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Gift Exchange in a Multi-worker Firm

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Gift exchange in a multi-worker firm[1]

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Abstract

One of the main findings of a large body of gift exchange experiments is that in an incomplete contracts environment workers on average do not shirk and usually provide more than the minimum enforceable effort level. In general, 40 to 60 percent of the workers reward higher wages with higher effort. These results are observed for simple one-employer – one-worker relationships. In this paper we investigate whether they generalize to the more realistic situation in which the employer employs several workers. We compare a bilateral gift exchange game with a treatment in which each employer has four workers. We find that effort levels in the latter treatment are only marginally lower. Gift exchange thus appears to be robust to increases in the size of the workforce and intention-based reciprocity rather than social preferences seems to be the main driving force behind gift exchange.

[1] We thank Hessel Oosterbeek for his help in designing this study and Robert Dur and Arno Riedl for valuable comments. An earlier version of this paper was presented at the ESA 2004 conference in Amsterdam.

1. Introduction

The main objection mainstream economists typically raise against laboratory experiments is their (supposed) lack of external validity: To what extent can the results of such experiments be generalized to more complex real world phenomena? One of the major criticisms concerns the artificiality and simplicity of the conditions and relations created in the laboratory, which do not prevail, and are also not representative of those in reality (cf. Loewenstein, 1999, Schram, 2003). Experimentalists typically defend and motivate their simplified design by referring to the economic theory to which the experiment relates. Any theoretical model necessarily has to simplify matters by leaving out many elements of reality and has to make simplifying assumptions about rationality, (homogeneity of) preferences, type of institutions etc. For practical reasons, the experimentalist who subsequently wants to test the model has to simplify even more and will typically focus only on what s/he considers to be the core elements of the model. In describing the design of the experiment the experimenter will argue that according to standard theory these simplifications are reasonable. The typical justification given is that "According to standard theory, it should not make a difference that…". But what if the experimental results point out that the behavior of subjects is not in line with standard theory? This may fire back and invalidate the experiment as (simplified) representation of the economic reality of the outside world.

A case in point is Akerlof's (1982) theory of the labor market as a gift exchange and the experimental tests of this model (see e.g. Fehr et al., 1993; Fehr and Gächter, 2000, summarize a series of gift exchange experiments). In the gift exchange model employers pay non-minimal wages to workers, who in response choose higher than minimum effort levels. As in all models, reality is necessarily simplified. For example, in reality most firms have multiple hierarchical levels and the owners of the firm (shareholders) are often not directly responsible for setting wages. In the experimental tests the situation is further simplified by limiting each employer to hire at most one worker, assigning participants randomly to the role of either employer or worker, by the choice of a specific (simple) payoff scheme etc. These design features are justified by common assumptions about individual rationality and preferences: agents are exclusively money maximizers. The typical experimental findings are that

wages and effort are above the minimum levels, supporting Akerlof's theory, but refuting the very assumptions that where used to justify the experimental design.

However, if players have social preferences or an inclination towards reciprocity, generalizing the experimental results to the real world can be problematic. For example, it is not self-evident that the findings can be generalized to situations with many workers per employer. An individual with social preferences who prefers equal earnings for everybody, will as a worker in the standard experiments respond to a high wage with a high effort, but will not do so (or at least will provide much less effort) when the employer has many workers. This holds because in the latter case the employer is likely to earn much more than any of her workers. Clearly, most labour relationships are more like the second situation than the first one. A similar remark applies to generalizing the results to multi-layer hierarchies in which the manager who decides on the wage is not residual claimant (cf. Baker et al., 1988).

Acknowledging the general problem of external validity, in this paper we focus on one particular aspect of it already mentioned above. We do so in the context of the gift exchange game. In particular, we compare a one-employer – one-worker (1-1) treatment with another one-employer – four-workers (1-4) treatment. In the 1-4 treatment the employer is playing the same game as in the 1-1 treatment, but with four workers at the same time. If wages and efforts would be the same in both treatments, the employer would make four times more money in the 1-4 treatment and, like in the real world, employers would make much more money than workers.

Frankly, we did not believe that the gift exchange model would survive the more realistic "multiple workers per employer" design. We were wrong. In the 1-4 treatment effort levels are only marginally lower than in the 1-1 treatment. It thus appears that the gift exchange relationship is quite robust to increases in the size of the workforce. Our results also suggest that the main driving force behind gift-exchange is intention based reciprocity rather than social preferences. The fact that the employer earns much more than the worker (in the 1-4 treeatment) seems only a minor consideration in a worker's decision whether to reciprocate a high wage offer.

Some experimental studies already exist that explore fairness and reciprocity issues in a one-principal – two-agents incomplete contracting framework.[2] Both Meidinger et al. (2001) and Warglien and Rossi (2001) investigate whether

[2] In the experiment of Cabrales and Charness (2003) the principal chooses between three different menus of *complete* contracts that he can offer to a team of two workers of unknown types.

cooperation between two team members is affected by the principal's (common) contract offer. They observe that the more generous the offer, the higher the level of cooperation among them. Güth et al. (2001) consider a situation in which the principal can offer a menu of contracts to two independent agents with different productivities. It appears that public observability of the co-worker's contract induces the employer to compress compensation schemes (i.e. fixed wage plus a return share). Because the worker benefits from higher effort levels himself through the return share, actual effort provided is not driven by pure gift exchange. The study that comes closest to ours is Charness and Kuhn (2004). They focus on pure gift exchange in a setup where the two workers have different productivities. Their main interest lies in horizontal fairness concerns between workers and whether this leads to wage compression by the employer. In constrast, we are concerned with vertical fairness between an employer and her workers. Moreover, in our 1-4 treatment there are four (rather than two) workers per firm and each worker receives the same wage by design.

