Positive and negative reciprocity in the labor market

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Abstract

This paper reports results of an experiment designed to analyze whether reciprocal behavior survives in a more hostile environment than usually considered in the literature. In fact, positive reciprocity survives in a treatment favoring selfish behavior, although there is a decrease in the deviations from the subgame perfect Nash equilibrium. Besides positive reciprocity there is negative reciprocity in this new treatment. Additionally, this paper highlights the influence of the experimental design, namely the importance of wage cut points, on subjects' behavior.

JEL classification: C72; C91; J30

Keywords: Reciprocity; Gift exchange games; Gift and offense exchange games; Incomplete contracts; Labor relations

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1. Introduction

> "I had been advised early in life that sound decisions came from a cool head ... I had grown up accustomed to thinking that the mechanisms of reason existed in a separate province of the mind, where emotion should not be allowed to intrude, and when I thought of the brain behind that mind, I envisioned separate neural systems for reason and emotion."
>
> Damásio (1994)

The *homo oeconomicus*, traditionally modeled as a rational and self interested actor aiming at maximizing material payoffs, seems to be partially challenged by late discoveries in neurology and economics showing that emotions are relevant in individual cognitive processes and decision making. In economics there is now a large body of experimental evidence using a variety of games (trust, gift exchange, ultimatum, dictator and moonlighting games) showing that people care not only about material payoffs, but also take into account fairness and the believed intentions of those who interact with them. An important result from trust or gift exchange experiments is that a significant number of subjects behave reciprocally. In fact, subjects often punish those who are perceived to be unkind, reveal bad intentions or offend them and reward those who are perceived to be kind, reveal good intentions or simply offer them gifts. Both punishment and reward involve a material cost to the subjects.
The main purpose of this paper is to analyze the robustness of this result using a different experiment, designed to be more hostile to reciprocal behavior. Before introducing the specific problems that will be addressed it seems worthwhile to briefly clarify the key concepts of trust and reciprocity as they will be considered.

In the context of a two-stage game played with two subjects, *trust* means that a subject *A* is willing to rely on subject *B* and "offers" him something, so that if *B* does not "counter-offer", *A* will be worse off than in the case he would have not trusted *B*. However, if *B* returns the "offer" both players become better off. Therefore, trust indicates a particular behavior within *A*'s domain of choice and is consistent with multiple motivations. The only certain characteristic of subject *A*, is that he is not completely risk averse, otherwise he would not have trusted *B*. In fact, *A* may be selfish and trust *B* if he is risk neutral and the expected payoff derived from trustiness is greater than the certain payoff of not trusting *B*.

Positive reciprocity is considered here as an act conditional on a trust initiative. *B* reciprocates to *A*'s positive offer (trust) choosing an action that will increase *A*'s payoff and will not maximize his

own. Negative reciprocity is the act of *B* who punishes the absence of trust, or even an offense from *A*, by reducing his payoff at a cost to himself.

Underlying reciprocal behavior, may be different motivations, however, reciprocity is not consistent with pure selfishness. In fact, a selfish agent would never sacrifice his own resources to punish or reward without any monetary advantage to him. It should be also noted that the concept of reciprocity requires that each individual has a fairness norm in order to distinguish a positive from a negative offer, a kind from an unkind act, a fair from an unfair outcome. This fairness norm is usually expressed as an aversion to inequality (see Bolton and Ockenfels 2000 or Fehr and Schmidt 1999). Other authors prefer to consider fairness related to the believed intentions of others (see Rabin 1993 and Falk and Fischbacher 1999).

The experimental evidence supporting trust and reciprocal behavior can be questioned due to the experimental design. Most papers analyzing reciprocity consider separately either positive *or* negative reciprocity and in general the designs create a potential bias favoring trust and reciprocity. In gift exchange games, for example, equilibrium assuming selfish subjects is a corner solution. Therefore, any error resulting from inexperience or confusion may be misread as reciprocal or trust behavior. Palfrey and Prisbrey (1996 and 1997), Ledyard (1995) and Andreoni (1995) made a similar critical argument to experiments using voluntary contribution mechanisms. In fact, in public good games the mutual defection equilibrium, being a corner pair of actions, tends to overestimate cooperation.

This paper addresses several problems that can be tackled if we consider variations to the traditional gift exchange design. Is reciprocity robust when equilibrium is not a corner solution? What is the effect of allowing positive and negative reciprocity in the same domain of choice? Can we still observe positive reciprocity when the marginal cost of negative reciprocity is lower than the marginal cost of positive reciprocity? What is the importance of an inevitable inequality of payoffs on subjects' behavior?

We will concentrate on gift exchange games framed in the labor market. A standard gift exchange treatment (*GET*) was conducted and results were consistent with the patterns of trust and reciprocal behavior reported in the literature. We also show that the specific design introduces wage "cut points" that significantly affect behavior. Additionally, a new treatment was created - the gift and offense exchange treatment (*GOET*) - to test the sensitivity of subjects' behavior to environment

changes. Experimental results show that positive reciprocity survived in this more hostile environment, although more subjects behave according to the subgame perfect Nash equilibrium. Besides positive reciprocity, it is shown that negative reciprocity has also a role in the labor market.

The following section presents the design, procedures and results of the standard *GET*. Section 3 introduces the new treatment, the *GOET*, and presents its experimental results. Section 4 discusses the experimental results of both treatments and section 5 concludes.

2. Gift Exchange Treatment (*GET*)

2.1. Utility functions and cut points

The Gift Exchange Treatment (*GET*) follows closely a strand of papers (Fehr, Kirchsteiger and Riedl 1993 and 1998, Fehr, Gächter and Kirchsteiger 1997, Charness 2000, Fehr and Falk 1999, *etc.*), which analyze reciprocity within the framework of labor relations. In the *GET*, each firm selects a wage (w) in a first stage and each respective worker responds with an effort level (e) in a second stage. Since workers' behavior is an act conditional on a kind initiative by the firm, it may be classified as reciprocal. Firms' behavior, on the other hand, can be classified as trustworthy or non trustworthy.

