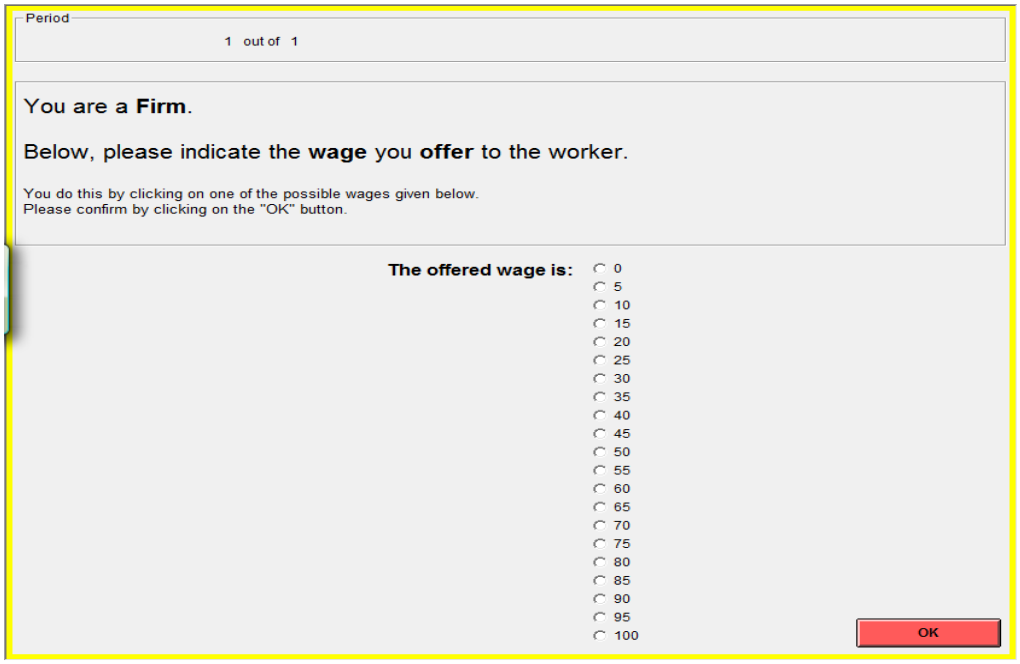
You will make your estimation decision on a screen as shown below.



Decisions for **firms**:

If you are a firm you have to indicate the **wage level you offer the worker**. What this means will be immediately clear to you if you take a look at the computer screen shown below. This screen shows a decision column as it will be presented to you in the experiment, in case you are a firm: The numbers to the right of the empty circles are the possible **wage offers** of the **firm**. You simply have to click on one of the circles to indicate your wage offer. **You can only make one wage offer**. When making your decisions you may want to consult the summary of the decision situation you received with these instructions. When you have made your entry in each box, please click “OK”.

ge-sm



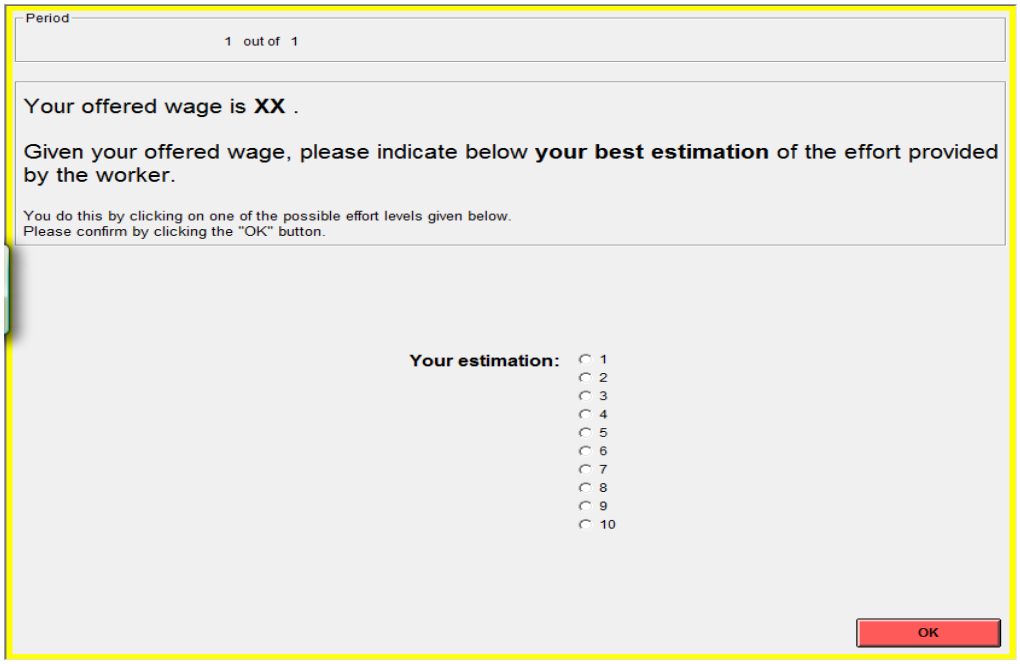
Note: You do not know the effort level actually chosen by the worker when you make your wage offer decision.