Other aspects of gift exchange robustness are addressed in a number of recent studies. Charness et al. (2004) observe that when subjects are provided with a comprehensive payoff table, employers offer lower wages and workers are less reciprocal compared to a treatment in which subjects just had the necessary information to compute their payoffs. Engelmann and Ortman (2002) make three comparisons: corner versus interior equilibrium solution, high versus low efficiency gains and abstract versus labor market frame. They find that efficiency gains interact with framing in affecting wage choices. For given wage offers, however, effort levels are unaffected by both efficiency gains and framing. Concerning subject pool effects, Hannan et al. (2002) find significant differences between Pittsburgh undergraduates and MBAs. The latter choose effort levels that are larger or equal to those reported by Fehr et al. (1993, 1998a), but the undergraduates provide less effort.[3] Hannan et al. also consider productivity differences between firms and the impact of adding an unenforceable 'requested effort level' to the wage offer. By and large they find that productivity differences do not affect worker's reciprocal effort choices, while adding non-binding requests resulted in increased overall effort from undergraduates (but not for MBAs). Finally, Fehr et al. (2002) report no evidence that less effort is provided when stakes are increased.

[3] Charness (1998) uses Berkeley students and gets results that are similar to the European subject pool experiments.

The remainder of this paper is organized as follows. In the next section we discuss the version of the gift exchange game that we consider, together with the theoretical predictions under various assumptions about social preferences and reciprocal attitudes. Section 3 describes the experimental design and the main differences with earlier experiments. Results are presented in Section 4. Section 5 summarizes and concludes.

2. The gift exchange game and the theoretical predictions

In this section we first describe the version of the gift exchange game that we use to study the robustness of the gift exchange relationhip to an increase in the size of the workforce. Subsequently we show that according to standard theory the number of workers employed should not make a difference, while there will be such an impact when subjects care about the distributional consequences of their choices.

2.1 The gift exchange game

We consider the following setting, based on the bilateral gift exchange game of Fehr et al. (1998a).[4] There is a firm consisting of one (female) employer and k (male) workers, with $k \geq 1$. The employer has an initial amount of capital (endowment) $k \cdot \omega$ available for employing the k workers and paying their salary, while workers have an initial wealth of $\omega \geq 0$. The employer moves first and chooses a wage $w \geq 0$ for each of her k workers; she has to pay the *same* wage to all her workers. (Workers cannot reject the wage offer made.) Subsequently, workers simultaneously decide how much effort e_i to provide at cost $c(e_i)$, for i=1,..,k. Here $c(e_i)$ denotes the costs of effort in monetary terms. Note that workers choose their individual effort without knowing the effort choices of their co-workers. The marginal value product of effort is fixed per unit of effort provided and equals $v>0$.

Under the above assumptions, the monetary payoffs m_i of worker i equal:

[4] Our version differs in some notable ways from the one used in the 'typical' gift-exchange experiment, see the next section for a discussion.

$$m_i = w - c(e_i) + w \qquad \text{for i=1,..,k} \tag{1}$$

For notational convenience we will refer to the employer as being player 0. Her payoffs in monetary terms are then given by:

$$m_0 = v \cdot \sum_{i=1}^{k} e_i - k \cdot w + k \cdot w \tag{2}$$

In the experiment agents' choices are restricted in the following way. For the employer, the wage w has to be a multiple of 5 and between 0 and 100. The effort choice of each worker has be an integer between 1 and 10. The value of v is set equal to 10. The costs of effort function is given by Table 1.[5] The initial wealth parameter ω is set equal to ω=90.

Table 1. The cost of effort function

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

Our treatment variable is the number of workers k per employer. We consider two treatments, viz. k=1 and k=4. The first one is referred to as the 1-1 treatment and provides the baseline. The second one is labelled the 1-4 treatment. Note that treatment 1-4 is just a four times replica of treatment 1-1; the employer has four times as much capital available and employs four rather than just one worker.

2.2 Theoretical predictions

Selfish preferences. First assume that employers and workers are completely selfish and just interested in maximizing their own monetary payoffs. The subgame perfect

[5] The same range of effort levels and the same cost function is used in e.g. Fehr et al. (1993, 1996a, 1996b, 1998a, 1998b) and Hannan et al. (2002).

equilibrium of the one-shot gift exchange game is then independent of the number of workers k employed. In particular, in the second stage each worker chooses the minimum effort level $e_i^*=1$ in response to any wage offered. Anticipating this, the employer's best response is to pay the lowest possible wage in the first stage, i.e. $w^*=0$. Trivially, the prediction of minimal effort and wages is independent of the precise specification of the cost function (cf. Table 1) as long as it is monotonically increasing. The exact level of the initial wealth parameter ω is also irrelevant for the theoretical predictions under selfish preferences.

H1 *Selfish preferences*: In both treatments wage offers and effort levels will be minimal.

Standard theory thus predicts that the size of the workforce is irrelevant for the observed outcome. As discussed in the introduction, this fact is typically used to justify the focus on the simpler *bilateral* gift-exchange games, i.e. the case k=1.

Outcome-oriented social preferences. Recent fairness theories assume that agents may care about the well-being of others and/or their intentions. The inequality-aversion models of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), for instance, assume that utility is either monotonically increasing or decreasing in the other agents' payoffs. The two models differ in two notable ways. First, Bolton and Ockenfels assume that agents care about their *relative* share of joint payoffs whereas Fehr and Schmidt assume that they care about the *absolute* payoff differences among them. Second, in Fehr and Schmidt's version agents make comparisons on an individual basis. In contrast, Bolton and Ockenfels assume that agents compare themselves only with the average of the other agents' payoffs. Here an agent does not care about how a given fixed amount is divided among others. Experimental evidence indicates that Fehr and Schmidt's model is more realistic on both accounts (cf. Camerer, 2003, pp. 110-111). In the sequel we will therefore focus on their specification.

The model of Fehr and Schmidt (1999) allows for heterogeneity among agents and assumes that inequality-averse agents gain utility from reducing the payoff difference between themselves and others. In particular, for a general (k+1)-player

game with monetary payoffs m=(m_0,..,m_k), player i's utility is given by (for i=0,1,..,k):

$$U_i(m) = m_i - \frac{1}{k} a_i \sum_{j \neq i} \max\{m_j - m_i, 0\} - \frac{1}{k} b_i \sum_{j \neq i} \max\{m_i - m_j, 0\} \qquad (3)$$

where parameter α_i measures the extent to which player i dislikes disadvantageous inequality and β_i the extent to which (s)he dislikes earning more than others. Like Fehr and Schmidt we impose the restrictions $\alpha_i \geq \beta_i$ and $0 \leq \beta_i < 1$.