Wages and effort levels are arguments of the firm payoff function, $p = p(w,e)$ with $\partial p / \partial w < 0$ and $\partial p / \partial e > 0$, and of the worker payoff function, $u = u(w,e)$ with $\partial u / \partial w > 0$ and $\partial u / \partial e < 0$. The effort cost function ($c(e)$) is increasing with effort ($\partial c(e) / \partial e > 0$) and convex in relation to effort ($\partial^2 c(e) / \partial e^2 > 0$).

In order to make predictions concerning this gift exchange game it is useful to consider a general utility function for a firm with two arguments, material payoffs and a measure of inequality,[1]

$$V_i = V_i(p_i(w_i, e_j), d_{ij}), \text{ with } d_{ij} = \left| p_i(w_i, e_j) - u_j(w_i, e_j) \right|, \ \frac{\partial V_i}{\partial p_i} > 0 \text{ and } \frac{\partial V_i}{\partial d_{ij}} \leq 0. \qquad (1)$$

[1] Note that intentions are not considered, although they are an important motivation to trigger reciprocal behavior. This utility function is used only to clarify predictions that take into account reciprocal behavior. As the introduction of intentions (Rabin 1993) or the consideration of asymmetric aversion to inequality (Fehr and Schmidt 1999) would increase complexity, without any additional insight for our purposes, they were not included.

A selfish firm only considers monetary payoffs ($\frac{\partial V_i}{\partial d_{ij}} = 0$), while a non selfish firm values both arguments (so that $\frac{\partial V_i}{\partial d_{ij}} < 0$). Note that, as argued in section 1, a firm may trust the worker being selfish.

On the other hand, workers' utility function is given by:

$$V_j = V_j(u_j(w_i, e_j), d_{ij}), \text{ with } \frac{\partial V_j}{\partial u_j} > 0 \text{ and } \frac{\partial V_j}{\partial d_{ij}} \leq 0. \quad (2)$$

Similarly to firms, a selfish worker only values monetary payoffs ($\frac{\partial V_i}{\partial d_{ij}} = 0$), while a reciprocal worker assigns weight both to aversion to inequality and to material payoffs ($\frac{\partial V_i}{\partial d_{ij}} < 0$).

The subgame perfect Nash equilibrium, assuming selfish agents, is the minimum wage offer and the minimum effort choice in every contingency. However, experimental evidence has consistently shown firms' willingness to trust, offering higher wages than minimum, and workers' willingness to reciprocate, revealed by higher effort levels in response to higher wage offers (*i.e.*, a positive correlation between wage offers and effort choices).

It should be highlighted that the payoff functions and the parameters used (that will be presented below) create cut points that may have a significant influence on subjects' behavior. These cut points are thresholds that define three different frames of decision. Consider first that there is a certain wage, $\underline{w}^c$, which will be labeled as low cut point, below which the following inequality holds:

$$p_i(w_i, e_j) - u_j(w_i, e_j) > 0 \text{ for } w < \underline{w}^c, \ \forall e_j. \quad (3)$$

This means that whatever the workers' choice the firm's profit is always higher than the worker's material payoff. Thus, the maximization of a worker utility function, whether he is a selfish or a reciprocal agent, is obtained with the minimum effort level ($e = e_{\min}$). In this case a clear prediction on the value of *e* is possible, assuming heterogeneous workers, because both selfishness and aversion to inequality lead to minimum effort. Therefore, it is not possible to discriminate between a selfish and a reciprocal worker.

There is also another wage, $\overline{w}^c$, labeled high cut point, above which a worker's payoff independently of his choice is always higher than a firm's payoff,

$$p_i(w_i, e_j) - u_j(w_i, e_j) < 0 \text{ for } w > \overline{w}^c, \ \forall e_j . \quad (4)$$

For wages higher than $\underline{w}^c$ and lower than $\overline{w}^c$ a worker who reciprocates will choose an effort level that minimizes d_{ij} and maximizes his payoff. Consequently, the higher the wage offers of a firm, the higher will be worker's potential payoff advantage. To minimize payoff differences his effort choice will increase with the wage offered. In contrast, a selfish worker will always choose $e = e_{\min}$. Thus, it is possible to discriminate between a selfish and a reciprocal worker. In this sense, the prediction of the effort level varies with the worker type.

In the case of wages higher than the high cut point workers are always in advantage to the firm. Thus, reciprocal workers will choose a higher effort level to minimize d_{ij}. However, as the effort domain is censored above and reciprocators are already choosing relatively high effort levels at $\overline{w}^c$, marginal wage increases will be associated with lower marginal effort increases when compared with wages within the range $\underline{w}^c < w < \overline{w}^c$.

2.2. Experimental design and procedures

Two experimental sessions were conducted with the gift exchange game described above: at the first stage, a firm offers a wage, *w*, to the worker with whom it has been matched. The worker, at the second stage, has to decide how much effort to provide, *e*. These two stages constitute a period of the game. In each session there were twelve periods to allow subjects' understanding of the game structure and to enable the study of potential convergence properties. It should be highlighted that in each period firms and workers were matched with different opponents, *i.e.*, a firm (worker) was never rematched with the same worker (firm).[2]

The firm's payoff function, in terms of experimental money, was given by $p = (v - w)e$, where *v* stands for an exogenously given redemption value equal to 120. The worker's payoff function was defined by $u = w - c_0 - c(e)$, where c_0 denotes the opportunity cost of being in a labor relation and is equal to 20. The term $c(e)$ represents a strictly increasing effort cost function

($c(e) = (10e - 1)^{1.3}$), which is represented in Table 1 associated to the feasible effort levels. To exclude the loss aversion effects described by Tversky and Kahneman (1991) as a possible explanation of experimental results, wage offers were restricted to the interval $[20, 120]$.[3]

Table 1

With the parameters used, the low cut point, $\underline{w}^c$, is equal to 30 experimental money units and the high cut point, $\overline{w}^c$, to 79 experimental money units. The null hypothesis that cut points do not affect the relationship between effort and wages will be tested against the alternative hypothesis of interference of cut points on subjects' choices as predicted above.

The subjects of these experimental sessions were students from ISEG/Technical University of Lisbon without knowledge of experimental economics. They participated voluntarily and for the first time in an economics experiment. For the recruitment only monetary incentives were used.