After you have made your wage offer decision you have to **estimate** the **effort level actually chosen for your wage offer.** You will be paid for the accuracy of your estimate:

- If your estimate is **exactly right** (that is, if your estimate **exactly** matches the actually chosen effort by the worker for your wage offer), you will receive **3 points** extra to your other earnings from the experiment.
- If your estimate **deviates by 1 point** from the actual result, you will receive **2 points** extra.
- If your estimate **deviates by 2 points** from the actual result, you will receive **1 point** extra
- If your estimate **deviates by 3 or more points** from the actual result, you will receive **no points** extra.

You will make your estimation decision on a screen as shown below.

ge-sm



After all participants of the experiment have made their decisions you will be informed about the choice made by the participant with whom you are paired (and will be reminded of your own choices). You will also be informed about the number of points you have earned in this part of the experiment.

This is the end of the instructions. If you have a question please raise your hand.

Specific instructions – Part 2

In this part of the experiment you can earn money with the decisions you make. How much you earn depends on your own decisions and the decisions of other participants. We will not speak of Euro during the experiment, but rather of points. All you earnings will first be calculated in points. At the end of the experiment the total amount of points you earned in this part will be converted to Euro at the following rate:

1 point = 2 Euro cent

At the beginning of this part of the experiment all participants will be divided into pairs. **You will not get to know the identity of the other person**, neither during nor after the experiment. **The other person will also not get to know your identity**.

The decision situation in this part of the experiment is similar as in part 1, with one important exception that will be explained below. For your convenience we briefly describe the whole decision situation.

The decision situation:

You will be randomly **paired with one other participant**. In part 1, in each pair one participant was randomly assigned the role of a **firm** and the other participant was assigned the role of a **worker**. You - as every other participant - will keep the role assigned in part 1 also throughout this part of the experiment.

Compared to part 1, there is an **important difference in the sequence of the decisions** in this part of the experiment. Now the **firm first** has to make a **wage offer** and this **wage offer** will be **transmitted** to the **worker**. Only **then** the **worker** has to decide on the **effort level**.

If you are assigned the role of a **firm** you have to make a **wage offer.**

The **wage** you **offer** can be any amount from **0 to 100** (as long as it is a multiple of 5). That is you can offer a wage of 0, or 5, or 10, ..., or 90, or 95, or 100.

If you are assigned the role of a **worker** you will get informed about the wage offer by the firm, then you have to decide **which effort level you provide for the received wage** offer by the firm**.**

The **effort level** you choose can be any integer number from **1 to 10**. That is you can decide to provide effort levels of 1, or 2, or 3, ..., or 8, or 9, or 10.

To each effort level correspond some costs the worker has to bear for this effort level. How the effort levels and costs are related is show in this table:

effort	1	2	3	4	5	6	7	8	9	10
cost of effort	0	1	2	4	6	8	10	12	15	18

The earnings are calculated in the following way:

If you are a **firm:**

First, multiply the effort level chosen by the worker with 10,

second, subtract the wage you offered,

third, add an endowment of 50.