Consider first the 1-1 treatment in which k=1. For this case the utility of the worker (player 1) reduces to:

$$U_1(m) = m_1 - a_1 \cdot \max\{m_0 - m_1, 0\} - b_1 \cdot \max\{m_1 - m_0, 0\} \qquad (4)$$

Given a particular wage w, choosing a more than minimal effort e>1 decreases the worker's payoffs $m_1 = w - c(e) + w$ and increases the employer's payoffs $m_0 = ve - w + w$. Clearly, with inequality-aversion like in (4) a worker is never willing to do so when he earns less than the employer. He is only willing to choose a higher than minimal effort when w is sufficiently high, such that the employer gets less than himself, and β_1 is large enough. The value of β_1 is thus decisive for the effort choice in response to a particular wage (the value of α_1 only has a marginal influence on this choice).[6] Figure 1 shows the model's predictions for β_1 equal to 0, 0.25 and 0.6 respectively (and α_1=1).[7] Workers will always exert minimum effort when the wage is low, and workers with β_1>0 will exert larger effort when wages are higher.

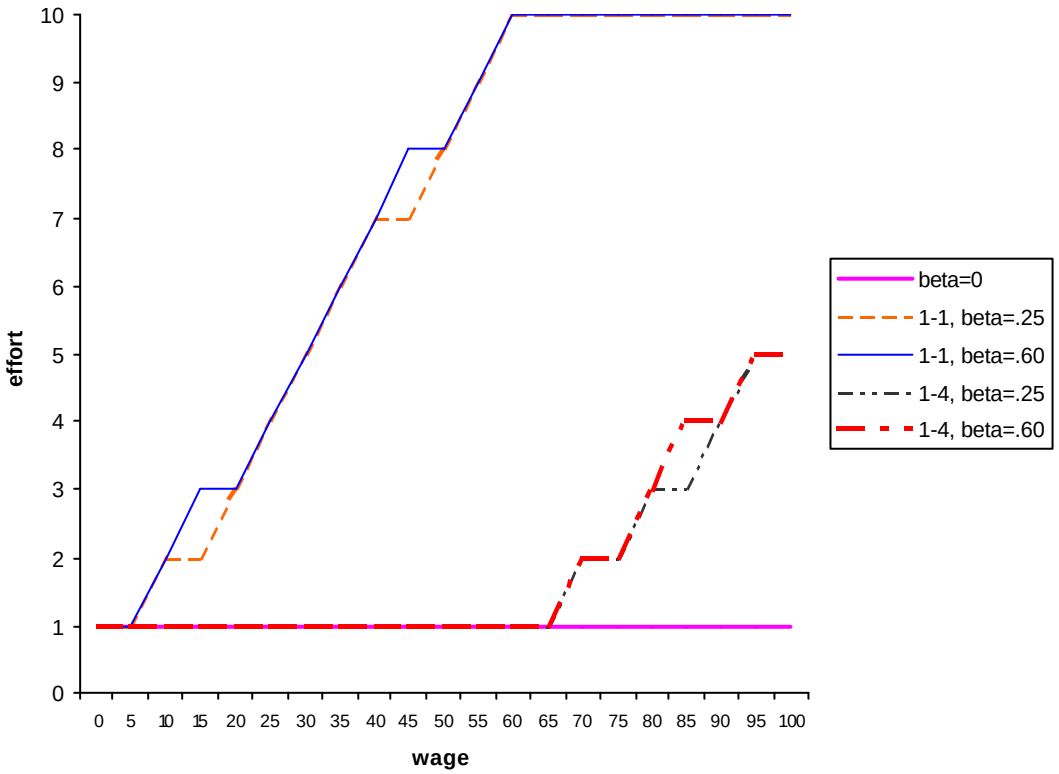
Next consider the 1-4 treatment. In order to make predictions we now have to make additional assumptions about how individual workers perceive the game. First assume that: (A) an individual worker is only interested in her own earnings and those

[6] When m_0 and m_1 are continuous variables the predictions do not depend on the exact size of α_1 at all. However, in the experiment effort levels and wages are restricted to particular discrete values (cf. Subsection 2.1), and so are m_0 and m_1. This introduces a marginal influence of α_1 on the predictions.

[7] The chosen values of β follow the type distribution inferred by Fehr and Schmidt (1999, Table 3 on p. 844) from a large body of ultimatum game data.

of the employer.[8] Workers' preferences are then given by expression (4). In order to consider the overall earnings of her employer m_1, the worker now has to predict the behavior of his co-workers. Because all workers are in exactly the same position, it is natural to assume that: (B) the worker assumes that the other workers will behave similar. Under assumptions A and B the analysis is the same as for the 1-1 treatment, with the single exception that (compared to the 1-1 treatment) the employer's payoffs are multiplied by four. She therefore earns less than her workers only if she pays a relatively high wage. An inequality-averse worker will therefore choose a positive effort level only for relatively high wages (see Figure 1). As a result, there is a big difference in the wage-effort relationship between treatment 1-1 and treatment 1-4.

Figure 1: Predictions of the Fehr-Schmidt model for different betas (and α_1=1).



[8]In our experimental design workers will never learn the effort and earnings of their fellow workers (cf. Section 3).

If we relax assumptions A and B, these predictions change only a little. First we relax assumption A and maintain B: each worker now perceives the situation as a 5-person game and is also concerned about the earnings of his co-workers, but still assumes that all of them choose the same effort. Workers' earnings will then be the same and inequality-aversion is relevant only for the comparison between the worker himself and the employer. Effectively, an individual worker's preferences are given by (4) when we multiply the second and third term by ¼ (=1/k). The effort levels will be marginally lower than those depicted in Figure 1 and the difference with treatment 1-1 will remain at least as large. To relax also assumption B we have to assume a distribution of β's over the workers. In line with Fehr and Schmidt (1999) we assume that β's of 0, 0.25 and 0.6 are equally likely, and that the workers know this. It can be shown that this doesn't change the predictions at all. The intuition is that providing effort is relatively cheap and workers' earnings are therefore very close to each other. The theoretical predictions are then almost completely determined by the income inequalities between employer and worker.

H2 *Outcome-oriented social preferences (inequality-aversion)*: Workers in the 1-1 treatment will make a larger effort if wages are higher but effort will be lower or even minimal in the 1-4 treatment.