Before the beginning of each experimental session a random mechanism determined whether a subject was included in the group of twelve firms or twelve workers. Subjects in the role of firms and subjects in the role of workers were located in different rooms to avoid the possibility of trading partners' identification. It was common knowledge that partners' identity would never be revealed. This procedure and the procedure of no rematching ensured that no reputation could be developed. Thus, firms' wage offers were the only way to trigger workers' reciprocal behavior.

Since payoff functions and procedures were common knowledge each subject could compute his and his opponent payoff. To guarantee that each subject understood payoff calculations a set of control questions was included in the instructions. Experimental sessions did not start until all subjects answered correctly each question.

Subjects' ability to compute the implications of their choices on mutual payoffs (firm and respective worker) is essential to allow the existence of fairness considerations. Additionally, the common information of wage and effort domains allows subjects to infer the intentions behind opponents' actions. It should be noted, also, that wage and effort choices were only known by the firm and the worker who were involved in a given labor relation. Each pair did not know other pairs decisions, so the options of others could not serve as a reference standard. This procedure was

[2] The procedure used followed the one described by Cooper *et al.* (1996), which was theoretically justified by Kamecke (1997).
[3] Note, though, that workers may incur in losses if they choose a non-minimum effort when responding to minimum or very low wages. This kind of behavior is neither explained by reciprocity nor selfishness.

implemented to rule out group-pressure effects and, consequently, to further contribute to isolate firms' wage offers as the only way to trigger reciprocal behavior.

2.3. Results

In each experimental session 24 subjects were present. Average earnings of a two hours session were 8.68 € for each subject, which was, according to the majority of answers to a optional questionnaire, enough to motivate their participation in future experiments.

The majority of subjects in the role of firms did not behave as predicted by conventional game theory. As Figure 1 shows, wage offers were higher than equilibrium (minimum wage) in each period and did not converge to it. In fact, firms were willing to trust, as reported in the literature of gift exchange experiments. By choosing wages higher than equilibrium firms tried to induce workers to choose effort levels higher than minimum.

Figure 1

Also consistently with previous experiments, workers chose effort levels far from game theory prediction as shown in Table 2. In fact, the effort choice according to *homo oeconomicus* ($e = 0.1$) was made only in 30 out of 288 cases (10.4%).

Table 2

To investigate if there is causality between firms and workers choices at the individual level the Spearman rank correlation between wages and effort levels was calculated for each worker. For 75% of workers there is a positive and significant (at the five percent level) correlation between wage offers and effort levels, *i.e.*, the majority of workers behaved reciprocally.

The positive correlation between wage and effort is also confirmed at the aggregated level by a two-sided censored Tobit regression $e = a + bw + e$ (effort levels higher than maximum are censored to the maximum and effort levels lower than minimum are censored to the minimum). In fact, as regression 1 of Table 3 shows the coefficient of wages is positive and statistically significant.

Table 3

Table 3 also presents the results of a Tobit regression estimated to analyze the influence of cut points on subjects' behavior. With that purpose two dummy variables D_1 and D_3 were defined: $D_1 = 1$ if $w < \underline{w}^c$ and 0 elsewhere and $D_3 = 1$ if $w > \overline{w}^c$ and 0 elsewhere. That is, the first dummy variable identifies situations where offered wages are below the low cut point and the second dummy variable

situations where wages are above the high cut point. Naturally, the situation where wages are between the two cut points are identified by a 0 value in both dummies.

Consistently with the theoretical considerations developed above, there is no significant relation between wages and effort levels when wages are below the low cut point or above the high cut point. Regression 2 results do not allow the rejection of the hypothesis that the coefficient associated with *w* is equal to minus the coefficient associated with $w \times D_3$ and equal to minus the coefficient associated with $w \times D_1$. In fact, the relation between wages and effort levels is almost flat when wages are below the low cut point or above the high cut point.

Given the conditional behavior of workers it is important to evaluate firms' wage policy. Figure 2 shows that there is a domain in which average profits have increased with wage offers.[4] Additionally, it shows that firms offered wages that gave them higher profits with higher frequency (according to the percentage of wage proposals expressed above the bars). Note that 73.3% of firms have offered wages in the range 50-79. This suggests that firms' behavior was instrumentally rational, since by offering higher wages - given workers' conditional effort choices - they received higher profits than predicted by conventional game theory (represented by the dash line).

Figure 2

To analyze the effect of subjects' behavior on payoffs, we have calculated firms' and workers' payoffs taking the results of regression 1 in Table 3 as describing subjects' behavior. For each wage value the effort level was calculated, as well as the resulting payoffs. These results are plotted in Figure 3, which also shows the firm and worker equilibrium payoffs and the most efficient equalitarian payoff ($p = u = 41$, which is obtained when $w = 79$ and $e = 1$).

Figure 3

As can be seen in Figure 3, for a significant range of the wage domain, both firms and workers had higher payoffs than equilibrium. Moreover, for wages below 68 experimental money units both sides of the market had higher payoffs as wages rose, *i.e.*, firms and workers benefited from a trust-reciprocity relationship. Above that value, firms' payoffs decreased as a result of the concavity of the profit-wage relation.

Nevertheless, firms could never get the efficient payoff that minimized payoff differences, because workers chose effort levels that gave them a higher payoff. That is, workers, in a great part of

the wage domain, made choices that gave them an advantage in relation to firms. This reveals that, on average, workers were averse to inequality, but took also into account their own material payoffs. Therefore, selfishness did not disappear, but it was softened by aversion to inequality. Firms, as a reaction to this partial reciprocity, made most offers below 79 experimental money units.

3. Gift and Offense Exchange Treatment (*GOET*)

3.1. Testing positive and negative reciprocity

The traditional gift exchange treatment considered above just takes into account one dimension of reciprocity, namely positive reciprocity. It does not allow testing simultaneously positive and negative reciprocity. Before presenting our new treatment it is worth to consider briefly some papers that have dealt with positive and negative reciprocity.