As formula:

Earnings of firm = 10 * effort level – wage offer + 50

Note: if the earnings of the firm determined in this way would be negative they are set to zero.

If you are a **worker**:

First, take the wage offered by the firm,

second, subtract the costs associated with effort level chosen (see table),

third, add an endowment of 20.

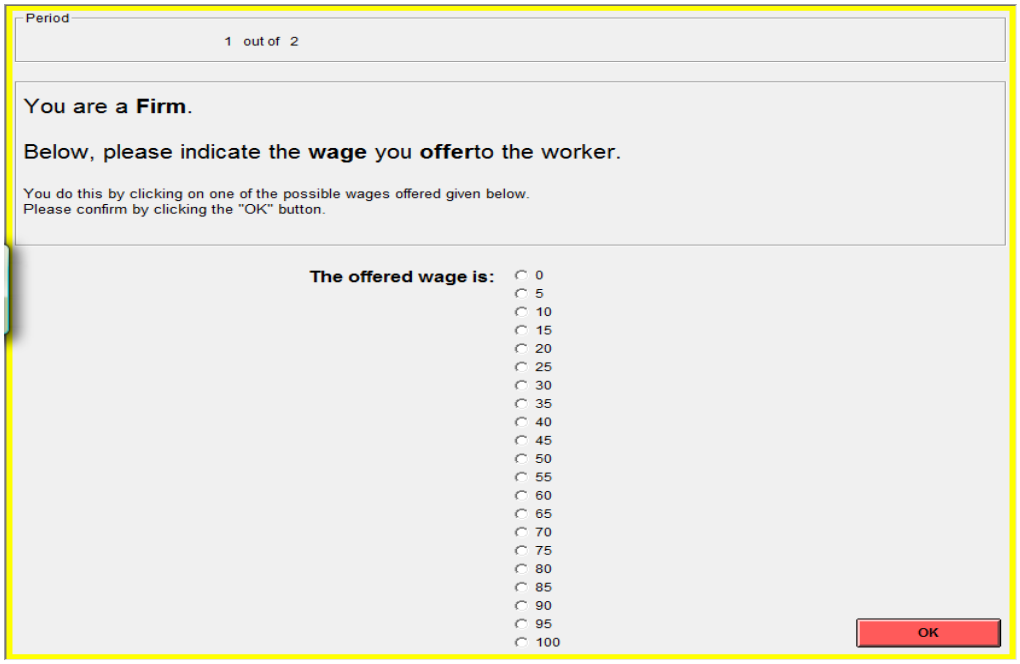
As formula:

Earnings of worker = Wage offer – cost of effort + 20

In this part of the experiment you will be engaged in the decision situation for **10** successive **periods**. In each period you will be randomly rematched with another participant. Thus, **in no period will your pair consist of the same two people for sure.**.

If you are a **firm**, in **each period** you have to make a **wage offer** without knowing what effort level will be chosen by the worker. If you are a **worker**, in **each period** you have to decide on the effort level after being informed about the **wage offer.** At the end of a period firm and worker will be informed about the offered wage and chosen effort levels in the pair in that period.

If you are a **firm**, in each period you will make **your wage offer** decision on a computer screen as shown here:

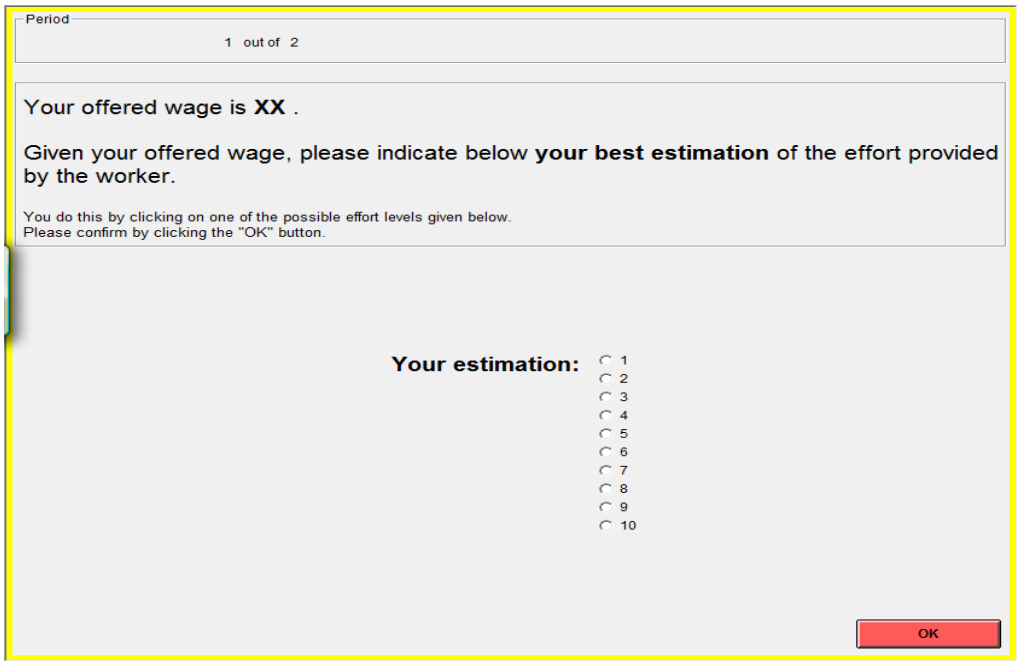


On this screen, you have indicate the **wage level you offer the worker**. You simply have to click on one

of the circles to indicate your wage offer. **You can only make one wage offer**.

In each period, after you have made and confirmed your wage offer you have to **estimate** the **effort level actually chosen for your wage offer.**

In each period you will indicate your estimation on a computer screen as shown here:

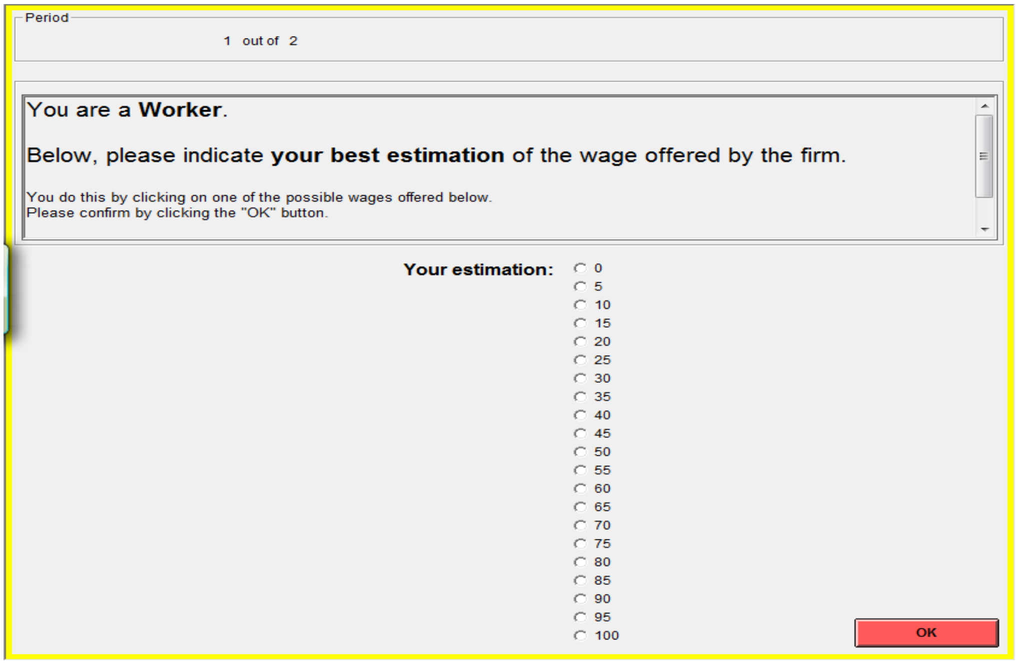


As in the part 1 of the experiment you can earn money with the accuracy of your estimate.