Intention-based reciprocity. A higher than minimal effort can also be caused by reciprocity: workers may want to reward kind actions and punish unkind ones. Which wage levels are considered kind or unkind depends upon the workers' interpretation of the intentions of the employer and on their reference point. In the model of Dufwenberg and Kirchsteiger (2004) this reference point is not related to the payoffs of others, but rather refers to what the employer could give the worker in principle. In both treatments higher wages increase the payoff of the worker and therefore will be considered kind. Because there is no reason to interpret a high wage differently in the two treatments, reciprocal workers will act the same in both treatments. Effort choices will increase in wages.

H3 *Intention based reciprocity*: In both treatments effort levels will be increasing in the wage and the wage-effort relationship will not differ between treatments.

The theories of Charness and Rabin (2002) and Falk and Fischbacher (1999) combine social preferences and reciprocity. In the latter model, for example, kindness is measured in terms of inequality-aversion. An action is considered kind if it will lead to a larger payoff for the other, or decreases the difference between payoffs. Inequality-aversion then causes the same wage decision of the employer to be interpreted differently in the two treatments. We then expect less reciprocal behavior to the same wage in the 1-4 treatment, more in line with hypothesis H2.

One remark is in order. Our interest lies in testing the robustness of gift exchange to expanding the number of workers per employer. We do not intend to test particular models of social preferences or intention based reciprocity per se. Numerous studies have already established the importance (and limits) of these motivational factors and a number of experiments have been purposely designed to discriminate between the various models, see e.g. Cox (2004), Falk et al. (2000) and McCabe et al. (2003). We did not design our experiment with that purpose in mind, but just want to point out that these models make different predictions about the impact of enlarging the workforce.

3. Experimental design and procedures

In Subsection 2.1 we discussed the particular game (and its parameterization) that we study in our experiment. In this section we first discuss some other important features of our experimental design and compare these with earlier gift-exchange experiments. Subsequently, we elaborate on the experimental procedures.

3.1 Experimental design

In general gift exchange experiments come in two forms. The most commonly used one is the gift exchange *market* (GEM), in which employers compete for workers and workers for employers. The wage is determined either in a one-sided oral auction (e.g. Fehr et al., 1993), a one-sided posted offer market (e.g. Brandts and Charness, 2004) or in a double auction (e.g. Fehr and Falk, 1999). GEMs are useful to isolate the role of social norms, because in other (complete contract) market experiments there is

typically quick convergence to the competitive equilibrium. The second type is the *bilateral* gift exchange game (BGE). In BGEs the number of employers and workers is the same and matching occurs exogenously. By comparing GEMs with BGEs, the effect of competition on social norms can be isolated. Fehr et al. (1998a) do not find significant differences between the two.[9]

Our experiment is based on the bilateral gift exchange game of Fehr et al. (1998a). Just like them we use a labor market frame, creating in the laboratory a small-scale replica of employer-worker(s) interactions. However, our design differs in a number of respects from theirs. Most importantly, in our experiment the interaction is really one-shot and the strategy method is used.[10] The strategy method implies that each worker has to make a contingent effort choice, i.e. each worker has to indicate his effort choice for every possible wage offer. The main advantage of using this method is that it allows us to study the wage-effort relationship of every individual worker (cf. Figure 1). In particular, for every possible wage level, we observe a worker's actual effort choice.

The theoretical predictions of Subsection 2.2 are unaffected by our use of the strategy method, at least when we exclude Nash equilibria in which workers use a weakly dominated strategy.[11] It is possible though that subjects in practice do behave differently, because the strategy method forces workers to think about all possible wage offers and not just about the employer's actual wage offer. The existing experimental evidence suggests that the impact of the elicitation method on subjects' choices is limited, especially in situations of low complexity (cf. Brandts and Charness, 2000). From this perspective the use of the strategy method seems justified. Moreover, even when the strategy method by itself affects behavior, there is no reason to assume that this impact differs between our two treatments (i.e. to assume that there are interaction effects).

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[9] The Spearman rank correlation between wages and effort for each worker is significantly positive at the 10 percent level for 60 percent of all workers in GEM and 57 percent in BGE. Wages in BGE are initially higher than wages in GEM but after a few periods wages in these two treatments coincide.

[10] Our design also differs in other, less important ways. Mainly for practical reasons, we do not allow workers to reject the employer's wage offer. This guarantees that in the 1-1 (1-4) treatment each employer always has one worker (four workers). Because in both treatments workers cannot punish low wage offers by rejecting employment, this difference is immaterial for our comparison across treatments.

[11] The subgame perfection criterion employed in Subsection 2.2 deletes Nash equilibria of the sequential move game in which workers use a weakly dominated strategy.

Rather than the usual practice of having the subjects play the gift exhange game repeatedly in a row, we let them play it only once. We do so to make the two treatments better comparable. Repeated interaction would lead to different learning and information updating possibilities in the two treatments.[12] Moreover, matching of subjects would also be problematic, because in treatment 1-4 it would be impossible to match subjects only once (without contamination) when more than just a couple of rounds are played. Reputational effects then cannot be avoided. A single round has the additional advantage that marginal incentives are particularly salient.

A final aspect of our design that deserves brief discussion is the employer's profit function. The typical gift exchange experiment calculates the employer's profit as $(v-w)\cdot e$, whereas in our design the profit per worker equals $ve-w$. The former specification is typically used to prevent that loss aversion pollutes fairness effects. For our profit function the employer makes a loss when she pays a high wage and a worker chooses a low effort in response. According to standard theory the choice between the two profit functions is immaterial, but under alternative motives the type of profit function used does matter (see below). Fehr et al. (1998a) compare a treatment where they completely avoid losses (i.e. profit equals $(v-w)\cdot e$) with another one in which the employer can make losses (profit equals $ve-w$). They observe that the pattern of reciprocal interactions is basically the same in both treatments.