In the gift exchange literature, besides the test of positive reciprocity through the stage of choosing an effort level (when effort costs are increasing with effort), negative reciprocity was tested through the stage of acceptance *vs*. rejection of the contract offer. However, negative reciprocity just occurs if the offered wage is higher than the minimum. In fact, a rejection of the minimum wage implies the same zero payoff to the worker as the acceptance of the minimum wage in the first stage and choice of $e = e_{\min}$ in the second. Remember that reciprocity implies the sacrifice of resources to punish or reward other subjects actions. Furthermore, this test to reciprocity involves two domains of choices: acceptance *vs.* rejection of the offered wage and the choice of an effort level. To really test reciprocity only one dimension of choice should be considered, so that one opportunity to reciprocate is not diminished by the perspective to reciprocate in another dimension of choice.

Fehr, Gächter and Kirchsteiger (1997) and Gächter and Falk (1998) tested both dimensions of reciprocity in the same domain of choice through the introduction of a third stage in the gift exchange game. In this stage firms could either reward or retaliate workers' effort choices, being therefore able to reciprocate positively or negatively. However, our goal is to understand the impact on labor market decisions if workers (and not firms) can either positively or negatively reciprocate in the same dimension of choice.

Finally, Abbink, Irlenbusch and Reener (2000) and Falk, Fehr and Fischbacher (2000) tested both positive and negative reciprocity in only one dimension of choice, but using the moonlighting

[4] The only exception is the interval 30-39, which was influenced by a worker choice of an effort level of 0.9 in

game. This paper aims to understand the impact of reciprocity in labor market and not in other frameworks.

In order to analyze the two dimensions of reciprocity in the same domain of choice we developed a new treatment in which a worker can show his willingness to sacrifice resources (effort costs) to respond kindly (with high effort levels) to kind actions (high wages) and unkindly (with low effort levels) to unkind actions (low wages) of firms. In this new treatment there is the possibility to exchange gifts (high wage offer, high effort level) and offenses (low wage offer, low effort level). Thus, the name of the treatment is gift and offense exchange treatment (*GOET*).

Besides the impossibility to test both dimensions of reciprocity another drawback of the traditional gift exchange treatment is its corner subgame perfect Nash equilibrium. In fact, every error or inexperience of the subjects penalizes the behavior predicted by conventional game theory (*i.e.*, the self-interest behavior) and benefits the thesis of reciprocity. The hypothesis of reciprocity is, then, favored by the experimental design. To avoid this problem, in the new treatment (*GOET*) the subgame perfect Nash equilibrium is in the interior of workers' choice domain.

3.2. Experimental design and procedures

The *GOET* is similar to the *GET*: in the first stage firms offer wages and in the second stage workers choose effort levels. The payoff functions and procedures are the same as in the *GET*. The main difference is a new effort cost function presented in table 4 associated to the feasible effort levels.

Table 4

The effort cost is minimum at the average effort level, so that the equilibrium effort for selfish workers is now 0.5. Contrarily to the *GET*, this equilibrium is now interior, so errors can occur for both sides, not favoring only one dimension of reciprocity. If a worker is reciprocal he can reward a firm wage offer by choosing an effort level higher than 0.5 and punish an unkind offer by choosing an effort level lower than 0.5. Thus, workers can either positively or negatively reciprocate in the same dimension of choice.

This cost schedule can be approximated by the function[5]

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response to a wage of 38 experimental money units.

[5] Note that $c(e)$ is convex so that the marginal cost of positive or negative reciprocity starting from the equilibrium is positive and increasing. Note also that the marginal cost of positive reciprocity in the *GET* and in the *GOET* is approximately the same.

$$c(e) = \begin{cases} 1 + (10e - 5)^{1.3} & if \quad e \geq 0.5 \\ 1 + p(0.5 - e) & if \quad e < 0.5 \end{cases}$$

A possible rationalization of this cost function is that there is a constant subjective unitary cost below $e = 0.5$ to which a penalty *p* should be added if the worker chooses an effort level lower than 0.5. [6] This penalty punishes the worker for choosing an effort level lower than defined in an implicit contract that, by hypothesis, is 0.5. The penalty is higher the greater the deviation from that value and is given by $p = (0.5 + 5(0.5 - e))$ for $e < 0.5$. Effort levels higher than 0.5 have disutility costs associated.

This design does not implement symmetry in reciprocity. The option for asymmetric possibilities to reciprocate results from the Vernon Smith (1998) approach that negative reciprocity is just the "policeman" that punishes those who failed a trust initiative. That is, the meaning of negative reciprocity is just to enforce positive reciprocity. There is, then, asymmetry between the components of reciprocity. Our treatment favoring the punishment of unkind actions, as compared to the reward of kind ones, aims to test the survival of positive reciprocity in a hostile environment.

With the purpose of avoiding loss aversion, wage proposals were restricted now to the interval $[23,\ 120]$. The lower limit was imposed so that workers could retaliate a minimum wage proposal without incurring in losses, although supporting costs. Remember that the definition of reciprocity made above involved the willingness to sacrifice resources (*i.e.*, supporting costs).

As in the *GET*, we can predict the impact of the low cut point, which is now equal to 31 experimental money units, and of the high cut point, which assumes now the value of 71 experimental money units. In the *GET* both arguments of the workers' utility function (material payoff and aversion to inequality) led to the choice of the same effort level in response to a wage offer below the low cut point. Now, in the *GOET*, selfishness leads to an effort level of 0.5 while aversion to inequality leads to choose a smaller effort level, *i.e.*, to negatively reciprocate. As a consequence, contrarily to the *GET*, a "flat" (nearly zero) coefficient for wage offers below this cut point cannot be expected. However, the effect of the high cut point remains basically the same as in the *GET* since both motivations perform in a similar way.

[6] This is a rationalization of the cost function that was not included in the instructions to the subjects, because the goal was to study workers behavior free of any conditionals such as the obligation to fulfill a required effort level. The transposition of this rationalization to the instructions would decrease the propensity to reciprocate.

3.3. Results

In the *GOET* each subject of the 24 that were present gained, on average, 8.17 €. Each experimental session lasted, on average, two hours. The gains were, again, considered sufficient to encourage subjects to participate in a future experiment.

Subjects in the role of firms did not behave as predicted by conventional game theory. As Figure 4 shows, there was a drastic wage decline in early periods, but after that the wage offers stabilized around 40 experimental money units. However, it was still distant from the minimum wage.