- If your estimate is **exactly right** (that is, if your estimate **exactly** matches the actually chosen effort by the worker for your wage offer), you will receive **3 points** extra to your other earnings from the experiment.
- If your estimate **deviates by 1 point** from the actual result, you will receive **2 points** extra.
- If your estimate **deviates by 2 points** from the actual result, you will receive **1 point** extra
- If your estimate **deviates by 3 or more points** from the actual result, you will receive **no points** extra.

<<<<<<<<<<<<<<<<<<<<<<<<>>>

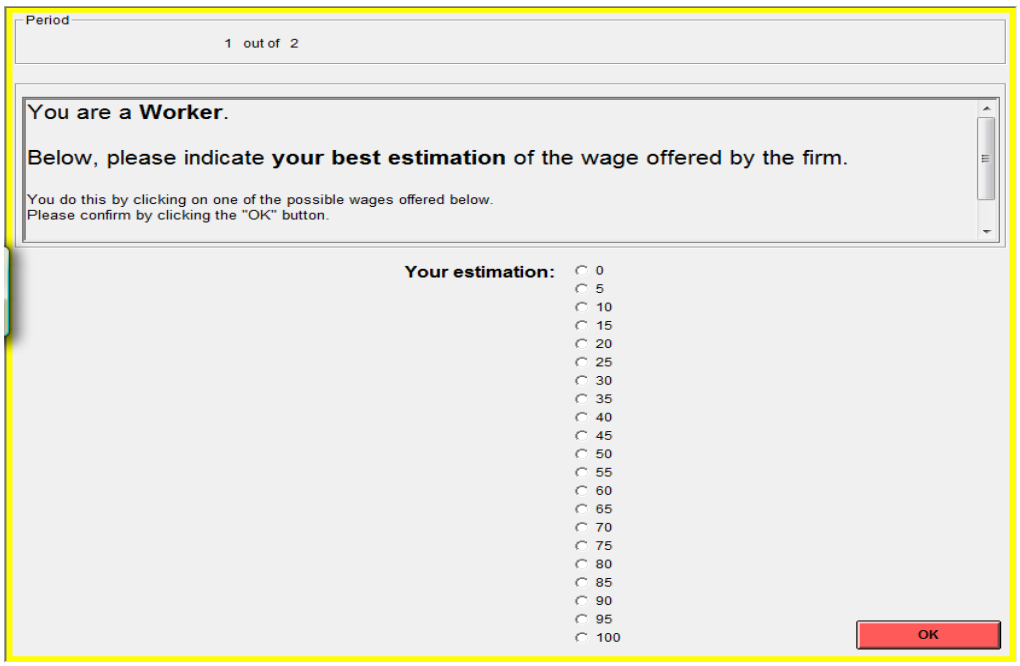
If you are a **worker**, In each period, before you are informed about the actually chosen wage offer you have to **estimate** the **wage offer actually chosen by the firm.**



As in the part 1 of the experiment you can earn money with the accuracy of your estimate.

- If your estimate is **exactly right** (that is, if your estimate **exactly** matches the actually chosen effort by the worker for your wage offer), you will receive **3 points** extra to your other earnings from the experiment.
- If your estimate **deviates by 1 point** from the actual result, you will receive **2 points** extra.
- If your estimate **deviates by 2 points** from the actual result, you will receive **1 point** extra
- If your estimate **deviates by 3 or more points** from the actual result, you will receive **no points** extra.

Next, in each period after receiving your wage offer, you will make your effort level decision on a computer screen as shown here:



On this screen, you will be informed about the wage offered by the firm. You then have to indicate the **effort level you choose**. You simply have to click on one of the circles to indicate your effort level.

After the 10 periods of this part are over you will be asked to fill in a short questionnaire. Thereafter, the whole experiment is over and you will be confidentially be paid out your total earnings in the experiment in cash.

This is the end of the instructions. If you have a question please raise your hand.