In our view a profit function equal to $ve-w$ is more appropriate. With this specification the surplus per worker equals $ve-c(e)$ and only depends on the effort level chosen. The wage itself simply acts as a transfer payment. In those papers that use the multiplicative specification $(v-w)\cdot e$, surplus equals $ve+w\cdot(1-e)-c(e)$ and is increasing in w for a given level of effort.[13] Employers may then choose a higher wage just to increase the surplus, rather than to elicit higher effort levels from workers. A high wage policy is then more difficult to interpret. Another disadvantage is that the multiplicative profit function hinders the effectiveness of high effort as a reciprocal response; the value of an additional unit of effort is substantially lower in

[12] This holds because informing a worker about his payoffs in treatment 1-1, enables him to infer the payoffs of the employer precisely. When we then also inform workers in treatment 1-4 about employer's payoffs, these workers can infer the average effort level chosen by others within the group.

[13] This holds because in these papers $e \leq 1$. For ease of presentation to the subjects we have scaled effort levels upwards (and marginal revenue v proportionally downwards), such that effort can take integer values only.

the upper wage ranges.[14] Choosing a higher effort level at a higher wage then does not necessarily indicate that the worker provides a larger gift in return. For the profit function that we use the interpretation of higher effort levels is more clear-cut.

To avoid losses, we provided all subjects with a sufficiently high initial endowment (besides a show up fee). This explains our choice of ω=90 (cf. Subsection 2.1). Charness and Kuhn (2004) similarly provide employers with sufficient initial capital to finance wages.

3.2 Experimental procedures

Overall we conducted 7 sessions. Four of them considered treatment 1-1 (84 participants), the other three sessions concerned treatment 1-4 (60 participants). Participation was restricted to one session. The subject pool consisted mainly of the undergraduate student population of the University of Amsterdam. Most of them were students at the Department of Economics and Econometrics. 58% of the particpants were male. The average earnings were 17,09 euros (including a show-up fee of 5 euros) for about one hour on avarage.

The experiment was computerized using z-Tree (Fischbacher, 1999). Subjects started with on-screen instructions. They also received a summary of the instructions on paper (see the Appendix). To ensure that subjects understood the experiment, in particular how their payoffs were calculated, all subjects had to answer a number of control questions correctly before the experiment started.[15] Then, at the start of the experiment, subjects learned their roles. In treatment 1-1, half of the participants were assigned the role of employer, the other half role of worker. Both of them received an initial endowment of 90 points (besides the show up fee). In treatment 1-4, 20% of the participants had the role of employer, the other 80% the role of worker. Here employers received an endowment of 360 points, while workers got 90 points. The conversion rate was 1 euro for 9 points.

[14] At the highest possible wage w=v the employer does not even benefit from higher effort levels at all.
[15] Subjects generated the numerical examples for the control questions themselves, by first making hypothetical choices for both the employer's and the worker's role. The control questions then asked them to calculate the payoffs. By using this procedure, subjects also got familiar with the decision task they would face in the actual experiment (although there they would take decisions for one of the two roles only).

In both treatments subjects were randomly and anonymously matched into firms. In treatment 1-1 a firm was composed of one employer and one worker, in treatment 1-4 a firm consisted of one employer and four workers. The employers had to set the wage without knowing the effort choices made by their worker(s). Recall that wages were restricted to multiples of 5 between 0 and 100. Workers had to fill in a wage-effort table without knowing the actual wage set by their employer (and the effort levels chosen by their co-workers). In particular, for every possible wage they had to indicate their effort choice, an integer between 1 and 10. When all subjects had made their decisions, workers were informed about the actual wage offered by the employer, and their own and their employer's payoffs.[16] Employers learned the effort choices of their workers for the wage chosen. No subject was ever informed about the choices of subjects in other firms. Finally, each participant learned his/her own earnings and was paid accordingly (after filling in a short ex post questionnaire).

4. Results

In this section we present the findings of our experiment. Because our main interest lies in the robustness of workers' willingness to reciprocate, we will primarily focus on their effort choices. After that we briefly turn to employer behavior and overall earnings. Recall that any influence of employers' *actual* wage decisions on the effort choices of workers is ruled out by our one-shot strategy design.

5.1 Worker behavior

Standard theory predicts that workers will choose the minimum effort level of one for every wage amount offered (cf. Hypothesis H1). In clear contrast to this, the actual mean average effort of the workers over all possible wages is 3.81 in treatment 1-1 and 3.31 in treatment 1-4. Moreover, the mean efforts increase with the wage level: for wages below 50 the average effort equals 2.27 in treatment 1-1 and 2.01 in treatment 1-4, while for wages of 50 and higher these numbers increase to 5.21 and 4.46 respectively.

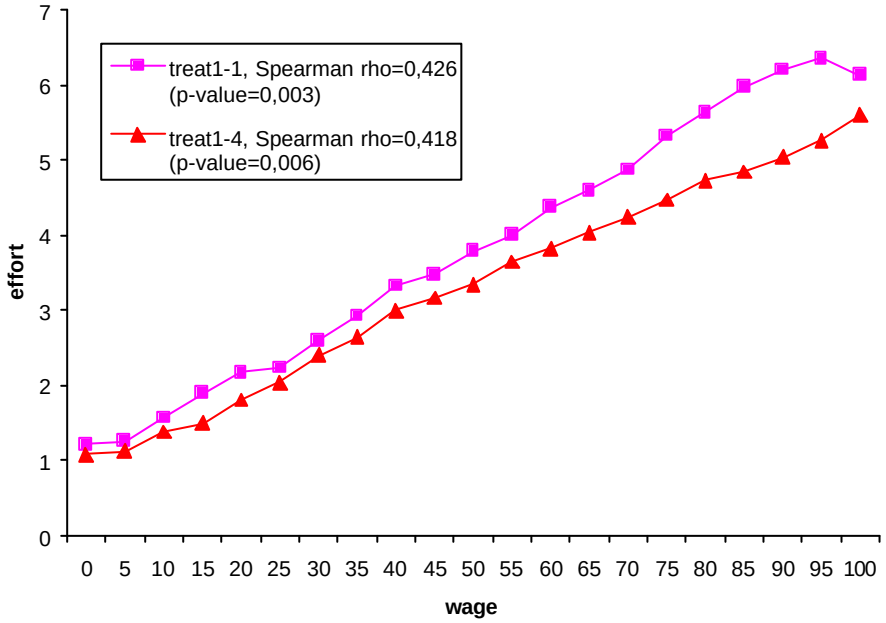
[16] In treatment 1-4 each worker was just informed about the wage chosen by his employer and not about the effort choices of his co-workers.