Figure 4

On the other hand, subjects in the role of workers chose effort levels near the conventional game theory equilibrium, according to Table 5. The 0.5 effort level was chosen in 145 cases (50.3%). Thus, when equilibrium is not a corner solution deviations from it fall considerably.

Table 5

However, at the individual level the correlation between wages and effort levels exist and is significant for 50% of workers (using Spearman rank correlation). The same happens at the aggregated level as indicated by the two-sided Tobit regression 1 presented in table 6. Therefore, reciprocal behavior survived in a hostile environment.

Table 6

To test the influence of cut points on subjects' behavior in the *GOET* a two-sided censored Tobit regression, similar to the one made for the *GET*, was estimated. Now, the dummy variable D_1 is not statistically significant neither when introduced in the slope parameter nor in the constant term. This is consistent with our previous prediction that the relation between wages and effort levels is not "flat" for wages below the low cut point. The dummy variable D_3 has an effect similar to that of the *GET* but much less effective as can be seen in regression 2 of Table 6. This is a result of the approximation of workers' choice to the equilibrium and the consequent lower responsiveness to wage variations.

It should be highlighted that in the *GOET* we can observe negative reciprocity. In 90 labor relations (31.75% of total) workers chose effort levels lower than equilibrium, *i.e.*, workers were willing to sacrifice resources to punish firms' unkind offers. However, when wage offers were generous workers rewarded firms. In 53 of the cases (18.4% of total) workers chose effort levels higher than equilibrium. That is, positive reciprocity survived in an adverse environment.

Figure 5 show the average profits as a function of wage offers. This figure clarifies that firms did not have incentives to offer higher wages. In fact, due to workers' near equilibrium effort choices (see Table 5) they had higher profits if they proposed lower wages, although they could not obtain a payoff as high as the subgame perfect Nash equilibrium (represented by the dash line and which results from $w = 23$ and $e = 0.5$).

Figure 5

Figure 6 plots firms' and workers' payoffs as a function of wages taking the results of regression 1 in Table 6 as subjects' behavior. Moreover, Figure 6 also introduces some focal points: firm and worker equilibrium payoff and the most efficient and equalitarian payoff (which is equal to approximately 44 experimental money units and is obtained with a wage of 71 experimental money units and an effort level of 0.9).

Figure 6

Figure 6 shows that firms had higher profits for low wage offers and that the greater the deviation from the wage predicted by conventional game theory the lower were firms' payoffs. Note, however, that firms would never obtain the equilibrium profit due to workers negative reciprocity. On the other hand, for wages higher than equilibrium workers would obtain higher gains than conventional game theory predicts. Thus, firms and workers' interests were opposed to each other.

As the majority of wage offers (according to Figure 5) were below 53 experimental money units, workers were in disadvantage in relation to firms in most cases. Moreover, as in the *GET*, the most efficient of equalitarian payoffs was never attained because workers did not abandon the maximization of their self-interest (although they also take into account averse to inequality). That is, in a great part of the wage domain, workers made choices that gave them advantage in relation to firms.

In summary, in early periods firms made relatively high wage offers. As workers responded with effort levels near the equilibrium, showing little willingness to reward firms' kind acts, firms decreased their proposals, obtaining higher profits. Thus, firms seem to have updated their beliefs concerning workers' reciprocal behavior and adapted to it. This may explain the wage decrease observed in Figure 4 in early periods. However, due to the negative reciprocity of workers firms never obtained a payoff as high as the conventional game theory prediction.

4. A cautious comparison between *GET* and *GOET*

The shift of the equilibrium to the interior of workers' choice domain led workers and firms to approach the prediction of conventional game theory. To formalize this greater attractiveness of the *GOET* equilibrium a variable *d* was constructed. For the workers this variable is given by the modulus of the difference between the effort level chosen by worker *j* in period *t* (e_{jt}) and the equilibrium effort level ($e_e = 0.1$ in the *GET* and $e_e = 0.5$ in the *GOET*), $d^{e}_{jt} = \left| e_{jt} - e_e \right|$. For the firms variable *d* assumes the following form: $d^{w}_{it} = \left| w_{it} - w_e \right|$, in which w_{it} stands for the offered wage in period *t* by firm *i* and w_e denotes the equilibrium wage ($w_e = 20$ in the *GET* and $w_e = 23$ in the *GOET*). The results are presented in Figures 7 and 8.

Figures 7 and 8

Variables d^{w}_{it} and d^{e}_{jt} are clearly lower in the *GOET* than in the *GET*.[7] This difference is confirmed (for wages and effort levels) by a nonparametric Mann-Whitney *U* test ($p < 0.001$) using values of variable *d* for each subject in each period. This evidence is consistent with the assumption made initially that every noise or learning error benefited reciprocal behavior in the *GET*.

Experimental results show that firms' behavior lay on a confidence base. In fact, in the *GET* firms had confidence in a trust-reciprocity relationship and were not disappointed along the twelve periods of the game. This trustiness was reinforced by two factors. Workers can only reciprocate positively and the prospect of mutual gains from cooperation is significant. However, in the *GOET* there was a break down in confidence in early periods. As workers' choices were near equilibrium firms lost confidence in their reciprocity and decreased their wage offers. This can also be explained by two factors. The possibility of both positive and negative reciprocity and on the other hand the smaller potential gains from cooperation.

To further examine the difference between treatments, taking into account slight differences in parameters, the following OLS regression was estimated:

$$\frac{e - e^{e}}{e^{\max} - e^{\min}} = a + bD + d\,\frac{w - w^{e}}{w^{\max} - w^{\min}} + q\,\frac{w - w^{e}}{w^{\max} - w^{\min}} \times D + e\,,$$

[7] For workers choices it might be argued that variable *d* should only be calculated for positive reciprocity in the *GOET* because marginal effort costs are just similar in that component of reciprocity to the marginal costs of the *GET*. However, the results of the comparison between the *GET* and only the positive reciprocity of the *GOET* are identical.

The endogenous variable is the difference between observed and equilibrium effort as a proportion of the effort range. The independent variable is the difference between observed and equilibrium wage as a proportion of the wage range. We further introduced a dummy variable *D* in the slope and in the constant term. Variable *D* is a dummy variable that assumes value one for observations of the *GOET* and value zero for observations of the *GET*.