More detailed information about the relationship between effort and wages is provided in Figure 2. This figure displays the average effort by wage for each of the two treatments separately. In both treatments a clear pattern emerges: workers on average choose a higher effort level when the wage is higher. The Spearman rank correlation between effort and wages is highly significant and around 0.42 in both treatments (more detailed regression results will be discussed below). We summarize this finding in the following result:

Result 1. In both treatments, mean effort levels are increasing in the wage.

Although our one-shot strategy design differs from previous gift-exhange experiments (cf. Subsection 3.1), for the 1-1 treatment Result 1 replicates earlier findings reported in the literature (Fehr and Gächter, 2000). This also holds for our findings concerning employer behavior and earnings, which will be discussed in the next subsection. For the 1-1 treatment our results are thus comparable to those of previous studies.

Figure 2: Average effort by wage



Our primary interest lies in comparing the two treatments. Figure 2 indicates that average effort in the 1-1 treatment is higher than in the 1-4 treatment for all 21 wage levels. The difference between treatments also increases as the wage increases (except for a wage of 100[17]). However, the differences are small and insignificant Nonparametric (Mann-Whitney) tests for each wage separately show no statistical significance at the 5% level. The same conclusion can be drawn when we compare *individual mean effort levels* across treatments. Comparing these individual means, no significant differences are found between the two treatments (two-sided Mann-Whitney test; p=0.3).

Table 2. Random effects linear regression with effort as dependent variable

Independent variable	*coefficient*
Constant	1.032***
	(0.3340)
Wage	0.0556***
	(0.0018)
Treatment 1-4	-0.0559
	(0.4654)
Treatment 1-4 * Wage	-0.0091***
	(0.0025)

Remark: Robust standard errors appear in parentheses. *** Indicates significance at the 1%-level. There are N=1890 observations in total, with 90 clusters (workers) and 21 observations per cluster. The Wald statistic equals χ^2=1653.03; p=0.000.

Non-parametric tests are based on order statistics only and thus neglect some of the information in the data. Regression analysis does not have this disadvantage. We therefore also consider the results from regressing effort on the wage level, a treatment dummy and an interaction term.[18] To account for the panel structure of our data (we have 21 data points per individual worker), a random effects model is

[17] This is due to the presence of some workers displaying non-monotonic behavior. Taking these workers not into account the average effort is increasing for all possible wages.

[18] Incorporating wage squared as an additional explanatory variable does not yield a significant coefficient at the 5% level and hardly affects the estimates of the other coefficients. Table 2 therefore only presents the simpler specification.

estimated. Table 2 shows the results. The intercepts in both treatments are equal and figure around one, but the slope is less steep in the 1-4 treatment. This is of course much like Figure 2. The difference in slope is small but statistically significant. Increasing the wage by 10 points leads to an estimated increase in effort of around 0.55 in the 1-1 treatment and of around 0.46 in the 1-4 treatment.

Result 2. The wage-effort relationship is significantly less steep in the 1-4 treatment than in the 1-1 treatment. Differences in effort levels are small though.

The analysis up till now is based on mean effort levels per treatment. Clearly, these average efforts may conceal large individual differences between subjects within a treatment. We therefore explore individual worker behavior in more detail. Like in other gift exchange studies, substantial heterogeneity among subjects is observed in the data. The following general picture emerges. A number of workers can be considered selfish; they choose the minimum effort level regardless of the wage. A second group acts reciprocally; these workers increase their effort with wages in a monotonic way. A small third group can be labelled erratic; they vary their effort, but with no clear relation to the wage.

To arrive at our exact classification, we fit a linear effort function $e_i = a + b \cdot w_i$ for each individual subject.[19] The estimated wage coefficient is then used together with the observed monotonicity of the relationship to classify the individual workers. The precise definition of our three different categories is as follows:

Selfish behavior: This group consists of workers that provide the minimum effort level for all possible wages. We also included one subject that chose the minimum effort for all wages, except for a wage of zero. For the workers within this category the estimated wage coefficient is not significantly different from zero; $b = \partial e/\partial w \approx 0$.

Reciprocal behavior: These subjects choose a monotonic and increasing wage-effort schedule. We also included two subjects with a monotonic wage-effort schedule for

[19] As is the case for the aggregate regressions, including the wage squared as regressor typically yields an insignificant coefficient and does not improve the fit. So, also at the individual worker level the wage-effort relationship appears to be linear.

all wages, except for the highest and the two highest wages respectively. Workers within this category have a significantly positive wage coefficient; $b = \partial e/\partial w > 0$.[20]

Erratic behavior: These subjects do not make monotonic effort choices. Possibly these subjects made some typing mistakes, did not understand the experiment, or were not taking it seriously (or only filled in a realistic effort level for wages they considered realistic).

Table 3 shows the classification of subjects in these three categories by treatment. In treatment 1-4 there appear to be more selfish workers than in treatment 1-1. There are two possible causes for this finding. First, it can represent a treatment effect; some workers who would have acted reciprocal in the 1-1 treatment are acting selfish in the 1-4 treatment. Second, the difference may be caused by chance. The latter explanation cannot be ruled out, because the difference in type distribution appears insignificant using a binominal test (although it must be noted that this test is not very powerful with these low numbers).

Table 3. Classification of the workers by treatment and average contribution per worker type

Type of behavior	*Treatment 1-1*		*Treatment 1-4*	
	frequencies	*average contribution*	*frequencies*	*average contribution*
Selfish	23.8% (10)	1.00	35.4% (17)	1.01
Reciprocal	64.3% (27)	4.75	60.4% (27)	4.61
Erratic	11.9% (5)	4.35	4.2% (2)	3.64
Total	100% (42)	3.81 (42)	100% (48)	3.31 (48)
Non-erratic workers	88.1% (37)	3.74 (37)	95.8% (46)	3.28 (46)

Remark: Number of individual workers in parentheses

[20] Rather than considering the estimated wage coefficient b, we could alternatively look at the Spearman rank correlation between wages and effort. The estimated wage coefficient reflects the tendency towards a *linear relationship* between effort and wages, while the Spearman rank correlation says something about the *monotonicity* of the relationship. In the category of selfish behavior all workers have a Spearman rank correlation that does not differ (significantly) from zero. The reciprocal workers all have a rank correlation that is positive and significant at the 1%-level.