As the results of Table 7 show, besides the significant positive correlation between wages and effort, the dummy variable is also significant (at the conventional significant levels) in the constant term and in the slope. That is, workers' effort choices varied with the treatment. There was a clear reduction in reciprocal behavior in the *GOET*, as confirmed by the negative coefficient of the dummy variable that influences the slope.

Table 7

Although there was a reduction in reciprocal behavior, positive reciprocity survived in the more hostile *GOET* environment. This result shows the strength of this component of reciprocity in an adverse treatment. The new experimental design also shows that negative reciprocity exists in labor markets. Thus, beside positive reciprocity firms should also consider in their decisional process workers' negative reciprocity.

Finally, it should be pointed out that comparisons between *GET* and *GOET* should be made with great caution since the designs are different. The *GET* has a corner equilibrium while the *GOET* has an interior equilibrium. Firms are better off in the *GOET* equilibrium than in the *GET* equilibrium. On the other side of the market, workers have a similar low payoff in equilibrium in both treatments.

5. Conclusions

The new design introduced in this paper (*GOET*) allows subjects to reciprocate either positively or negatively. However, workers have greater incentives to behave according to selfishness when compared to the design where they can reciprocate only positively (*GET*). The effort level that minimizes workers' costs, being the average (*GOET*) and not the minimum level (*GET*) also reinforces the attraction of the equilibrium in the new design. Nonetheless, even in this more hostile environment to reciprocity, we still observe a significant trust and reciprocity relationship. This finding strengthens the perspective that reciprocal behavior is a relevant pattern of human conduct.

The design chosen deliberately makes negative reciprocity "cheaper" for the worker (*i.e.* at a lower cost) than positive reciprocity. This creates a potential bias favoring negative reciprocity. Even though, we still observe that higher wages induce higher levels of effort. Further research could develop other designs namely, making the marginal cost of positive and negative reciprocity identical (a symmetrical effort cost function). Additionally, an experiment could also be devised where the Nash equilibrium is the same level of effort in both treatments.[8]

A more methodological note is that experimental designs sometimes introduce hidden thresholds that may have a significant influence on subjects' behavior. It was shown that the gift exchange treatment has two relevant thresholds, a low wage and high wage "cut-point", that create payoff inequalities, whatever the decision of the worker. In the *GET* when workers are always worst off irrespective of their choices, no reciprocity is observed and the same happens when workers are always better off and receive high wages. However, these wage cut points loose their significance in the *GOET*. That is, the change in the experimental variables can dissolve the influence of these hidden thresholds.

Finally, it should be mention that the experimental evidence given by this paper reinforces the importance attributed to reciprocal behavior in the literature. In fact, reciprocal behavior survived even in a hostile environment. However, this paper also emphasizes the sensibility of subjects' behavior to changes in stimulus. By changing the environment characteristics behavior changes. Therefore, it is not only important to investigate if certain human motivations and behavior exists, but also the subjects' reaction function to changes in the environment. In other words, it is important to study the domain in which each motivation and behavior applies and its sensibilities to changes in the context characteristics.

Acknowledgements

We would like to thank Jens Grosser, Ingrid Seinen, Arthur Schram and Rafael Marques for helpful suggestions for the experimental design and Manuel Maria Braga and Teresa Bomba for the help in the experiment implementation. A preliminary version of this paper was presented at workshops in Amsterdam and the V Hamburg Workshop in Game Theory. We would like to thank participants in both workshops, in particular comments by Arno Riedl, Arthur Schram, Werner Güth, Simon Gächter, .

[8] An example is a different *GET* with the equilibrium at $e = 0{,}5$. We would like to thank Arno Riedl for this suggestion.

The usual proviso applies here. Partial financial support from the Portuguese Fundação para a Ciência e Tecnologia (FCT) and POCTI as well as from research centers CISEP and SOCIUS is gratefully acknowledged. Results available from the authors on request. (English to be revised)

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Tables

Table 1 – Effort levels and associated costs in the GET

e	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
c(e)	0	1	2	4	6	8	10	12	15	18

Table 2 – Average effort per period in the GET

Periods	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1-12**
Session 1	0.61	0.49	0.58	0.55	0.61	0.46	0.61	0.53	0.46	0.48	0.41	0.40	**0.52**
Session 2	0.49	0.41	0.50	0.44	0.43	0.33	0.37	0.37	0.39	0.35	0.33	0.39	**0.40**
Sessions 1-2	0.55	0.45	0.54	0.50	0.52	0.40	0.49	0.45	0.43	0.41	0.37	0.40	**0.46**

Table 3 –Tobit regressions for the GET

(effort level as dependent variable)

Independent Variables	**Regression 1**	**Regression 2**
Constant	-0.138664 (0.054286)	-0.115296 (0.087298)
D_3		0.739300 (0.347364)
w	0.009201 (0.000818)	0.009023 (0.001388)
$w \times D_1$		-0.009369 (0.004792)
$w \times D_3$		-0.008815 (0.004038)

Note: There are 288 observations. Standard errors are in parentheses. Regression 1 is the Tobit regression two-sided censured; regression 2 tests the influence of cut points. D_1 and D_3 are dummy variables: $D_1 = 1$ if $w < \underline{w}^c$ and 0 elsewhere and $D_3 = 1$ if $w > \overline{w}^c$ and 0 elsewhere.

Table 4 – Effort levels and associated costs in the GOET

e	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
c(e)	2	1.6	1.3	1.1	1	2	3.5	5.2	7.1

Table 5 – Average effort per period in the GOET

Periods	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1-12**
Session 1	0.47	0.47	0.48	0.48	0.46	0.45	0.43	0.43	0.36	0.52	0.50	0.49	0.47
Session 2	0.50	0.43	0.43	0.39	0.45	0.38	0.43	0.36	0.42	0.37	0.43	0.46	0.50
Sessions 1-2	0.48	0.45	0.45	0.43	0.45	0.41	0.43	0.39	0.39	0.44	0.47	0.48	0.48

Table 6 –Tobit regressions for the GOET

(effort level as dependent variable)

Independent Variable	Regression 1	Regression 2
Constant	0.260757 (0.030977)	0.210542
w	0.00404 (0.000686)	0.005542 (0.0009932)
$w \times D_3$		-0.00163 (0.000780)

Note: There are 288 observations. Standard errors are in parentheses. Regression 1 is the Tobit regression two-sided censured; regression 2 tests the effect of cut points. D_1 and D_3 are dummy variables: $D_1 = 1$ if $w < \underline{w}^c$ and 0 elsewhere and $D_3 = 1$ if $w > \overline{w}^c$ and 0 elsewhere.

Table 7 – OLS regression $\dfrac{e - e^e}{e^{\max} - e^{\min}} = a + bD + d\dfrac{w - w^e}{w^{\max} - w^{\min}} + q\dfrac{w - w^e}{w^{\max} - w^{\min}} \times D + e$

Independent Variables	
Constant	0.039434 (0.035725)
D	-0.191451 (0.039997)
$\dfrac{w - w^e}{w^{\max} - w^{\min}}$	0.824832 (0.076724)
$\dfrac{w - w^e}{w^{\max} - w^{\min}} \times D$	-0.406961 (0.102642)

Note: There are 576 observations. Standard errors are in parentheses. *D* is a dummy variable that assumes value one for observations of the *GOET* and value zero for observations of the *GET*.

Figures

Figure 1 – Evolution of wage offers in the GET

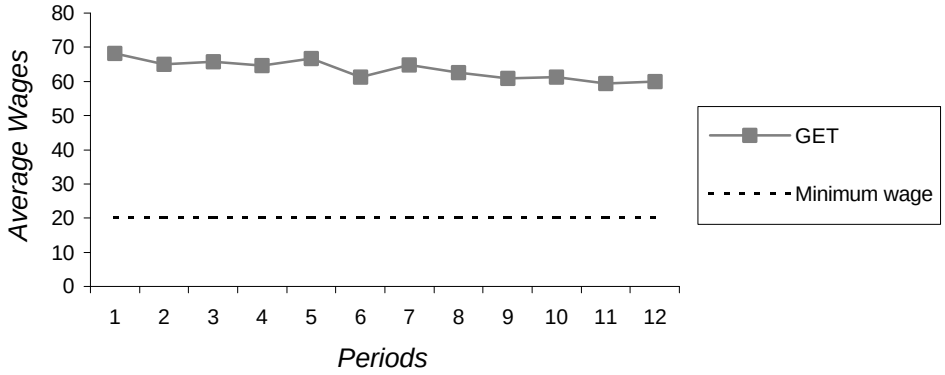

Figure 2 – Average profit and percentage of labor relations by wage interval in the GET