Result 3. The percentage of selfish workers is higher in treatment 1-4 than in treatment 1-1, but not significantly so.

The fact that there are less selfish workers in treatment 1-1 provides one explanation for our finding that the wage-effort relationship is slightly steeper in this treatment (cf. Result 2). Another explanation would be that the reciprocal workers behave less reciprocally in treatment 1-4. To explore the latter possibility, Table 3 also compares average efforts of the different worker types across treatments. It appears that the reciprocal workers make the same average efforts in both treatments. The same conclusion follows from estimating a random effects model like in Table 2, but now restricted to the reciprocal types only. For this subsample the wage-effort relationship is not significantly different in the 1-4 treatment. The (small) differences observed in Figure 2 can thus be accounted for by the fact that fewer subjects act reciprocal in treatment 1-4, rather than by reciprocal subjects acting less reciprocal in the 1-4 treatment.

Summing up, Results 1 through 3 clearly reject Hypothesis H1. Effort levels are typically above minimum and we find a positive correlation between effort and wages. Although the relationship is somewhat steeper in treatment 1-1 as compared to treatment 1-4, the difference is less than one would expect on the basis of social preferences only (cf. Hypothesis H2 and Figure 1). In turn this suggests that intention-based reciprocity may play an important role: one reason why workers choose high effort levels in response to high wages is to reward the good intentions of the employer. Overall the wage-effort relationship appears to be quite robust to increasing the number of workers within a firm.

5.2 Employer behavior and earnings

Although workers' effort choices are the main focus of this study, it is interesting to compare the wages offered by the employers in the two treatments. Standard theory predicts that employers should pay the minimum wage in both treatments. Inequality-averse employers or employers that expect positive reciprocity may pay more than the minimum wage. In treatment 1-4 the initial endowment and the potential earnings of

the employer are substantially higher compared to treatment 1-1. In particular, they are four times as large. When the employer offers the minimum wage and workers provide the minimum effort, employers make a profit of 40 points in treatment 1-4 (besides the endowment of 360) and of 10 points in treatment 1-1 (besided the endowment of 90). Inequality-averse employers will therefore offer higher wages in treatment 1-4 than in treatment 1-1.[21]

The average wage offered in treatment in 1-4 is higher (41.67, n=12) than the mean wage in treatment 1-1 (33.21, n=42). However, this difference is far from statistically significant (two sided Mann-Whitney test; p=0.221).[22] Moreover, the percentage of employers that offers the minimum wage is slightly higher in treatment 1-4 (16.7%) than in treatment 1-1 (14.3%). We thus do not find strong evidence that the employer offers higher wages when she has more workers.

We next turn to the actual earnings subjects obtain in the experiment. Table 4 reports the subjects' average earnings by treatment and by role, excluding the show up fee of €5 every participant received for showing up on time. Workers earn a little bit more in the 1-4 treatment than in the 1-1 treatment. This is in line with the marginally higher wages that are observed in the 1-4 treatment, together with the somewhat lower effort levels chosen (cf. Result 2).

Employers earned much more in the 1-4 treatment than in the 1-1 treatment. The main cause here is that in the 1-4 treatment the initial endowment is four times as large as in the 1-1 treatment. Ignoring the initial endowment, the average profit the employer makes is actually much smaller in the presence of multiple workers (they then make a loss on average). Again, the driving force for this observation is twofold. In treatment 1-4 workers provide less effort on average and employers also pay (marginally) higher wages than in treatment 1-1. As a result, employers with four workers earn less than four times the amount employers with only one worker earn. In practice treatment 1-4 is thus not simply a four times upscaling of treatment 1-1.

[21] This result is conditional on workers' behavior. Assuming that workers provide the same effort level in both treatments an equal payoff for both workers and employers requires a higher wage offer in treatment 1-4. However, the difference in wages between treatments decreases as effort increases.
[22] The dispersion in the wage distribution does not differ between treatments as well. The homogeneity of variances test statistic yields a p-value equal to p=0.945.

Table 4. Average earnings by treatment (excluding show up fee of €5)

		Treatment 1-1	*Treatment 1-4*
Workers	Endowment	90	90
	Profit	29.4	38.48
	Total	119.4 (€13.26)	128.48 ((€14.28)
Employers	Endowment	90	360
	Profit	-0.36	-47.5
	Total	89.64 (€9.96)	312.5 (€34.72)

Remark: Earnings in points. The conversion rate is 9 points = 1 euro.

Comparing average earnings across roles, in the 1-1 treatment workers on average earn more than employers do. This is a common finding in gift-exhange experiments. In treatment 1-4, however, employers earn substantially more than workers. Also in this respect the 1-4 treatment seems a better representation of actual worker-employer relationships.