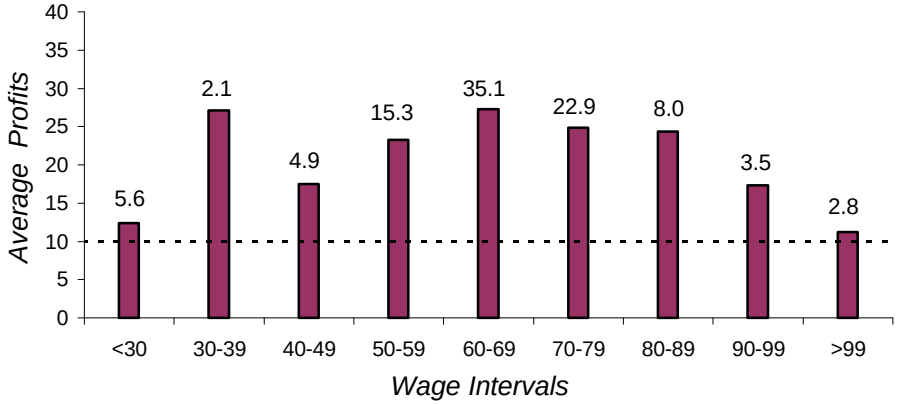

Figure 3 – Estimated payoffs in relation to wages in the GET

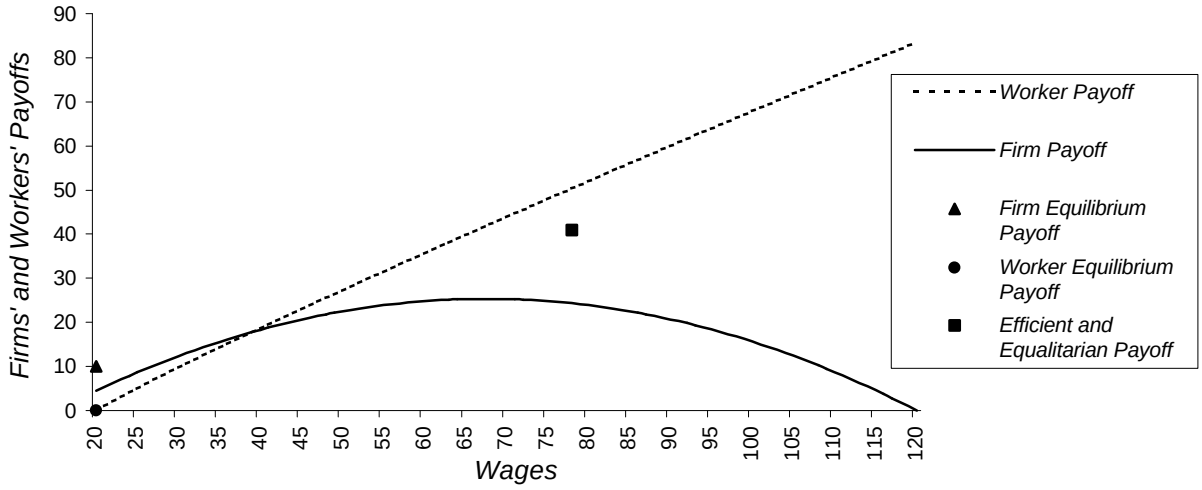

Figure 4 – Evolution of wage offers in the GOET

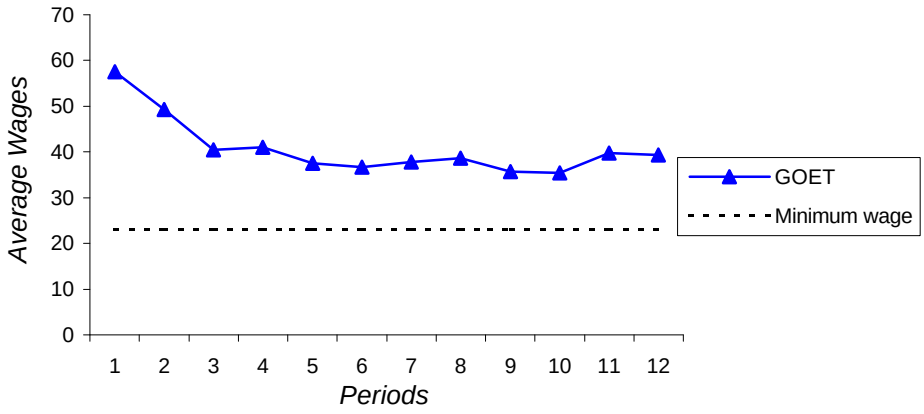

Figure 5 – Average profit and percentage of labor relations by wage interval in the GOET

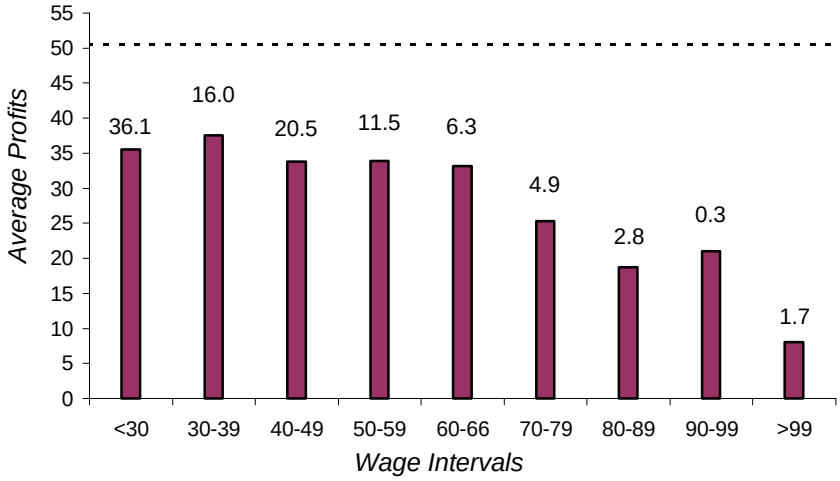

Figure 6 – Estimated payoffs in relation to wages in the GOET

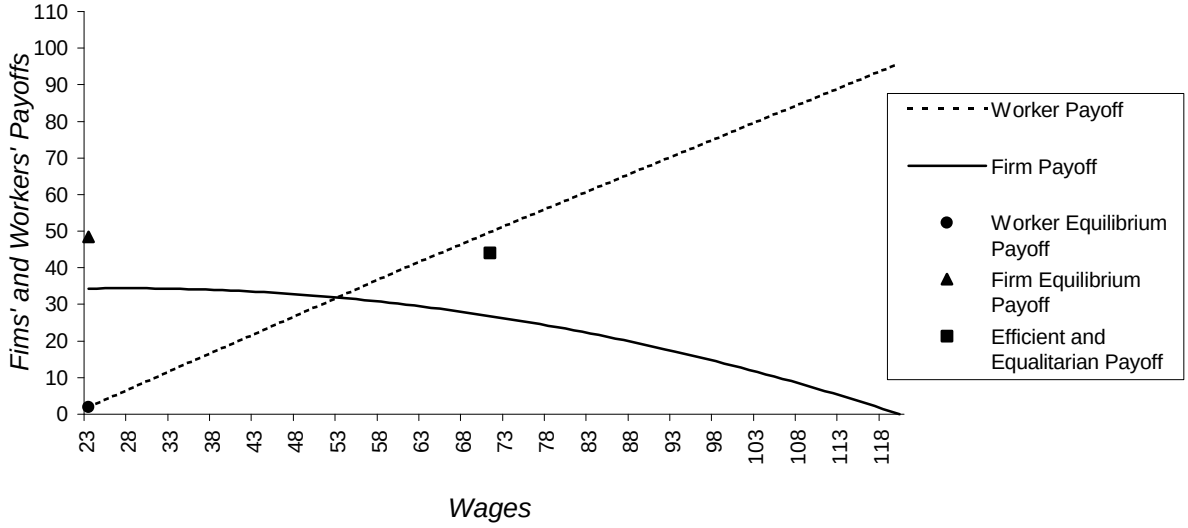

Figure 7 – Evolution of the average value of d_{it}^{w} in the GET and in the GOET

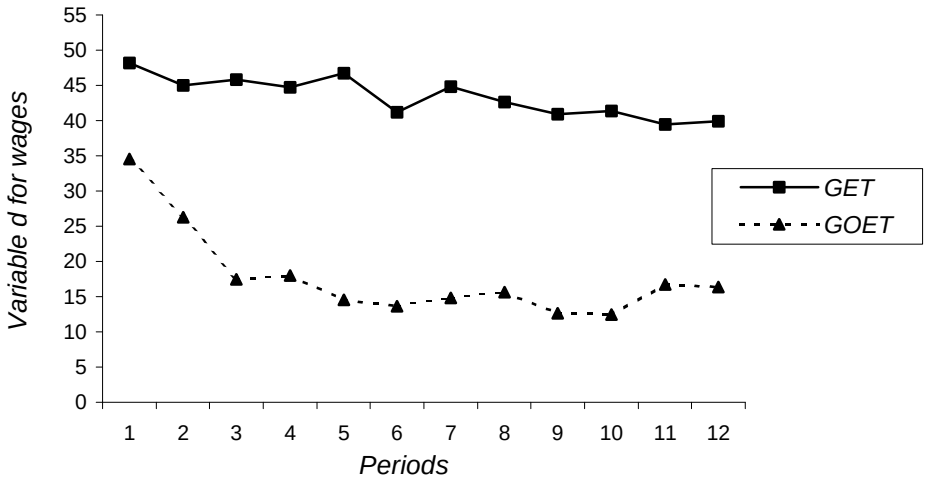

Figure 8 – Evolution of the average value of d_{it}^{e} in the GET and in the GOET