Figure 3: Average potential profits for the employer

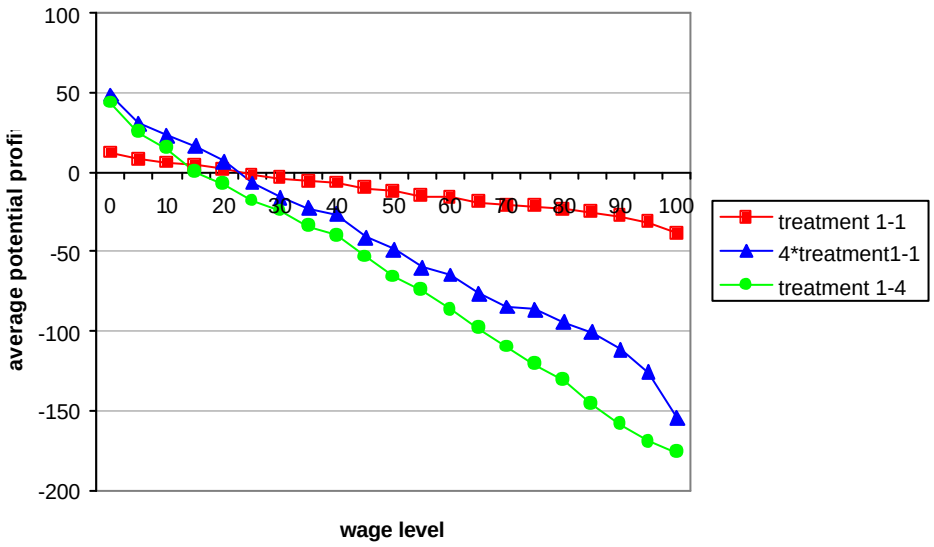


Table 4 concerns subjects' actual earnings. It does not indicate what subjects could earn at the most by making 'optimal' choices, taking the (unknown) behavior of others as given. Clearly, given our one-shot strategy design, choosing the minimum effort in response to any wage offered would maximize the worker's expected earnings. The optimal wage level for the employer depends on the actual wage-effort schedules of the workers. Averaging over these actual schedules, Figure 3 depicts the potential profits employers could obtain for each possible wage. In both treatments these potential profits are monotonically decreasing in the wage. Even though a higher average effort is provided for higher wages, the higher returns do not outweigh the additional wage costs. So, in general it is not profitable for employers to offer higher than minimum wages. For the 1-1 treatment this finding again replicates previous studies.

To make our two treatments better comparable, Figure 3 also depicts the average potential profits in treatment 1-1 multiplied by four. Compared to this imaginary situation, employers on average make a lower profit in treatment 1-4 and the difference between the two situations increases as the wage increases.[23] This finding of course replicates our earlier observation that in treatment 1-4 effort levels are somewhat less sensitive to the wage offered (cf. Result 2).

5. Conclusion

In this paper we explore whether experimental gift exchange is robust to enlarging the size of the work force. To that purpose we compare a baseline one-employer – one-worker treatment with another treatment in which each employer has four workers. Although our experimental design is different from earlier studies, most notably in the use of the strategy method and the play of just a single round, the results for our 1-1 treatment are in line with previous findings (cf. Fehr and Gächter, 2000). In particular, we also find that workers on average provide more than the minimum effort and that

[23] This does not hold for the maximum wage of w=100. Like in Figure 2, this is caused by the presence of some workers displaying erratic behavior (see our earlier classification of workers). Taking these workers out, monotonicity is restored.

around 60% of them have an upward sloping wage-effort relationship. Moreover, employers typically pay more than the minimum wage but do not really gain from doing so. In the baseline treatment workers earn more than employers, as is typically obtained in bilateral gift exchange games. The results of the 1-4 treatment show that the findings on gift exchange are quite robust. Effort levels are only marginally lower than in treatment 1-1, despite the fact that the employer now earns much more than the worker does. This in turn suggests that intention-based reciprocity rather than social preferences are the main driving force behind gift exchange.

In contrast to other recent experiments that focus on horizontal fairness between workers, this paper is mainly concerned with fairness and reciprocity considerations between agents at different levels in the hierarchy. Given that the gift exchange model survives the more realistic 'multi-worker' design, it is worthwhile to investigate robustness in other, related directions. A first extension that comes to mind is towards a multi-level hierarchy. In larger firms the hierarchical structure is typically quite complex. Apart from shareholders there are usually multiple managerial layers. The person who is responsible for a worker's wage is typically not full residual claimant and thus does not get the full benefits generated by the worker's reciprocal reaction (if at all). Under the assumptions of selfishness and rationality this does not matter and a focus on a simple principal-agent relationship is justified. This is not the case anymore when alternative motives come into play.

Another issue that seems worth investigating in the context of the gift exchange model is the endogenous selection of employers. In a typical experiment (like ours) participants are students who want to earn some money. They are randomly assigned to act either as a worker or as an employer. A positive effort level is not very costly for a worker, while the benefits for the employer can be huge. A student in the worker's role may therefore be inclined to help the fellow student playing the employer (who behaves nice), also because the roles could easily have been the other way around. This kind of Kantian or Rawlesian reasoning is less likely in the real world, because being an employer or a worker is to a large extent determined by background variables and/or personal choice and not by lot.

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Appendix: Summary of the instructions for the 1-4 treatment

In this experiment you are taking part in a study of the labor market. There are two types of participants: employers and workers. 20% of the participants will be assigned the role of employer; the other 80% will be workers. You will be randomly assigned one of these roles. Which role you have, you will hear at the start of the experiment. Your role will not change during the experiment.

The experiment consists of one period only. In this period you will be randomly and anonymously matched with other subjects. Each worker is matched with one employer and each employer has four workers. You will not know with whom you are matched. During the experiment you will earn money based on the choices you and the participants with whom you are matched make. These earnings are calculated in points.

The single period has two stages. These stages have the following setup:

Stage 1 You have to make a decision without knowing the choices of those with whom you are matched. If you are an employer, you have to set the wage of your workers. This wage should be a multiple of 5 and in between 0 and 100. Each employer is allowed to set only one wage. The wage is equal for all four workers.

If you are a worker, you have to decide which effort level you want to provide for each possible wage set by the employer. There are 21 possible wages (ranging from 0 till 100), so each worker has to make 21 effort choices. These effort levels should be integers and in between 1 and 10. Effort is costly for the worker, and the costs (in number of points) belonging to a particular level of effort are reflected in the following cost schedule:

Cost schedule of feasible effort levels

Effort	1	2	3	4	5	6	7	8	9	10
Cost	**0**	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**15**	**18**

Stage 2 In this stage you will be informed about the choices of others. If you are a worker, you will learn the wage chosen by the employer to whom you are matched. If you are an employer, you will learn the effort choices of your four workers for the wage that you offer. You will also be informed about your period earnings. If you are an employer you will also learn your workers' period earnings and if you are a worker you will also learn your employer's period earnings. These period earnings (in number of points) are calculated as follows:

Employer's period earnings = 10*(Effort level 1 + Effort level 2 + Effort level 3 + Effort level 4) – 4*Wage offered

Worker's period earnings = Wage – Cost of effort provided

At the start of the experiment you will receive an endowment that depends on the role that you have in the experiment. If you are an employer you will receive 360 points and if you are a worker you will receive 90 points. The total number of points that you earn in the experiment equals the sum of your initial endowment and your period earnings. At the end of the experiment these points will be converted into euros at the rate of: 9 points = 1 euro. In addition to the earnings earned in the experiment you will receive 5 euros.